



# EARLY REHABILITATION

In Conflicts and Disasters

Edited by: Charmi Lathia, Peter Skelton and Zoe Clift



## PROJECT COORDINATOR

Charmi Lathia

## EDITORS

Charmi Lathia  
Peter Skelton  
Zoe Clift

## CONTRIBUTORS

Humanity & Inclusion	Livability
AO	CBM
WHO	MSF-France
ICRC	



## ACKNOWLEDGEMENTS

Jane Wiedler, Michiel Steenbeek, Stephen Muldoon, Jody-Anne Mills, Leslie Angama-Mueller, Andre Da-Silva, Claire O'Reilly, Claude Tardif, Tom Potokar, Alice Harvey, Gaelle Smith, Debbie Gray, Alberta Rockson, Michelle Fitzgerald, Sudan Rimal, Lauren Eve, Pushpak Newar, Julien Clause, Erica Bleakley, Penny Broomhead, Caroline Cater, Eric Weerts, Fiona Stephenson, Michael Baumberger, Esha Tapa Dungana, Holly Soper-Doyle, Claire Downs, Lucia Olive Lennon, Laura Cocco, Caroline Jagoe, Amelia Shaw, Fiona Craven Bernhard, BACPAR and Interburns. Thanks to content reviewers and endorsers GRA, WCPT, WFOT, ISPO, ISPRM and ISCoS.



### Photograph Credits:

Davide Preti © Davide Preti/Hi

Cover: © Hardy Skills/Hi

Handicap International © Handicap International

You are free to share-copy and redistribute the material in any medium or format, under the following terms:

### Attribution:

You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

### Non Commercial:

You may not use the material for commercial purposes.

### No Derivatives:

If you remix, transform, or build upon the material, you may not distribute the modified material.

### DISCLAIMER:

This handbook is written for rehabilitation professionals (physiotherapists and occupational therapists) living in, working in, or preparing to work in conflict or disaster settings.

1st Edition, January 2020

# FOREWORD

From the first world war to more recent disasters, such as the 2015 Nepal earthquake, the importance of integrating rehabilitation into emergency responses to conflicts and disasters has been clear. The World Health Organization emergency medical team standards and recommendations for rehabilitation, launched in 2016, signalled significant progress in recognising the role that rehabilitation professionals play and the necessity of early intervention.

However, while the emergency medical community takes strides towards integrating early rehabilitation in conflict and disaster response, early rehabilitation remains an emerging area. Rehabilitation professionals face unique challenges associated with complex trauma, injury surge and resource scarcity that many have never encountered before.

Practical guidance to deliver quality early rehabilitation in these contexts is essential if conflict and disaster response is to evolve beyond its life- and limb-saving mandate to deliver care that maximises patient outcomes. Rehabilitation professionals need to be equipped with the knowledge and skills to meet patient needs and navigate the demands of emergency medical response.

This field handbook, the outcome of a highly collaboration process among key international organisations and experts, is an invaluable resource for rehabilitation professionals preparing to work in conflict and disaster response. It has the potential to have a major impact on the care that people injured in conflicts and disasters receive and will go far to ensuring they achieve the outcomes that enable them to return to work, school and community life.



A handwritten signature in black ink, appearing to read 'Flavio Salio'.

**FLAVIO SALIO**  
Manager, Emergency Medical Teams  
World Health Organization  
Geneva, Switzerland



A handwritten signature in black ink, appearing to read 'Alarcos Cieza'.

**ALARCOS CIEZA**  
Coordinator, Vision, Hearing, Disability and  
Rehabilitation  
World Health Organization  
Geneva, Switzerland

# PREFACE

Conflicts and Disasters affect societies at a profound level, with consequences often lasting for generations. Early rehabilitation for patients with traumatic injuries is a crucial element of the acute medical response and is a vital step towards long-term recovery strategies.

As a leader in innovation in research and development in trauma and musculoskeletal disorders, and as a premier provider of education for surgeons and operating room personnel, all AO activities are focused on the goal of delivering improved patient outcomes.

Humanity and Inclusion (HI) is an independent non-governmental organisation that provides essential rehabilitation services in situations of poverty, exclusion, conflicts and disasters. Over the past 38 years, HI has been present as a core leader in rehabilitation and capacity building of rehabilitation staff and partners in areas of conflicts and disasters around the world.

Together, AO and HI are convinced that this comprehensive, evidence-based field handbook will address the need to prepare rehabilitation professionals for emergency settings as well as acting as a reference for safe practice of early rehabilitation of major trauma in challenges environments.

We are honoured to contribute to this multidisciplinary project, in collaboration with the ICRC, WHO, MSF-France, CBM, and Livability. We welcome this opportunity to share our expertise in relevant areas, supporting healthcare professionals across the world as they work on early rehabilitation in conflicts and disasters.

We thank all those who made this humanitarian project possible, and look forward to continuing our global endeavour to improve patient outcomes.



A handwritten signature in black ink, appearing to read 'R. McGuire'.

**ROBERT MCGUIRE, MD**  
AO President



A handwritten signature in black ink, appearing to read 'Isabelle Urseau'.

**ISABELLE URSEAU**  
Humanity and Inclusion Rehabilitation  
Division Director

# CONTENTS

## CHAPTER 1: INTRODUCTION

Early Rehabilitation in Conflicts and Disasters Introduction ..... 07

## CHAPTER 2: KEY CHALLENGES

Key Challenges in Delivering Early Rehabilitation in Conflicts and Disasters ..... 29

## CHAPTER 3: PATIENT ASSESSMENT AND TREATMENT - THE BASICS

Early Rehabilitation Patient Assessment and Treatment - the Basics ..... 45

## CHAPTER 4: FRACTURES

Early Rehabilitation of Fractures ..... 67

## CHAPTER 5: PERIPHERAL NERVE INJURIES

Early Rehabilitation of Peripheral Nerve Injuries ..... 89

## CHAPTER 6: AMPUTEES

Early Rehabilitation of Amputees ..... 115

## CHAPTER 7: ACQUIRED BRAIN INJURIES

Early Rehabilitation of Acquired Brain Injuries ..... 149

## CHAPTER 8: SPINAL CORD INJURIES

Early Rehabilitation of Spinal Cord Injuries ..... 169

## CHAPTER 9: BURNS

Early Rehabilitation of Burns ..... 191

## SELECTED DEFINITIONS

These definitions are taken from the United Nations Office for Disaster Risk Reduction (UNISDR) unless stated:

**Disaster** — a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

**Disaster preparedness** — pre-disaster activities that are undertaken within the context of disaster risk management and are based on sound risk analysis. This includes the development/enhancement of an overall preparedness strategy, policy, institutional structure, warning and forecasting capabilities, and plans that define measures geared to helping at-risk communities safeguard their lives and assets by being alert to hazards and taking appropriate action in the face of an imminent threat or an actual disaster.

**Disaster prevention** — 'is the outright avoidance of adverse impacts of hazards and related disasters. Prevention expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high risk zones, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake. Very often the complete avoidance of losses is not feasible and the task transforms to that of mitigation. Partly for this reason, the terms prevention and mitigation are sometimes used interchangeably in casual use.'

**Disaster risk** — the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

**Disaster risk management** — the systematic process of using administrative directives, organisations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

**Disaster risk reduction** — the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

**Emergency management** — the organisation and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps.

**Emergency Medical Team** – EMTs are groups of health professionals (doctors, nurses, paramedics etc.) that treat patients affected by an emergency or disaster. They come from governments, charities (NGOs), militaries and international organizations such as the International Red Cross/Red Crescent movement (WHO).

**Hazard** — a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

**Risk** — the combination of the probability of an event and its negative consequences.

**Risk assessment** — a methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

**Risk management** — the systematic approach and practice of managing uncertainty to minimise potential harm and loss.

**Vulnerability** — the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

**Vulnerable groups** — include indigenous peoples, ethnic minorities, refugees, migrant workers, women, children, people with HIV/AIDS, persons with disabilities and older persons. People belonging to these groups have certain common characteristics or are in a situation that have been shown to make these people more vulnerable to discrimination. They are especially “vulnerable”, because these grounds for discrimination have been overlooked or insufficiently addressed



**Video icon:**

Refers to an educational YouTube Channel; Early Rehabilitation in Conflicts and Disasters.  
<https://www.youtube.com/c/EarlyRehabilitationinConflictsandDisasters>



**Webpage icon:**

Refers to accompanying web resources designed to be used in conflict and disasters settings; available on <https://www.disasterready.org>

## SELECTED ABBREVIATIONS

<b>CBM:</b>	International non-governmental organisation, formerly Christian Blind Mission
<b>CBR:</b>	community based rehabilitation
<b>DH:</b>	Drug History
<b>DPO:</b>	disabled people's organisation
<b>EMT:</b>	emergency medical team
<b>HI:</b>	Humanity and Inclusion (previously Handicap International)
<b>HIC:</b>	high income countries
<b>IASC:</b>	Inter Agency Standards Committee
<b>ICRC:</b>	International Committee of the Red Cross
<b>INGO:</b>	international non-governmental organisation
<b>LMIC:</b>	low and middle income countries
<b>OCHA:</b>	Office for the Coordination of Humanitarian Affairs
<b>MDT:</b>	multi-disciplinary team
<b>MH:</b>	Medical History
<b>MHPSS:</b>	Mental Health and Psychosocial Support
<b>NEPTA:</b>	Nepal Physiotherapy Association
<b>NGO:</b>	non-governmental organisation
<b>PMH:</b>	Past Medical History
<b>SCI:</b>	spinal cord injury
<b>SH:</b>	Social History
<b>SOD:</b>	Sudden onset disaster
<b>UKEMT:</b>	United Kingdom Emergency Medical Team
<b>UNISDR:</b>	United Nations Office for Disaster Risk Reduction
<b>UN:</b>	United Nations
<b>WASH:</b>	Water, sanitation and hygiene
<b>WHO:</b>	World Health Organization



# CHAPTER 1

## EARLY REHABILITATION IN CONFLICTS AND DISASTERS INTRODUCTION

### AIMS:

By the end of this chapter you should be able to:

- Understand the different types of conflicts and disasters and the injury patterns that result from them
- Understand what early rehabilitation is and its role in conflict and disaster settings
- Understand the importance of preparedness for rehabilitation professionals
- Understand who is involved in conflict and disaster responses



# CHAPTER 1: EARLY REHABILITATION IN CONFLICTS AND DISASTERS INTRODUCTION

## INTRODUCTION

The role of rehabilitation professionals in responding to conflicts and disasters is constantly evolving, and the development of our professions are intertwined with global events that have generated the need to provide care for overwhelming numbers of injured people. From the evolution of the early rehabilitation professions during the first world war, to the emergence of the ICRC rehabilitation program for victims of armed conflict and violence in 1979 and the birth of Handicap International in 1982 on the Thailand/Cambodia border to support victims of land mines, to the rapid advancement in rehabilitation for war wounded military personnel made in some countries in the early 21<sup>st</sup> century, our professions have developed to meet the needs of a changing world. Lessons learned from more recent disasters, such as the 2010 Haiti and 2015 Nepal earthquakes, have underlined the importance of integrating rehabilitation into emergency responses in disasters, as well as conflicts.

With the strengthening of emergency medical preparedness and response, improvements in battlefield medical care and the continued development of humanitarian health coordination, we now face a paradox where we are getting better and better at saving lives in conflicts and disasters, but where the effective rehabilitation required to change these lives still lags behind. While in many countries rehabilitation now begins at the earliest possible point in a patient's care, too often in conflict and disasters, when faced with overwhelming numbers or insecurity, it remains an afterthought. Even where therapists are present, they sometimes lack the major trauma skills to work effectively. Patients who miss out on quality early rehabilitation are then at increased risk of developing complications, poor outcomes or being lost to follow-up altogether.



## WHAT ARE DISASTERS AND CONFLICTS?

### Disasters:

When we think of disasters, we often automatically think of the phenomenon that has caused them – for example the earthquake, cyclone, or flood. In reality, though, this event is simply the 'hazard' – and the disaster itself is caused by a combination of the hazard, our own exposure to the phenomenon (such as whether we live in the area affected) and our vulnerability to it (how we have prepared or mitigated for it). To illustrate this, we can consider two tropical cyclones (hazards) in 2019 with similar wind speeds; one in Mozambique (a low-income setting with low preparedness) that killed 1,297 people and involved a major international emergency medical response, and one in Japan (a high-income setting with high preparedness) that killed 86 people and where no request for international emergency medical assistance was made. Put simply, a disaster occurs when a hazard impacts on vulnerable people.

A disaster is formally defined by the UN office for Disaster Risk Reduction as: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting

with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.

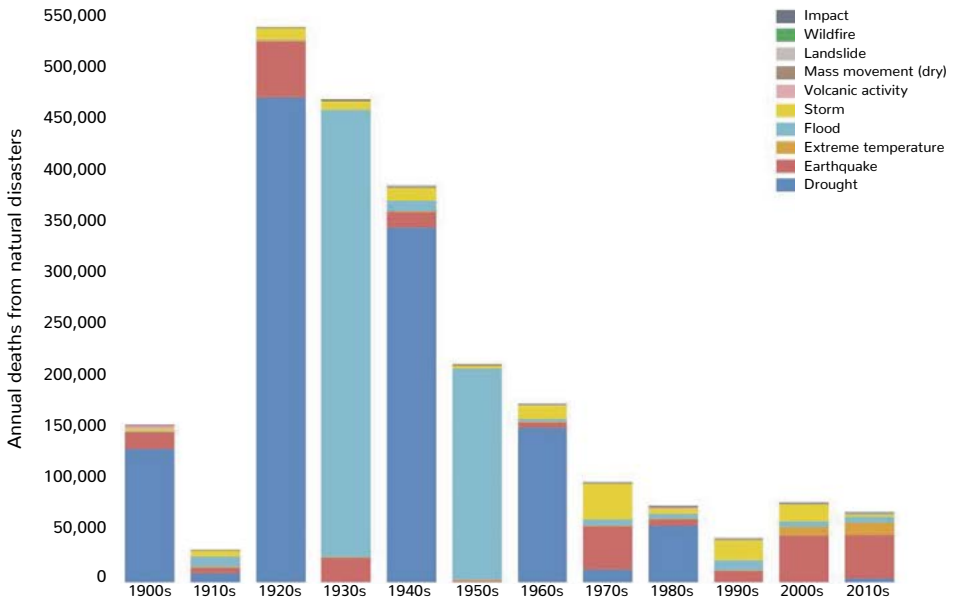
This then leads to the equation: Disaster = Hazard x Vulnerability x Exposure.

We understand now that the vulnerability and exposure of people are just as important as the hazard itself when we think about disaster severity. Vulnerability and exposure can also be interpreted on individual, community, regional or national levels. Trends of urbanisation and greater populations will increase exposure to hazards; whilst factors such as policies, laws, preparedness, economic situation, environmental degradation, infrastructure, construction quality, health system strength, and health and education status can all impact on the vulnerability of a population. This also explains why low-income countries have taken the brunt of economic and human impact from disasters in the last ten years. Critically, low-income countries often have weak health systems, and weak health systems also generally mean reduced quality and quantity of rehabilitation services. Furthermore, in many cases disaster and conflict co-exist, compounding and increasing vulnerabilities and exposure.

Every disaster is different, but by understanding basic trends we can better prepare and respond to them.

### Diagram 1: Global annual deaths from natural disasters, by decade

Absolute number of global deaths from natural disasters, per year. This is given as the annual average per decade (by decade 1900s to 2000s; and then six years from 2010-2015)



Source: EMDAT (2017): OFDA/CRED International Disaster Database, Université catholique de Louvain - Brussels - Belgium. The data visualisation is available at [OurWorldinData.org](https://www.ourworldindata.org). There you find research and more visualisations on this topic.

Licensed under CC-BY-SA by the authors Hannah Ritchie and Max Roser.

## Sudden Onset Disasters (SODs)

SODs are usually the result of sudden-onset hazards, although the term ‘sudden onset’ can be misleading; with advancement in warnings of major storms and knowledge of where major earthquakes are likely to strike. Multiple factors contribute to the variety of type and distribution of injuries:

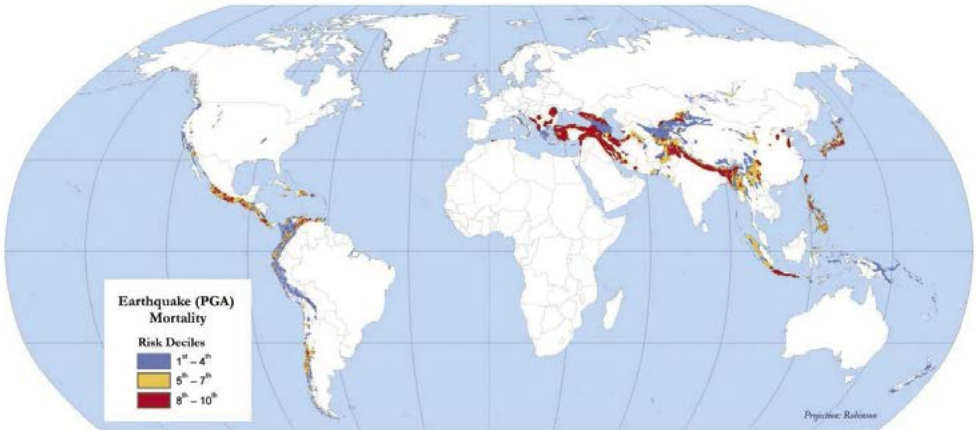
- Type and severity of hazard
- Time of day
- Local preparedness and risk mitigation, including building quality and density
- Level of health infrastructure

Across all hazards, it should be remembered that their health impact is not limited to the deaths and injuries they cause directly, but also the damage and disruption of the existing health system.

**Earthquakes:** Between 2010 and 2019, 350,000 people have been killed, and more than 1,000,000 people have been injured by earthquakes. Injury numbers and patterns vary between events, but mortality: morbidity is typically around 1:3 or 1:4. Factors including time of day, building materials and depth and strength of earthquakes will impact injury type and number.

Orthopaedic injuries make up the bulk of injury burden, with past figures suggesting 65% of these were fractures (predominantly lower limb), with other injuries including compartment syndromes,

**Diagram 2: Global earthquake mortality risk distribution**



Mortality risk is found by weighting the value of population exposure to earthquakes for each grid cell by a vulnerability coefficient to obtain an estimate of risk. The vulnerability weights are based on historical losses in previous disasters. The mortality weights are applied to population exposure to obtain mortality risks. The weights are an aggregate index relative to losses within each region and country wealth class (classifications based on 2000 GDP) over the 20-year period from 1981-2000.

Source: Dille, Maxx, Robert S. chen, Uwe Deichmann, Arthur J. Lerner-Lam, and Margaret Arnold. 2005. *Natural Disaster Hotspots: A Global Risk Analysis*. Washington, D.C.: World Bank.

This Document is licensed under a Creative Commons 3.0 Attribution License. <http://creativecommons.org/licenses/by/3.0/>

Copyright 2005 International Bank for Reconstruction and Development/The World Bank and Columbia University.

major soft-tissue injuries and crush syndromes. Other injuries seen include amputations, spinal cord injuries and traumatic brain injuries, although numbers seen may depend on a number of additional local factors, including the speed and quality of extraction and the availability of appropriate intensive care and surgical interventions. Complications from crush injuries such as rhabdomyolysis and compartment syndrome are common. Burns may occur as a result of secondary fires, electrocution or due to local cooking practices (both during and after the disaster).

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Damage to health infrastructure across a wide area, overwhelming numbers of complex trauma patients, internal displacement creating challenging discharge environments and ongoing risk of aftershocks and secondary disasters, such as landslides.

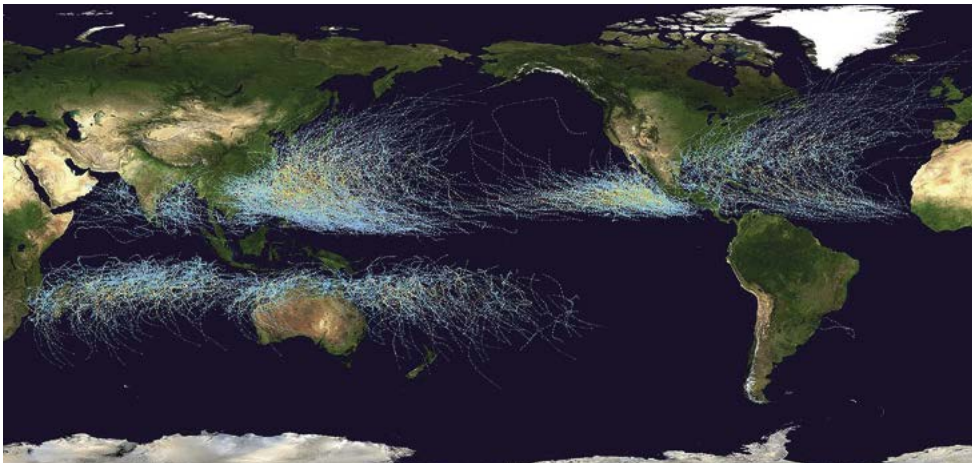


**Picture 1: Earthquake aftermath in Nepal, 2015; Lady stood outside her home**

© William Daniels / Handicap International

**Tropical cyclones:** Known as hurricanes, cyclones and typhoons depending on where in the world they appear, these storms typically occur in seasons and with lead times of several days, although their paths can alter.

**Diagram 3: Tropical cyclones**



Much of the mortality and morbidity data from cyclones comes from high-income countries, but figures indicate that most deaths and injuries do not normally arise directly from the wind, but from sequelae such as flooding and landslides. Storm surges in coastal areas can be particularly dangerous. Contusions and lacerations (particularly to the head and extremities) are the widest reported injuries, particularly in strong cyclones where shelter has been limited. Serious injuries such as fractures may constitute as low as 1% of all injuries. As with earthquakes, there may be a significant proportion of indirect injuries reported, such as electrocution and burns, as well as injuries that occur during clean-up activities. As with earthquakes, preparedness can significantly lower mortality and morbidity.

Scales for measuring tropical cyclones vary depending on where in the world they occur, but the Saffir-Simpson Hurricane scale provides a useful illustration of the impact of windspeeds:

#### Diagram 4: Saffir - Simpson hurricane scale



**Category 1**  
Winds 119-153 km/h (74-95 mph). Some damage and power cuts.



**Category 2**  
Winds 154-177 km/h (96-110 mph). Extensive damage.



**Category 3**  
Winds 178-208 km/h (11-129 mph). Well-built homes suffer major damage.



**Category 4**  
Winds 209-251 km/h (130-156 mph). Severe damage to well-built homes, trees blown over.



**Category 5**  
Winds 252+ km/h (157+ mph). Many buildings destroyed, major roads cut off.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Damage to health infrastructure across a wide area, small surges in complex trauma cases, internal displacement creating challenging discharge environments. Possible spikes in infectious diseases.



**Picture 2: Cyclone Idai** (Mozambique, 2019) © C.Briade/HI

**Tornados:** Tornados can cause death and injury, in particular if they hit areas with lightly constructed homes. The March 2019 southern Nepal tornado (Nepal’s first confirmed tornado) killed 28 people and injured over 1,000, while a tornado in Dhaka (Bangladesh) in 1989 was estimated to have killed over 1,000 people and injured around 12,000. Tornadoes occur most frequently in North America, particularly in central and south-eastern regions of the United States, as well as in southern Africa, north-western and south-eastern Europe, western and south-eastern Australia, New Zealand, Bangladesh and adjacent eastern India, eastern China and south-eastern South America. Data on injuries is limited. A study in China of 451 patients injured in a 2016 tornado found most had minor injuries. Minor and soft-tissue injuries were most common, although head (46.63%), and lower-limb (29.43%) injuries were present and over one-third of injuries were fractures.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Localised damage to infrastructure, surges in complex trauma cases and displacement.



**Picture 3: HI responders** providing early rehabilitation in the community following the 2019 Nepal Tornado  
© Handicap International

**Floods:** Flooding can occur as a result of tropical cyclones, prolonged heavy rainfall or due to failures of critical infrastructure, such as dams. Floods are the most common natural hazard worldwide, with drowning the number one cause of death. Studies indicate that most injuries are mild lacerations due to floating debris, with a high risk of infection. Flood water is typically heavily contaminated, and open injuries sustained are likely to be contaminated. Long-term health issues, such as spread of communicable diseases and compromised access to healthcare facilities, cause more problems than acute injuries.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Damage to health infrastructure, small surges in trauma cases with a high risk of infection, internal displacement creating challenging discharge environments, risk of infectious disease outbreaks.



**Picture 4:** Crowded evacuation centre during Sri Lanka floods, 2015  
© Handicap International



**Picture 5:** HI intervention during the floods in Jammu & Kashmir state, 2014  
© Handicap International

**Landslides:** These have a high death-to-injury ratio (4.5:1). Most deaths are due to suffocation. Survivor injuries range from lung injuries, thoracic and pelvic injuries and most commonly: mild bruising and lacerations. A recent review of landslides in Bangladesh in 2017 found a high number of minor injuries reported. Authors suggest that 'physical rehabilitation treatment capacity in future landslides may be increased by providing rehabilitation technical skills training to responders and augmenting the emergency response structure with individual rehabilitation specialists and/or teams of rehabilitation professionals'.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Small surges in complex trauma cases, localised displacement creating challenging discharge environments.



**Tsunamis:** These are caused by the displacement of large volumes of water, most commonly resulting from earthquakes. There is a high death-to-injury ratio (4:1) with almost all deaths caused by drowning. Reports have suggested large proportions of injuries are mild extremity trauma, including lacerations and also minor fractures. Due to delayed care, challenging discharge environments and contaminated wounds, infections are common. Of note, a common adverse health effect after a tsunami is pneumonia, due to aspiration of seawater. This has implications for the need for respiratory therapy. If the tsunami hits an area affected by an earthquake, it is possible that responders have to manage both events simultaneously.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Damage to health infrastructure in low-lying coastal areas, small surges in complex trauma cases with a high risk of infection, potential respiratory care needs.



**Picture 6:** Consequences of the Tsunami in Indonesia, 2004  
© P. Maury/HI



**Picture 7:** Tsunami aftermath at a hospital in Indonesia, 2004  
© A. Simonazzi/HI

**Volcanic eruptions:** Major urban centres are commonly found within close proximity to volcanoes, including Naples and the capital cities of Mexico, Japan and the Philippines, with the highest population densities in close proximity to volcanoes in south-east Asia and Central America. There is currently limited evidence for mortality and morbidity figures, with large variations between eruptions. A median death/injury ratio of 0.63 has been postulated, though morbidity from eruptions, in particular respiratory complications, are likely to be underestimated. Leading causes of death are asphyxiation from ash, thermal injuries from pyroclastic flow and trauma. Traumatic injuries are less common, but can include burns or trauma from projectile impact or collapse of ash-covered roofs. Respiratory complications are well-documented, particularly for those with pre-existing respiratory conditions.

## KEY ISSUES

**Potential key issues for acute rehabilitation providers:** Potential surges in burns cases, small surges in complex trauma, and more widespread surges in respiratory complications.

## Man-made disasters

Man-made disasters are those resulting entirely or predominantly from human activities and choices. Such disasters may arise from chemical, nuclear or radiological hazards, as well as transport hazards. Examples include industrial pollution, ionising radiation, toxic wastes, dam failures, building collapses, transport accidents, factory explosions, fires and chemical spills.

Case Study: The 2013 Dhaka garment factory collapse (also referred to as the Rana Plaza collapse) was a structural failure that occurred on 24 April 2013 in Bangladesh, where an eight-storey commercial building called Rana Plaza collapsed. The disaster killed 1,134 people, while approximately 2,500 people were injured.

## KEY ISSUES

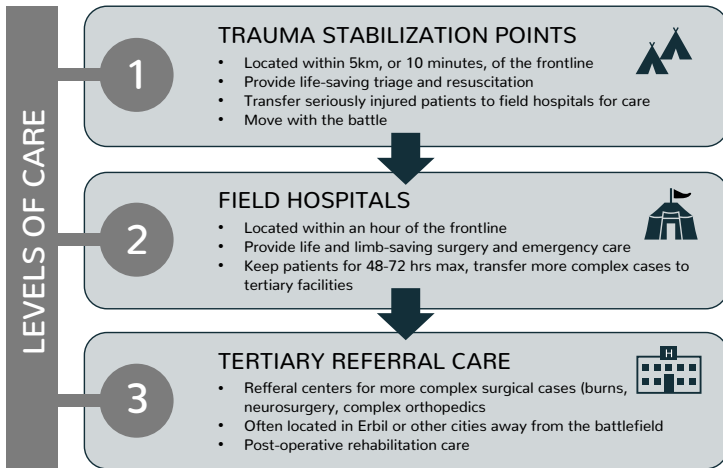
**Potential key issues for rehabilitation provision:** These vary widely depending on the hazard. There may be a need for specialised rehabilitation (such as for burns) and overburdened local health facilities. Healthcare staff (or family members) may also be affected. There may be unknown long-term effects of the hazard, and therefore unknown medium- to long-term rehabilitation needs. There may be an additional requirement for isolation of exposed patients to certain hazards – making treatment more challenging.

## Conflict and terrorist attacks

**Conflict:** Numerous armed conflicts are currently taking place around the world, including those involving warring parties within a single state (non-international armed conflicts) and those involving armed forces from two or more states (international armed conflicts). There were 52 active conflicts in 36 different countries in 2018, causing death, injury, displacement and suffering on a massive scale. Indirect mortality and morbidity due to destruction of infrastructure (including the specific targeting of health facilities), displacement of people and food and water insecurity is also significant.

The type and impact of conflict varies enormously. Weapons can vary from knives and machetes to explosive weapons capable of causing massive destruction. Those injured and killed will be both civilians and members of the armed groups. Since 2013, over 90% of casualties from explosive weapons used in populated areas were civilians.

When compared to disasters, conflicts are often less predictable, often with no one single surge of trauma cases. Additional security constraints, including the targeting of health staff, mean that conflict and protracted conflict and their associated displacement of populations are an extremely complex setting for early rehabilitation provision. There may be a constant influx of patients or surges in patients, depending on conflict activity; injury mechanisms and complexity will be varied and often require long-term specialist interventions. While some civilian and military rehabilitation providers may operate in the midst of active conflict, in other cases, rehabilitation may only begin once the patient is removed from an area of active fighting, with patients being stabilised and then transferred to safer areas for definitive care, including rehabilitation. An example of this is the trauma pathway utilised by the World Health Organization (WHO) in the 2016–2017 Battle of Mosul.



Please see the ICRC/TED Talk by Alberto Cairo here on the importance of continuing rehabilitation provision during conflict: [https://www.ted.com/talks/alberto\\_cairo\\_there\\_are\\_no\\_scraps\\_of\\_men?language=en](https://www.ted.com/talks/alberto_cairo_there_are_no_scraps_of_men?language=en)

## KEY ISSUES

**Potential key issues for rehabilitation provision:** Access to injured people, safety and security, very short hospital admissions for life-saving care only, a breakdown in referral pathways, resource constraints, psychological distress of patients and healthcare staff, long-term rehabilitation uncertainties, movement constraints and population displacement, challenges in identifying patients, ethical challenges, and targeting of health professionals (see Chapter 2).

**Terrorist attacks:** Terrorism remains a highly contentious term, but for the sake of this publication we will consider a terrorist attack to be an act that deliberately and violently targets civilians for political or ideological purposes, occurring either in peace time or in the context of war.

Methods of attack include explosive devices such as car-bombs, suicide bombs or improvised explosive devices (IEDs), close quarter attacks using firearms or blades and chemical, biological or radiological (CBR) devices. As with conflicts, the type of injury and implications for early rehabilitation vary wildly.

## CASE STUDY

The 2017 Manchester Arena suicide bombing killed 22 people, with 800 injured, of which 112 were admitted to hospital. The blast resulted in injury patterns (and poly-trauma) not normally seen by medical teams away from the battlefield, while the scale (and need for ongoing complex medical, surgical and rehabilitation input) was sufficient to challenge the regional health system, and underlined the need for whole team preparedness for mass casualty events, even in high-income settings.

## KEY ISSUES

**Potential key issues for rehabilitation provision:** A localised surge in highly complex poly-trauma cases that can overwhelm both general and specialist services.

Like many disasters, conflicts and terrorist attacks can cause overwhelming numbers of casualties with complex traumatic injuries. However, injuries sustained in conflict and terrorist attacks present unique challenges which differ from disasters above, and are also rarely seen in day-to-day practice away from the conflict zones. Working in situations of conflict, it is important to understand what weaponry is commonly used and the typical injury patterns and surgical and rehabilitation implications. In conflict medicine, the concept of ballistics and energy transfer plays an important role. In short, the level of tissue damage will depend on the efficiency of the energy transfer of the missile – whether this be a bullet or blast fragment. The ICRC and AO Foundation Field Guide *'Management of limb injuries during disasters and conflict'* summarises this excellently. [https://icrc.aoeducation.org/files/downloads/A\\_Field\\_Guide\\_Low\\_res.pdf](https://icrc.aoeducation.org/files/downloads/A_Field_Guide_Low_res.pdf)

Limitations to healthcare can also result from a restricted ability to access patients, and other factors such as infrastructure breakdown, shortage of medical supplies, lack of human resources and threats of kidnappings and attack. More information on working in conflict, including the Humanitarian Principles and Healthcare in Danger, can be found in Chapter 2.

The following table summarises common conflict related injuries and their implications for rehabilitation:

Injury type	Implications for rehabilitation
<b>Explosive weapons and their subsequent blast injuries</b>	<p>This includes missiles, grenades, mortars, landmines and improvised explosive devices, unexploded ordnance or explosive remnants of war.</p> <p>Blast injuries are the injuries caused by the multiple effects of explosive weapons and the 'overpressure' created by them. There are four blast injury types: primary, which is from the blast itself commonly damaging the lungs and brain; secondary is the result of fragments, which can be bomb casing, shrapnel or even rubble; tertiary injuries are caused by people being thrown by the blast and finally, quaternary injuries are from other things caused by the blast, such as burns or inhalation injury.</p> <p>The damaging effects of blasts are exacerbated in enclosed spaces, such as buildings or public transport, where the blast wave undergoes multiple reflections and causes greater morbidity.</p> <p>Common injuries include blast lung injury and tympanic membrane perforation (more common in enclosed spaces), fractures, penetrating wounds and burns. Treatment is often damage limiting, followed, where available, by extensive reconstruction. Complex poly-trauma (at times combining neurological, orthopaedic and soft-tissue injury), missed injuries and the associated psychological impact of blast injuries can all complicate early rehabilitation.</p>

Injury type	Implications for rehabilitation
<b>Bullet wounds</b>	Can cause extensive soft-tissue, muscle, nerve and bone damage. Exit wounds, the level and extent of penetration and degree of cavitation will depend on the type of weapon and ammunition, as well as proximity and path. Wide excision or fasciotomy may be required to clear foreign material and dead tissue. Primary suture is frequently delayed for high-velocity injuries with grafting and suture at 3-5 days. Fractures are typically severely comminuted.
<b>Chemical, biological, nuclear or radiological incidents (CBRN)</b>	The health impact will be determined by the agent, concentration of the agent, the route of exposure, the rate of exposure and the transmissibility/potential for spread of the agent or contamination of others. Potential routes of exposure include: inhalation, ingestion, irradiation, dermal exposure through intact or non-intact skin and injection. Training in Personal Protective Equipment (PPE) use is essential for all staff, including rehabilitation personnel. Long-term effects of CBRN exposure are often unknown and patients may require extensive follow-up and rehabilitation.
<b>Knife/machete attacks</b>	Machete attacks and survivors' resulting amputations became a symbol of genocide in Rwanda and civil war in Sierra Leone in the mid to late 1990s, and such weapons continue to be used in attacks in a variety of contexts. Often resulting in trauma to the upper limbs, torso and head, the psychological trauma associated with this type of attack is likely to be high, while traumatic brain injury should be considered with scalp lacerations.

### Infectious disease outbreaks

Although not classed as sudden onset disasters or causes of major trauma, infectious disease outbreaks are worthy of mention and can occur as a result of (or be exacerbated by) conflict and disaster. Some outbreaks have specific implications for rehabilitation professionals, including viral haemorrhagic fevers (such as Ebola), measles and pandemic flu. Rehabilitation input will depend entirely upon the specific disease, context and skill of the rehabilitation professional. Patients treated in isolation or with prolonged illness can develop secondary complications like blood clots, muscle wasting, weakness and deconditioning. 70% of Ebola survivors reported musculoskeletal pain and functional difficulties, while Diphtheria can lead to cases of polyneuropathy similar to Guillaume Barré syndrome. Measles can lead to severe pneumonia and also encephalitis, and particularly affects young children, with a clear role for acute paediatric respiratory therapy. Respiratory therapy also undoubtedly has a significant role in pandemic flu management, particularly around bronchial secretion management and supporting those with exacerbations of chronic respiratory conditions. Due to infection control risks during these procedures, appropriate Personal Protective Equipment (PPE) should be a key feature in the preparation for such events (see Chapter 3).

### What is early rehabilitation in conflicts and disasters?

In disaster and conflict settings, rehabilitation is a vital part of healthcare provision required from the onset of the event providing timely rehabilitation is essential to offer patients the best outcome.

According to the WHO: 'Rehabilitation is a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment.'

Emergency care and surgical responses have historically been at the forefront of emergencies (particularly conflicts and earthquake response); with rehabilitation previously considered only in the later stages. This is changing with the concept of ‘early rehabilitation’ positioning itself firmly within the initial emergency in recent responses and in international guidelines.

There are, however, challenges in defining what exactly ‘early’ rehabilitation is, particularly in disaster settings. Often, it is considered as beginning on acute admission to a health facility, but in emergencies, some patients requiring early rehabilitation may never be admitted to an inpatient facility, or may be rapidly discharged due to limited bed capacity or insecurity, meaning that early rehabilitation actually starts in the community. It can also be defined in terms of timeliness (from initial injury), but what then of the patient rescued after days trapped in a collapsed mountain home, days from their nearest hospital? Or the patient with the bilateral amputation who is lost to follow-up and only starts rehabilitation one month after the disaster? Would this still be early rehabilitation?

For the sake of this resource, we will consider early rehabilitation to be the initial rehabilitation that takes place around the time of initial injury and the onset of acute medical care. It often has both preventative and rehabilitative components, with a strong emphasis on patient and caregiver education, and is complicated by the fact that those receiving care may still be acutely unwell. It aims to prevent complications, optimise the potential for long-term functional recovery and quality of life, reduce length of stay at hospital level and to ensure links to ongoing services. Early rehabilitation may include the provision of mobility devices, acute burn care and splinting, peri-operative fracture and amputation care, the prevention of complications of spinal and nerve injuries, early mobilisation and respiratory care, patient and caregiver education, pain management and early supported discharge planning or coordination. Provision of such care following an injury can significantly improve outcomes for patients, but also support overall healthcare delivery by decongesting crowded health facilities, preventing readmission and improving discharge planning.

Though poorly defined, early rehabilitation is now grounded in international guidelines, including *The Sphere Handbook: universal minimum standards for the delivery of quality humanitarian response* and *Emergency Medical Teams: minimum technical standards and recommendations for rehabilitation*

The context, requirements and challenges for early rehabilitation provision will vary enormously between emergency situations. In general, with the acceptance of the World Health Organization Trauma Pathway (<http://www.emro.who.int/images/stories/palestine/documents/trauma-pathway-4.pdf>) and continued strengthening of the national and international health system preparedness, surgical and immediate trauma response during conflict and disasters is becoming more effective and efficient. Patients with life-changing injuries who would previously have died are now surviving. This implies improved outcomes for patients, **but only if early rehabilitation can capitalise on these advances.**

*The realities of providing rehabilitation care in a mass casualty situation in conflict or disaster:*

- The health system may be overwhelmed, damaged or destroyed – this includes the possibility that healthcare staff have themselves been injured or killed
- Patients may present with complex trauma, including poly-trauma
- Patients may experience a much shorter length of stay in hospital than in times of stability – leading to an increased burden on community care

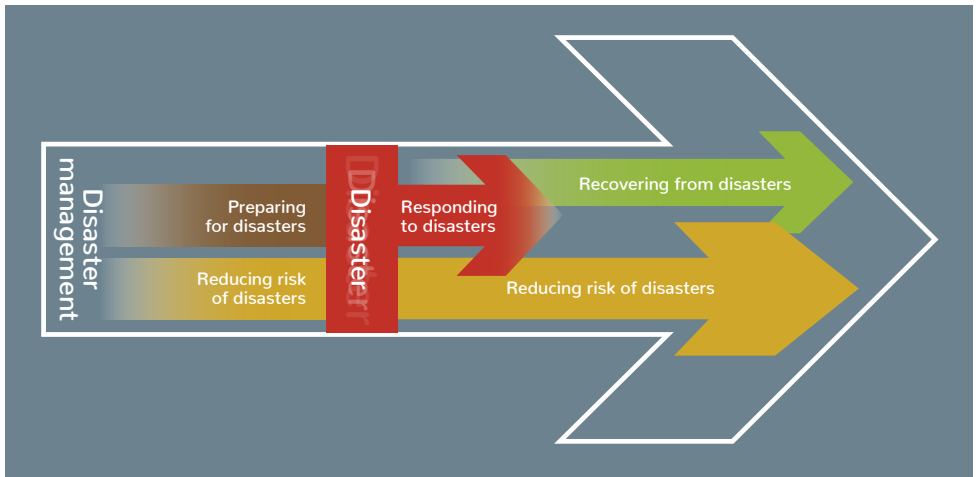
- Due to resource and time limitations there may be sub-optimal or adjusted medical or surgical management of injuries, with limited access to services, such as imaging or specialist surgery
- Rehabilitation equipment may also be in limited supply
- There may be a breakdown of record systems and patient follow-up
- Patients' homes may be damaged, destroyed or inaccessible, creating challenges for safe discharge planning
- There may be multiple actors on the ground, with potential for confusion between providers and for local populations
- There may be ongoing risks to local populations and health workers, either from enduring hazards or continued armed conflict
- Patients and staff may have experienced, or continue to experience, psychological distress

For a 30-minute talk on being a rehabilitation professional working in conflict and disasters, listen to this global physio podcast here, presented by Peter Skelton from HI: <https://globalphysio.ca/gp012-deployments-with-peter-skelton/>

### What exactly is the role of rehabilitation professionals within conflicts and disasters?

The disaster management cycle is actually a continuum of four phases: preparedness, response, recovery and mitigation. Each phase often blends into the next, with no clear beginning or end.

**Diagram 5: Disaster management cycle**



International Federation  
of Red Cross and Red Crescent Societies

For the purposes of early rehabilitation, we will focus on the role of rehabilitation professionals in preparedness and response here.

## Preparedness

Rehabilitation professionals can make significant contributions to disaster management preparedness. As such, they should be aware of any specific hazards and the vulnerability of their country/region, and the likely consequences of disasters that could occur. This should include consideration of likely specific disease or injury types, as well as response capacity and possible impact on existing healthcare services. Early rehabilitation should then be incorporated into the healthcare disaster management plan, ensuring an integrated response with clear roles for rehabilitation professionals from the outset and definitive referral pathways for patients.

*The Inform Database* ([www.inform-index.org](http://www.inform-index.org)) is a global, open-source risk assessment for humanitarian crises and disasters. It provides an excellent overview of the risk profiles of individual countries based on the likelihood of emergencies, vulnerability and coping capacity of the country.

One way to consider preparedness for early rehabilitation in emergencies can be to consider it in four domains: staff, stuff, systems and space:

Staff	Stuff	Systems	Space
<p>Should have personal preparedness plans to look after themselves and their families</p> <p>Are aware of work-based emergency plans (including evacuation)</p> <p>Can be rapidly mobilised in an emergency (sometimes via a regional or national roster)</p> <p>Are trained to manage major trauma (or likely event related health events) as part of a team.</p> <p>Know their roles (and colleagues also know and understand their roles).</p>	<p>Equipment is stockpiled to manage immediate surges (wheelchairs, crutches, splints, dressings, etc.)</p> <p>Equipment is available to create overflow or step-down areas (see space)</p>	<p>Rehabilitation is included in local and national health emergency management plans</p> <p>Rehabilitation providers/services are mapped and their capacities noted</p> <p>MDT clinical protocols are in place</p> <p>There is an agreed data management system to measure injury type and severity (not just mortality)</p> <p>There are agreed emergency referral pathways for certain conditions (e.g. burns, SCI, patients sustaining amputations)</p> <p>There are agreed methods to be able to rapidly assess need and capacity following an event.</p>	<p>Existing rehabilitation spaces would withstand and continue to function during identified hazards</p> <p>Overflow areas are identified</p> <p>Rehab and nursing step-down for stable patients is considered as a means of decompressing acute ward areas</p> <p>Cohorting of certain patients is considered (for example patients with spinal cord injury)</p>





**Picture 8:** Equipment stockpile being released in Nepal, 2015  
© Brice Blondel / Handicap International

A short video from WCPT on the importance of preparedness can be found here: <https://www.youtube.com/watch?v=EgIVz6VrRV4>

Preparedness planning should take place on the level of the individual (personal), their place of work (organisational) and their locality (both regional and national). Mapping of human and institutional resources from across the rehabilitation sector is critical and aids a coordinated disaster response; it informs training needs and the prepositioning of equipment. An example of a personal preparedness plan template can be found at the end of the chapter.

Further detailed information (and case studies) concerning the role of occupational therapists and physical therapists in disaster preparedness and response can be found here:

- Occupational Therapy in Disaster Risk Reduction (DRR) (World Federation of Occupational Therapists) <https://www.wfot.org/resources/occupational-therapy-in-disaster-risk-reduction-drr>
- The role of physical therapists in disaster management (World Confederation for Physical Therapy) [https://www.wcpt.org/sites/wcpt.org/files/files/resources/reports/WCPT\\_DisasterManagementReport\\_FINAL\\_March2016.pdf](https://www.wcpt.org/sites/wcpt.org/files/files/resources/reports/WCPT_DisasterManagementReport_FINAL_March2016.pdf)

## Response

The first people to respond to conflicts and disasters are those affected by them, with local, national or international support arriving over the first days and weeks. The response phase can last from a few days to several months, and much longer in many conflicts. The role of rehabilitation professionals in this phase will be dependent on the nature and scale of

emergency, the experience and training of individuals, as well as local health and rehabilitation infrastructure. In sudden onset disaster scenarios, such as the Nepalese earthquake of 2015, where rehabilitation has been appropriately embedded into trauma emergency plans, physical and occupational therapists have been involved in the response from the initial few hours.

Rehabilitation professionals may be required to work outside of their usual workplace, in other healthcare facilities, community venues and with national or international emergency medical teams.

Responsibilities in the initial response may include:

- Early rehabilitation for those with injuries
- Assessing, advising, fitting and providing assistive devices, as well as providing training in their use and maintenance
- Rapidly discharging existing patients to free up bed space for incoming acute patients
- Providing guidance and education to patients, carers and other healthcare professionals
- Coordinating discharge, onward referrals and follow-up of patients once they leave healthcare facilities
- Assessing environments and environmental adaptations needed to ensure accessibility

Additional responsibilities are context specific, and specific to the skills and experience of individuals. These can include:

- Conducting rehabilitation needs assessments in the disaster context, mapping available resources and gaps and coordinating an integrated rehabilitation response at either local or national level
- Triage
- Providing basic psychosocial support, such as psychological first aid, or onward referral to appropriate services
- Identifying and assessing people with specific vulnerabilities (such as age, gender or disability) who may find it harder to access services or receive support
- Rapid on-the-job training of rehabilitation colleagues in more specialised areas (such as spinal cord injuries)
- Rapid training of community workers, or other professionals or organisations, to identify people with a disability and others in need of rehabilitation
- In the absence of rehabilitation assistants – training healthcare workers to perform tasks traditionally carried out by rehabilitation assistants
- Advocating for quality rehabilitation provision and basic needs for those injured, at organisation, local and national levels – including use of injury-specific data
- Ensuring inclusion of injured people and people with disabilities in the emergency response and recovery phases (specifically considering long-term service provision, education, livelihood, shelter and accessibility)

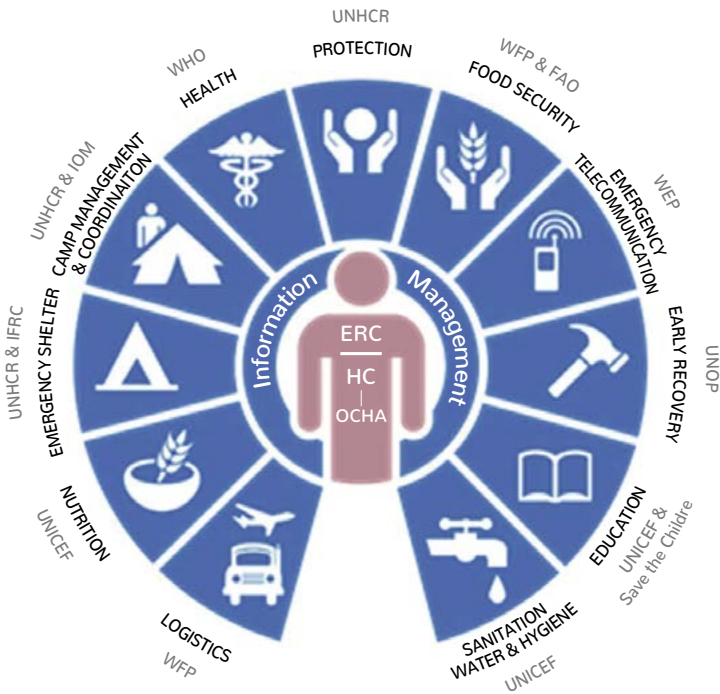
### **Leadership and co-ordination in a response**

Primary responsibility for coordinating national health sector disaster response lies with the affected government, usually by means of the command and control centre, commonly

known as a Health Emergency Operations Centre (HEOC) or CICOM in the Americas. While rehabilitation may fall under the responsibility of the ministry of health or another government ministry, early rehabilitation is generally best coordinated via the same mechanism as the overall health response. Where there are large numbers of trauma patients requiring ongoing care, a rehabilitation working group (or sub cluster) may be required. National and international rehabilitation actors alike engage with this leadership structure to support effective coordination and ensure adherence to local guidelines, referral pathways and data collection.

There are certain situations where national coordination mechanisms are unable to cope – due to the severity of the humanitarian situation, or where existing national response or coordination capacity is unable to meet needs in a manner that respects humanitarian principles (see Chapter 2). This could include such scenarios as conflict or where there is no sovereign state. In these situations, the Inter Agency Standing Committee (IASC) Cluster Approach may be implemented. Clusters are groups of humanitarian organisations, both UN and non-UN, in each of the main sectors of humanitarian action, e.g. water, health and logistics. WHO is the lead agency for the Health Cluster, and when activated, allows organisations to coordinate and pool information, such as shared needs assessments, gaps and priorities.

**Diagram 6: Leadership and coordination actors in a response**



## Actors involved in early rehabilitation

The variety and quantity of rehabilitation actors involved in emergency response will be dependent on the scale and severity of disaster, pre-existing level of health/rehabilitation infrastructure and the ability of local and regional actors to cope in both the immediate and longer term. The initial stages of large-scale emergency response can often be chaotic, especially if there are no clear preparedness plans in place and infrastructure has been damaged. In areas of chronic instability and conflict, this disorder can persist. It is essential that the individuals responding understand their own role and that of the wider humanitarian response, in particular the Humanitarian Principles. Further online learning is recommended around this subject, and a variety of multi-lingual courses can be found at [www.disasterready.org](http://www.disasterready.org).

## Common actors in emergencies

### National

It is well documented that, where they are present locally, it will be national rehabilitation staff providing the significant bulk of early rehabilitation. Appropriate international assistance from the rehabilitation sector should only be deployed if it is required and requested from the host country. Those considering travelling to other countries to offer assistance should consider what national capacity there is first and also consult the document: *'Responding internationally to disasters: a do's and don'ts guide for rehabilitation professionals.'*

In-country rehabilitation responders may include:

- Governmental health/rehabilitation services
- Military health/rehabilitation services
- Non-governmental organisations (NGOs) (that is national non-profit groups which are independent from government)
- International non-governmental organisations (if already present in the area, pre-emergency)
- Private providers
- National associations (such as the relevant national physiotherapy association)

### International

In large-scale emergencies, at the request of the host country, or in response to humanitarian needs, a host of International Non-Governmental Organisations (INGOs) may respond to provide assistance in many sectors, such as WASH (water, sanitation and hygiene), education, health, shelter etc. INGOs have different mandates, priorities and funding streams and can operate across multiple sectors.

The following INGOs are examples of those that have recently supported rehabilitation responses in emergencies:

- CBM
- Humanity and Inclusion
- International Medical Corps
- International Organization for Migration
- Médecins du Monde
- Médecins Sans Frontières

Additionally, the International Committee of the Red Cross (ICRC) and The International Federation of Red Cross and Red Crescent Societies (IFRC) often have roles to play in rehabilitation.

In addition to organisations directly involved in health and rehabilitation, it may be necessary for rehabilitation providers to liaise with actors beyond their sector. Camp management, shelter, protection, nutrition, water, sanitation and hygiene and education are all areas which interlink with rehabilitation to provide a truly holistic response.

### Emergency medical teams (EMTs)

EMT refers to groups of health professionals and supporting staff that aim to provide direct clinical care to populations affected by disaster or outbreaks and emergencies by acting as surge capacity to support the local health system. They include governmental (both civilian and military) and non-governmental teams and can be sub-classified as either national or international, dependent on the area of response. EMTs can range from small group of healthcare workers to a fully functional field hospital.

They comply with the classification and minimum standards set by WHO ([https://www.who.int/hac/global\\_health\\_cluster/fmt\\_guidelines\\_september2013.pdf](https://www.who.int/hac/global_health_cluster/fmt_guidelines_september2013.pdf)) and its partners, and arrive pre-trained and self-sufficient, in order to avoid further burdening an often overwhelmed national health system.

Any EMTs with surgical inpatient capacity (known as Type 2 and Type 3 EMTs) are required to include rehabilitation professionals and equipment in their team, while there are also standards for teams that will just be delivering rehabilitation. Further explicit guidance exists in a separate set of standards: '*Minimum technical standards and recommendations for rehabilitation for EMTs*' (<https://extranet.who.int/emt/sites/default/files/MINIMUM%20TECHNICAL%20STANDARDS.pdf>).

In emergencies where significant numbers of national or international EMTs are deployed, an emergency medical team coordination cell (EMTCC) is likely to exist, either as part of the HEOC or under the health cluster. The core purpose of the EMTCC is coordinating the surge of responding EMTs, both national and international, to best meet excess healthcare needs resulting from the current emergency. Rehabilitation professionals responding as part of an EMT must ensure they are appropriately trained to deploy and engage fully in a coordinated response by way of providing information, data collection and updates as to capabilities and activities.

## REFERENCES

UNISDR Terminology on Disaster Risk Reduction 2017 Available at

<https://www.unisdr.org/we/inform/terminology>

*Natural Disasters 2018* 2019 CRED. Brussels

*Trends in Armed Conflict – 1946 – 2018* Oslo, Peace Research Institute, Oslo: PRIO 2018

*The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response* Association, Sphere. Geneva: s.n., 2018

*Emergency medical teams: minimum technical standards and recommendations for rehabilitation* Organization, World Health. Geneva: s.n., 2016

*WCPT report: The role of physical therapists in disaster management* Therapy, World Confederation for Physical. London: s.n., 2016

*Implementation Guide for Man-made and Technological Hazards* UN Office for Disaster Risk Reduction s.l.: UNISDR, 2017

*Lessons from the 2015 earthquake(s) in Nepal: implication for rehabilitation* Sheppard P. S., Landrey M. D. 9, s.l.: Disabil Rehabil, 2016, Vol. 38, pp. 910-13

*Natural Disasters and Injuries: What Does a Surgeon Need to Know?* Bartholdson, Sofia and Schree, Johan von. 2, 2018, Curr Trauma Rep, Vol. 4, pp. 103-108

The International Disaster Database Disasters, Centre for Research on the Epidemiology of. EM-DAT. Available at: <http://www.emdat.be/> [Cited: 20 06 2019]

*2017 Bangladesh landslides: physical rehabilitation perspective.* Uddin T., Gosney J., Islam M. s.l.: Disability Rehabilitation, 2019, Vol. 28, pp. 1-8

*The Human Impact of Volcanoes: A Historical Review of Events 1900-2009 and Systematic Literature Review.* Doocy S., Daniels A., Dooling S., Gorokhovich Y, PLOS Currents Disasters, 2013 Apr 16. Edition 1

*Ebola virus disease* Beeching N., Fenech M., Houlihan C. 2014, BMJ, pp. 7348-5

*Management of limb injuries during disasters and conflict* ICRC, WHO. Geneva: ICRC, 2016

*Health Care in Danger* ICRC, 2019. Available at: <http://healthcareindanger.org/the-issue/>

*Stop Bombing Civilians* Inclusion, Humanity and. 2018. Available at:

[https://humanity-inclusion.org.uk/en/campaign/stop-bombing-civilians?qclid=Cj0KCQjwkK\\_qBRD8ARIsAOteukAxadFUx-6gZFuIX9766A\\_1tQ7pHMHQ8yiPIVeJvRvdhoJrUf4DMaAgnTEALw\\_wcB](https://humanity-inclusion.org.uk/en/campaign/stop-bombing-civilians?qclid=Cj0KCQjwkK_qBRD8ARIsAOteukAxadFUx-6gZFuIX9766A_1tQ7pHMHQ8yiPIVeJvRvdhoJrUf4DMaAgnTEALw_wcB)

*Blast Injuries: The impact of explosive weapons on children in conflict* s.l.: Save The Children, 2019

*Aid worker security report: Figures at a glance* Stoddard, A., Harmer, A. and Czwarono, M s.l.: Humanitarian Outcomes, 2018

## CHAPTER 2

### KEY CHALLENGES IN DELIVERING EARLY REHABILITATION IN CONFLICTS AND DISASTERS

**AIMS:**

By the end of this chapter you should be able to understand the challenges faced in delivering early rehabilitation in conflicts and disasters, including:

- Managing large numbers of patients with limited resources
- Adhering to key professional and humanitarian standards
- Knowing who might be more vulnerable in conflicts and disasters
- Keeping yourself safe and well



## CHAPTER 2: KEY CHALLENGES IN DELIVERING EARLY REHABILITATION IN CONFLICTS AND DISASTERS

### INTRODUCTION

---

#### CASE STUDY

An earthquake has struck your city at 6am – your house and immediate family are OK, but many properties in your surrounding area are damaged and the roads are blocked by debris. Communication is down and you can't contact the rest of your family and friends. The radio is reporting that thousands of people are expected to have been killed and all the main hospitals are already overflowing. Already there is talk of search-and-rescue and medical teams arriving from outside of the affected area, but you don't know when. You also don't yet know which of your rehabilitation services (and colleagues) have survived. You are pulled between supporting your family, helping with the immediate needs in your local area and your role as a rehabilitation professional.



Picture 1: Destruction following a 7.8 magnitude earthquake in Nepal, 2015

© ADH /Timm Schamberger

---



Conflicts and disasters result in health services being overwhelmed. They create multiple challenges to the delivery of safe and effective rehabilitation care, though the type and impact of these challenges will vary according to the context, severity and acuity of the emergency. While high-income countries may have more resilient health systems, they may be less familiar with managing the complexities of mass casualty trauma, while low-income health systems may be more vulnerable but more familiar with managing conflict or disaster-type injuries and practising with reduced resources.



## Typical challenges for the rehabilitation professional include:

### Overwhelming patient numbers and how to prioritise care

In the first days following mass casualty situations, there is usually an overwhelming surge of patients and it is important to be able to prioritise rehabilitation input. It will not be possible to treat all patients with rehabilitation needs. This can be an enormous challenge, and means treatment time with patients is also reduced. It is often best to focus initially on risk management, and patient and caregiver education can maximise input and carryover. Priorities will vary widely depending on the setting, resources available, individual presentations and your own skills, but suggested priorities might include:

1. Patients whose **life may be at risk** without rehabilitation input, e.g. new suspected spinal injuries, or patients in need of urgent respiratory input (if within your scope of practice)
2. Patients who are likely to **quickly develop complications** without rehabilitation input, e.g. patients with spinal injuries or burns
3. Patients who may be facing **early discharge** or who can potentially be safely discharged from acute care with rehabilitation input (therefore freeing up resources for others), such as patients requiring assistive devices, education and a follow-up appointment (e.g. patients with lower limb fractures following surgical management)
4. Patients whose conditions will be **quickly improved** through rehabilitation input or who might be at risk of **slowly developing complications**, such as patients with new amputations, patients on traction and patients with brain injuries

Issues with prioritisation will carry on beyond the first days, and in conflicts and protracted crises they can continue for the duration of a response, with a persistent challenge of balancing the needs of new patients requiring early rehabilitation and those with ongoing needs. In these situations, patient and caregiver education and 'active' treatment programmes (using exercise, functional activities and positioning) are key, with patients also taught to identify potential complications and how to seek assistance if they develop. Passive treatment modalities carried out by the therapist (whether passive movement, stretching or other modalities) are usually not indicated or are a low priority.



**Picture 2:** HI Physiotherapist providing early rehabilitation in a busy hospital setting after Haiti earthquake, 2010  
© William Daniels / Handicap International

When considering whom to treat (or where to provide care), it is essential to do so based on humanitarian principles and considering basic medical ethics. Humanitarian principles provide the fundamental foundations for humanitarian action which rehabilitation professionals working as humanitarian responders in conflict and disaster settings should adhere to:

Humanity	Neutrality	Impartiality	Independence
Human suffering must be addressed wherever it is found. The purpose of humanitarian action is to protect life and health and ensure respect for human beings	Humanitarian actors must not take sides in hostilities or engage in controversies of a political, racial, religious or ideological nature	Humanitarian action must be carried out on the basis of need alone, giving priority to the most urgent cases of distress and making no distinctions on the basis of nationality, race, gender, religious belief, class or political opinions	Humanitarian action must be autonomous from the political, economic, military or other objectives that any actor may hold with regard to areas where humanitarian action is being implemented

(OCHA, 2012) [https://www.unocha.org/sites/dms/Documents/OOM-humanitarianprinciples\\_eng\\_June12.pdf](https://www.unocha.org/sites/dms/Documents/OOM-humanitarianprinciples_eng_June12.pdf)

Upholding and representing the humanitarian principles are important in supporting acceptance by the local community whom you are serving, and thus contributing to a safe operating environment for healthcare staff in emergency settings. Particularly in conflict settings, both local and international healthcare professionals are particularly vulnerable to being perceived as non-neutral actors, even when working as healthcare staff. Clear signposting outside health facilities stating that all are welcome, weapons may not be brought in and including a clear establishment of criteria for admission or services – so that receiving care is not perceived to be at the discretion of any individual health provider – can all help to reduce this risk and foster acceptance in the community. If you are an international rehabilitation worker supporting national staff, be sensitive to local cultural norms and be aware that your behaviour will reflect upon your organisation and colleagues, often even after you have left.

### Complexity of injuries

Though this guide presents clinical injuries in distinct chapters like ‘amputation’ and ‘fracture’, in reality, many patients in both conflicts and disasters will present with complex poly-trauma, meaning therapists need to be skilled in multiple clinical areas. The treatment of one injury will require consideration of others. It is not unusual to treat a patient with multiple fractures, an amputation and significant burns, that all have to be managed concurrently.

### A lack of staff with experience in major trauma

In high-income settings, many therapists quickly specialise in particular areas, while in low-income settings, rehabilitation professionals are sometimes less likely to be integrated into



**Picture 3: Patient with lower limb polytrauma**  
© Davide Preti/HI

acute medical teams. Staff with experience in major trauma are almost always in short supply. Therapists working in trauma care need to be able to perform basic rehabilitation safely for all patients, including those with orthopaedic, neurological, respiratory and soft-tissue injuries.

There are challenges in expecting generalist physiotherapists to work in major trauma without prior experience – and so building trauma training into professional training and continuing professional development is paramount. Therapists who are not appropriately trained need to be given appropriate roles, or be rapidly trained up and supervised accordingly. In some recent disasters, to address initial surge needs, physiotherapy and nursing students have been drafted in and given more basic tasks to perform, while in Nepal the physiotherapy association played a key role in coordinating the mobilisation of additional physiotherapists for the 2015 earthquake response.

### **Adaptive medical and surgical practice**

Medical teams also have to change the way they work in emergencies – access to specialist services are likely to be limited (at least initially) and management choices are adapted depending on the environment and pressure on services. For example, intensive care units, where available, are likely to be overwhelmed. Anaesthesia practices have to be modified and patients without life-threatening injuries may have to wait longer for definitive management. Infection risks mean external fixation, delayed primary closure and recurrent debridement's are often preferred, while limited access to specialised imaging and surgery may mean that spinal cord and traumatic brain injuries may need to be managed conservatively. Rehabilitation professionals need to be familiar with such adaptive practices and adapt their own methods accordingly. Adaptive practices are detailed in each clinical chapter.

### **Challenging rehabilitation work space**

In large-scale disasters, it is not unusual to be treating acute patients outside of acute wards – whether in hospital corridors, overflow tents in car parks or tents in formal or informal camps; patients are managed in a wide variety of places. This is magnified in situations that result in the damage or destruction of healthcare facilities. Multi-disciplinary team (MDT) support is likely to be more limited in these situations, and risks to patients are further magnified if they face limited monitoring, or lack an appropriate bed. Patient treatment and education need to be adapted, in particular for patients being managed on the floor, and manual handling needs to be adapted to protect patients, caregivers and staff.

### **Limited access to equipment**

A lack of essential equipment (including assistive devices) can limit rehabilitation; in many areas it is not possible to scale up local manufacturer and importation timescales, which can cause problems beyond just the first weeks of an emergency (and persist throughout a conflict). The pre-positioning of assistive devices has been successful in high-risk areas (such as in Nepal prior to the 2015 earthquake). For national and international emergency medical teams (EMTs), the minimum standards for rehabilitation highlight equipment essential (and non-essential but recommended) for initial deployment; however, these standards are minimum and aimed at field hospitals and so not directly transferable to fixed trauma or rehabilitation facilities. Offers of international donations are not uncommon in emergencies, but close examination of equipment suitability, sustainability (especially for prosthetics) and cost (for example, shipment or maintenance) is required. EMTs should come with their own equipment, but even then, it will be limited and will need to be rationed.

Depending on your role, one priority may be the provision of assistive devices to those with pre-existing conditions if their devices have been lost or destroyed and they will be unsafe without them.

General examples of useful early rehabilitation equipment (which should include both paediatric and adult versions) include:

- Elbow crutches
- Gutter crutches
- Walking frames
- Wheelchairs (for inpatient and discharge use – able to be fitted with pressure cushion seating)
- Stump boards
- Pressure mattresses
- Basic splints (ankle-foot orthosis and wrist splints)
- Portable commodes (for discharge)
- Exercise bands

Other equipment may be required depending on the role and competency of the therapist, including:

- Goniometer
- Stethoscope
- Blood pressure monitor
- Pulse oximeter
- Splinting kit
- Spinal braces

### A lack of information from medical notes

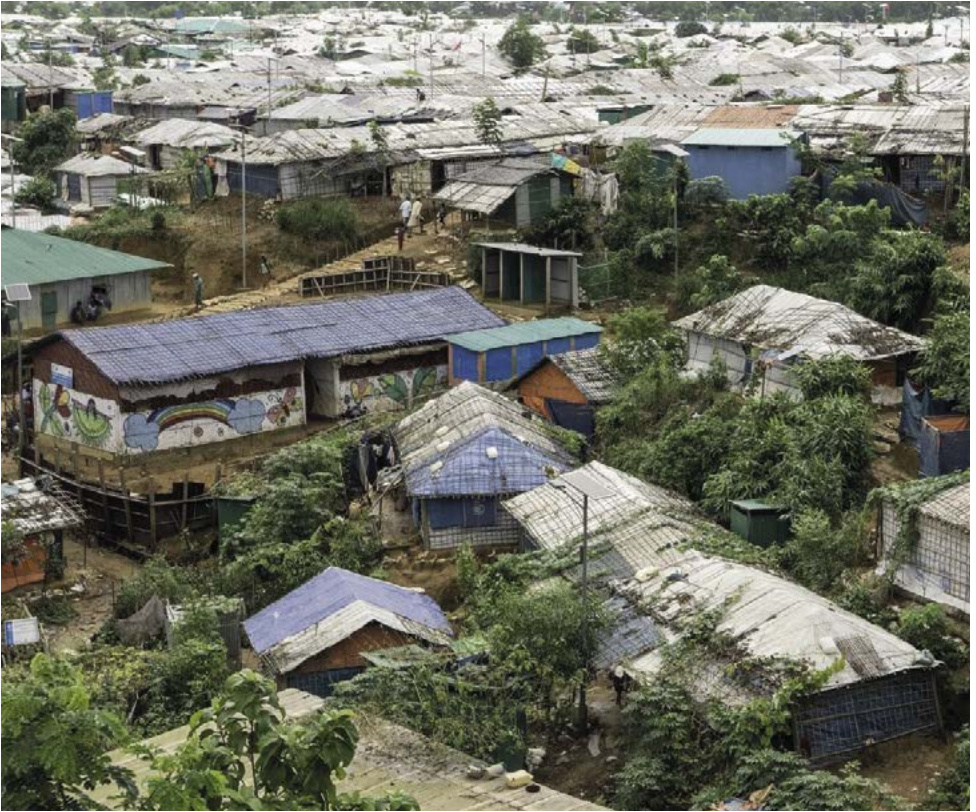
It is often considered good practice in emergencies for patients to keep a copy of their medical notes; however, in many situations, notes may be missing or limited. As a result, it can be difficult to ascertain what treatment and investigations a patient has had. This can be particularly problematic where there is a lack of documentation of post-operative or post-injury precautions, such as restricted weight-bearing status or limited range of movement. Unless within your scope of practice, in the absence of documented guidance you must obtain guidance from a physician regarding issues like fracture stability and ability to weight bear.

### Barriers to safe discharge and follow-up

The coordination of inpatient discharge planning and follow-up is still one of the greatest challenges in emergency settings, especially where patients have been transported from remote areas, or if their homes have been destroyed. Due to hospitals being overwhelmed, further anticipated surges or insecurity, patients may need to be moved from an acute setting as soon as possible, therefore it is important to consider the following points:

#### 1. Early discharge of acute patients

A lack of bed spaces may lead to earlier than expected discharge; sometimes as soon as a patient is stable post-operatively. Short stays in hospital and limited possibilities for follow-up place increased pressure on initial rehabilitation sessions, and again emphasise that patient and caregiver education, maintaining a database and considering follow up plans are all critical in the early stage, otherwise patients are lost to follow-up. Even for expected longer-stay patients, it is still important to make discharge plans early, as emergency settings can be unpredictable. Establishing rehabilitation criteria and emergency care pathways in advance of an event can help to limit patients being discharged to an unsafe environment. During an emergency rehabilitation professionals may have a role in advocating for patients to remain in health facilities if they are being placed at risk by being discharged.



**Picture 4: Rohingya Camp, Bangladesh 2019**

© Davide Preti/HI

## 2. Challenging discharge destinations

Think about where your patient is being discharged to. This could be (amongst other things) their home, a displaced people's camp or shelter, a step-down facility or to stay with friends or family. They could be travelling several days, or staying alongside the hospital. Examples of the challenges patients face on discharge in emergency settings include sleeping on hard floors, camps being severely inaccessible, not being able to access aid distributions, a lack of caregivers, inaccessible toilet facilities and patients not being able to return for follow-up due to distance, cost or availability of transport. If patients are commonly being discharged to camps, try to find out what the environment is like. This will help you to problem-solve and set up appropriate treatment plans before they are discharged.

## 3. Family and/or community support

Be mindful that there may be a lack of family/community support, as those affected by the conflict/sudden onset disaster may have also lost their own families, friends, homes and livelihoods. Pay particular attention to unaccompanied children, people with existing disabilities and older people (see the vulnerability section below).

#### 4. Follow-up

Disasters often affect rural and isolated communities; transport infrastructure and terrain, which may make accessing medical care (and in particular follow-up care and rehabilitation) difficult. Critically injured patients may be evacuated to more central urban centres for treatment, but wish to return home as soon as possible. Similarly, it is rare to provide rehabilitation for civilians on the frontline in conflicts. More often, patients are stabilised and then transferred for further care, but their length of stay in facilities is often short, and safety and security challenges can make follow-up a challenge. This is further complicated in situations of displacement, where populations are on the move, creating huge challenges in ensuring continuity of care. Ideally, a patient will be followed up by the hospital that carried out their main treatment, but in emergencies this is not always possible. In the early days, there will be uncertainty about what services and facilities are available to patients needing long-term rehabilitation. Often, private services are made available free of charge, but may later revert to being charged for. Do not make assumptions or unqualified promises to patients about access to services in the future. Community follow-up can also be a challenge, due to safety and security issues and the sheer volume of patients. For international teams, such as EMTs, follow-up can be even more challenging, especially if the length of stay of the team is limited or unknown.

#### 5. Onward referral to other rehabilitation services

Rehabilitation professionals should play a role in making sure that patients who have rehabilitation needs are identified, and referral mechanisms are established. This would include linking emergency response services with hospital and community-based rehabilitation facilities. Appropriate follow-up is key to successful patient outcomes, therefore coordination should be done through existing mechanisms to avoid duplication. In large emergencies, this may be done through the Health Cluster or the EMT coordination cell. Recently, the inclusion of rehabilitation specialists in overall coordination (such as in Nepal in 2015 and Mosul in 2016) has included referral pathways and hotlines being coordinated centrally, so it is critical for rehabilitation actors to engage with coordination. Where local services are unable to meet demands, INGOs are likely to be establishing services, and so being aware of all actors involved in the response is important.

An example of a referral form is available on page 42 of the EMT Minimum Standards and Recommendations for Rehabilitation: <https://extranet.who.int/emt/sites/default/files/MINIMUM%20TECHNICAL%20STANDARDS.pdf>

Where it is possible to refer patients, they should be given all the information about their referral and treatment to date so that they can also follow up themselves (for example knowing where a prosthetic service is and how to access it).

#### Dealing with non-emergency related rehabilitation needs

In populations where services have not been available or accessible, or where people are displaced or have lost essential equipment, those with disabilities and impairments unrelated to the current emergency may also need to access the rehabilitation services. Balancing the needs of those with disabilities and chronic health conditions against those with new injuries can be a challenge, in particular where resources are limited. Prioritising based on clinical need (see earlier prioritisation tool and the professional standards section overleaf) is vital.

### Integrating international support

Offers of international assistance can create challenges for local responders. Some international assistance can be vital, whereas those that stay for short periods of time, or who are not equipped for the challenges of humanitarian support, can draw time and resource away from a local response. International rehabilitation responders who will be treating patients are still subject to the same professional requirements as in a non-emergency, and must register with the national authorities. Normally, unless registered as part of an EMT or INGO, rehabilitation professionals should not travel to conflict or disaster zones to provide treatment. International responders should prepare in terms of language and cultural competency as soon as they learn of their deployment. They should also be sensitive to the position and experience of local colleagues, and be aware of differences in remuneration, accommodation and security measures for international and national staff. To mitigate the likely rapid turnover of international staff in early weeks, clear focal points for contacts and referral mechanisms should be made and handed over. More information is available in: *Responding Internationally to Disasters: A Do's and Don'ts Guide for Rehabilitation Professionals*: [https://humanity-inclusion.org.uk/sn\\_uploads/uk/document/responding-disasters-dos-and-donts-guide-rehabilitation-professionals-april-2016.pdf](https://humanity-inclusion.org.uk/sn_uploads/uk/document/responding-disasters-dos-and-donts-guide-rehabilitation-professionals-april-2016.pdf)

### Maintaining standards of practice in conflicts and disasters

Despite facing overwhelming needs, it is vital that rehabilitation professionals maintain appropriate levels of practice. These include professional standards (such as those published by the World Confederation for Physical Therapy (WCPT) and the World Federation of Occupational Therapists (WFOT)) and also wider humanitarian-specific standards, such as humanitarian principles, Sphere Standards and the WHO Emergency Medical Team Minimum Standards and Recommendations.

### Professional standards

Profession-specific ethical principles (either national or global) continue to apply in emergency settings. Both WCPT [https://www.wcpt.org/sites/wcpt.org/files/files/WCPT-DoP-Ethical\\_Principles-Aug07.pdf](https://www.wcpt.org/sites/wcpt.org/files/files/WCPT-DoP-Ethical_Principles-Aug07.pdf) and WFOT <https://www.wfot.org/resources/code-of-ethics> have published ethical principles for their professions.

### Scope of practice

The sheer volume and diversity of cases faced in emergencies can challenge our scope of practice. Therapists should work within the boundaries of their professional scope of practice, as defined in the country in which they are working. Even in emergencies, rehabilitation professionals should practise only in those areas where they are individually safe and competent to do so. It may be possible to seek support from within the team, or from other responders, if something is outside of your scope.



## Documentation

### Informed consent and confidentiality

Principles of informed consent and patient confidentiality are vital during emergencies; both the WCPT policy statement for informed consent and the EMT Minimum Standards apply in emergency settings.

### Database

Keeping a central record of the patients you see is critical, both to ensure they can be followed up, but also to inform the overall response patterns of need. Most services will already maintain a database, but in the midst of an emergency this can be disrupted or need adaptation. The purpose of a database is to enable effective tracking and follow-up of patients, and to enable overall reporting and contribution to a coordinated response. Suggested minimum items for a rehabilitation database include:

- Patient name
- Gender
- Date of birth or age
- Telephone number (or number for a family member or friend if they don't have one)
- Type of injury/diagnosis (ideally as part of an agreed response-wide classification system)
- Address or discharge destination (if known)
- What type of follow-up is required (including any additional medical, equipment or specialist rehabilitation input).

By recording and reporting on types of injury (normally via a central coordination mechanism, such as the HEOC), rehabilitation professionals can help guide the overall response. For example, rehabilitation professionals reporting on numbers of spinal cord injuries or amputations can help ensure that adequate resources (bed spaces, prosthetic services etc.) are mobilised.

For established multi-disciplinary teams, more comprehensive examples of datasets are available, such as those included in the ICRC guide: *Management of limb injuries during disasters and conflicts* [https://icrc.aeducation.org/files/downloads/A\\_Field\\_Guide\\_Low\\_res.pdf](https://icrc.aeducation.org/files/downloads/A_Field_Guide_Low_res.pdf) and for EMTs, the EMT Minimum Data Set: <https://www.mdsgateway.net/>

### Documentation of assessment and treatment

Effective documentation is essential where patients may encounter multiple professionals or medical teams during the course of their treatment, and may consequently lack a thorough understanding of their medical care to date. A lack of systematic record-keeping is detrimental to any coordinated response. Overall, documentation is frequently neglected during emergencies, which could result in treatment duplication or error.

Maintaining a record of patient assessment, treatment and future treatment plan is vital. It can:

- Avoid duplication of questioning or treatment and save time
- Ensure contraindications and precautions are known
- Enable therapists to monitor progress and identify complications
- Enable other individuals or teams to easily continue care
- Simplify referrals
- Ensure accountability to those we work with and work for

Rehabilitation professionals should ensure that all interventions are documented; notes should be legible, avoiding the use of acronyms and abbreviations. At present, specific guidelines for occupational therapists do not exist; therefore the guidance set out by the WCPT should be adhered to (WCPT Standards of Practice). <https://www.wcpt.org/guidelines/records-management>

More detailed information about what to include in your assessment and treatment can be found in Chapter 3.

### Record management

Where possible, rehabilitation notes should be integrated into the patient's main clinical file. If this is not possible, a separate record should be maintained.

Ownership of medical records in emergencies has been identified as a controversial area (see *Management of limb injuries during disasters and conflicts* - [https://icrc.aeducation.org/files/downloads/A\\_Field\\_Guide\\_Low\\_res.pdf](https://icrc.aeducation.org/files/downloads/A_Field_Guide_Low_res.pdf)). However, where patients may receive treatment from more than one team, it is vital that some kind of clinical record (either complete or summative) remains with a patient so that other healthcare workers can see what treatment they have undergone.

Patients in conflict settings may be much safer if they are identified using a numerical identifier rather than their name. Additionally, you should consider providing de-identified data to protect patients if governments demand a record of the medical care provided. Regardless of the setting, any data should be stored safely and securely, ensuring confidentiality.

### Research in conflicts and disasters

Research into early rehabilitation in conflicts and disasters is required to improve preparedness and response. It is important to collect data and gather evidence to guide future responses. It is vital to protect patient confidentiality and data collection processes must always place patient care and dignity prior to any research purposes. Additionally, all research should be conducted within this context, gain research ethics approval and, ideally, receive ethical approval from a local research ethics committee or authority.

### Protecting the most vulnerable

Conflict and disaster environments place people at an increased risk of discrimination and/or abuse, in particular children, women, older people and those with existing disabilities or chronic health conditions (WHO, 2013). In some contexts, this may also include particular ethnic or religious minorities. We need to be aware of (and act upon) factors that can make certain people more vulnerable.

**Gender:** Be aware that women, men, boys and girls are affected by conflicts and disasters differently. Girls and women in particular face increased risks during and after conflict and disasters: gender-based violence may increase at times of instability, while women and girls may also face an increased burden of care-tasks (such as provision of food and water) and caring for the sick and injured. Further information can be found from UNFPA at [https://www.unfpa.org/sites/default/files/pub-pdf/GBVIE.Minimum.Standards.Publication.FINAL\\_.ENG\\_.pdf](https://www.unfpa.org/sites/default/files/pub-pdf/GBVIE.Minimum.Standards.Publication.FINAL_.ENG_.pdf)

**Age:** While children may be particularly vulnerable during emergencies (see below), older people are also disproportionately affected by conflicts and disasters. They may be more vulnerable to a risk, less able to flee and have reduced access to humanitarian aid. They often play key roles in families and communities, which frequently become even more important in a crisis (e.g. caring for grandchildren). Further reading from HelpAge can be found here: <https://www.helpage.org/what-we-do/emergencies/older-people-in-emergencies/>

**Disability:** People with disabilities may be disproportionately affected by disasters. They might be more likely to be left behind in emergency responses, or fail to benefit from humanitarian services due to a range of environmental, physical and social barriers. Rehabilitation professionals should have an understanding of issues which may affect patients' reintegration into their communities, such as stigma around disability, as well as access to basic services and environmental accessibility. Read more about disability-inclusive humanitarian action in the WHO (2013) *Guidance Note on Disability and Emergency Risk Management for Health*: [https://apps.who.int/iris/bitstream/handle/10665/90369/9789241506243\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/90369/9789241506243_eng.pdf)

### A focus on vulnerable children

Children are more vulnerable than adults to exploitation and abuse, due to their age, size and limited participation in decision-making. In emergencies, systems that protect children, including family and community structures, often break down and children may be separated from their families, placing them at risk. Unaccompanied and separated children are at increased risk of injury, abuse and exploitation, including trafficking or being recruited by armed groups.

## KEY POINTS

1. Make sure, first and foremost, that rehabilitation professionals do not pose a risk to those with whom we are working by ensuring that, even in emergencies, new staff are appropriately screened and inducted
2. Never separate a child from their family or caregivers. Try to group children and their families together in child-friendly environments and protect them from distressing scenes
3. Rehabilitation professionals should be aware of the protection focal point in their organisation, and know who, how, and when to escalate concerns; particularly around the safeguarding of children
4. Organisations and individuals should be familiar with the Minimum Standards for Child Protection in Humanitarian Action
5. Take time to understand the social norms and expected behaviours for girls and boys of different ages in the culture you are working in. This will help in identifying concerns, as well as planning services and treatments.

A wealth of resources on protection in emergencies is available from the Global Protection Cluster: <http://www.globalprotectioncluster.org>

### Safety and security

Safety and security risks are heightened in situations which are insecure, so when working during an emergency your personal safety and security must be a priority. These concerns are context-specific, but it is worth remembering that the usual personal safety fears which may be encountered in more secure settings are still the most likely sources of danger – your own underlying health conditions, petty crime and road traffic accidents in particular.

The guide *Responding internationally to disasters: a do's and don'ts guide for rehabilitation professional* is an essential read prior to travelling to a response and highlights the risks of deploying independently, or without the necessary attributes and experience.

Prior to starting work, a safety and security briefing should be offered by your organisation. General issues which will normally be included are travel, communication (including social media), cultural safety, community relationships and specifics around equitable provision of healthcare services.

Conflict and emergency situations change rapidly; it is essential to continually analyse the context and associated security risks (using multiple sources), and to be aware of and respect organisational security procedures. The protection of aid workers is enshrined in international humanitarian law and rules governing non-international armed conflict. However, with the decline in international conflicts and corresponding increase in non-international conflicts involving non-state armed groups, often driven by political, religious or ethnic ideologies, there has been clear erosion in respect for the legal frameworks that protect aid workers. In 2017, 158 major incidents of violence against humanitarian operations occurred in 22 countries, affecting 313 aid workers – over 90% of whom were staff working within their own countries.

Additional training about working in insecure environments is available, such as BSAFE (available in multiple languages) <https://training.dss.un.org/course/category/6> or trainings available on humanitarian training platforms, such as [www.disasterready.org](http://www.disasterready.org) or [www.kayaconnect.org](http://www.kayaconnect.org)

## Healthcare in Danger

Safety and security for healthcare facilities can often be precarious and cause constraints for healthcare delivery. Despite healthcare being protected by the Geneva Convention, there are increasing attacks on health workers, facilities, vehicles and indeed, patients. Health Care in Danger (HCID) is an initiative of the International Red Cross and Red Crescent Movement aimed at addressing the issue of violence against patients, health workers, facilities and vehicles, and ensuring safe access to and delivery of healthcare in armed conflict and other emergencies.

In 2016, in line with international human rights and humanitarian law, the United Nations Security Council adopted a resolution condemning attacks and threats against the wounded and sick, humanitarian and medical staff providing healthcare and their equipment, transportation and facilities, including hospitals. Nevertheless, attacks on healthcare have continued, and in recent years, healthcare activities in Yemen, Syria, Democratic Republic of the Congo (DRC) and South Sudan have been suspended due to attacks on staff, patients or directly on the facilities. Provision of healthcare in emergency situations may entail delivering healthcare in countries where domestic law is used to criminalise health professionals providing services to certain groups, or in situations of conflict where the provision of healthcare (or prevention thereof) has been manipulated by a party to the conflict. Healthcare providers may also be harassed or targeted by non-state armed groups or warring militia who are suspicious of the actions of INGOs or see an opportunity to leverage a ransom.

## Looking after yourself

Ensuring the wellbeing and safety of those responding to emergencies is paramount. The inherent nature of disasters and conflict settings means that there can be significant risk to your own physical and mental health.

Long working hours, tough environmental conditions, restricted diet, increased stress and exposure to both distressing events and (in some cases) communicable diseases may all affect your health. You must take suitable rest periods from working, be aware of current disease outbreaks and trends and ensure the use of appropriate PPE and adherence to vaccination regimes.

Mental health issues, such as depression, anxiety and ‘burn-out’, are well-documented in humanitarian workers and volunteers. It is known that national volunteers can be particularly affected. Not only are they experiencing the same workload stressors, but they have come from affected communities themselves. They are experiencing the same loss and grief as those they are working to support, but without the same training, support and structure as professional workers.

It is not just individual traumatic events (such as a violent attack or earthquake), but also the stress of heavy workloads, disagreements with colleagues, long hours and a lack of time for self-care that are key contributors to stress.

### Self-care

Self-care is vital to ensure you can continue to operate safely in austere environments. Ways in which this may be done include:

- Ensuring adequate rest periods
- Seeking peer/managerial support, access to psychosocial support and counselling (even if only long-distance)
- Being aware of warning signs in oneself and others, and seeking support around signs of burn out and severe stress such as behaviour changes, sleep difficulties, risky behaviours and experiencing withdrawal, outbursts or emotional distress

Negative coping strategies (such as drug or alcohol abuse or excessive working) commonly occur and can be associated with mental health disorders in humanitarian workers. Stress and ‘burn out’ have an adverse effect on an organisation’s ability to provide services to people directly affected by the emergency. It is therefore in everyone’s best interests to prioritise self-care and stress management where possible.

IFRC have published helpful field guides on self-care, including “managing stress in the field” <https://www.ifrc.org/Global/Publications/Health/managing-stress-en.pdf> and *Caring for Volunteers – a psychosocial support toolkit* [http://legacy.pscentre.org/wp-content/uploads/volunteers\\_EN.pdf](http://legacy.pscentre.org/wp-content/uploads/volunteers_EN.pdf)



Picture 5: HI Team participating in a football tournament, Nepal 2015

© Claire Wissing / Handicap International

## KEY REFERENCES

*Responding internationally to disasters: A do's and don'ts guide for rehabilitation professionals* Humanity and Inclusion, 2016. Available at: <https://humanity-inclusion.org.uk/sites/uk/files/documents/files/responding-disasters-dos-and-donts-guide-rehabilitation-professionals-april-2016.pdf>

*Management of limb injuries during disasters and conflict*. Geneva: ICRC, 2016 [https://icrc.aeducation.org/files/downloads/A\\_Field\\_Guide\\_Low\\_res.pdf](https://icrc.aeducation.org/files/downloads/A_Field_Guide_Low_res.pdf)

*The Role of Physical Therapists in Disaster Management* WCPT, 2015 [https://www.wcpt.org/sites/wcpt.org/files/files/resources/reports/WCPT\\_DisasterManagementReport\\_FINAL\\_March2016.pdf](https://www.wcpt.org/sites/wcpt.org/files/files/resources/reports/WCPT_DisasterManagementReport_FINAL_March2016.pdf)

*Guidance Note on Disability and Emergency Risk Management for Health* WHO, 2013. Available at: [https://apps.who.int/iris/bitstream/handle/10665/90369/9789241506243\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/90369/9789241506243_eng.pdf)

*WHO Emergency Medical Team Minimum Technical Standards and Recommendations for Rehabilitation* WHO, 2016 <https://extranet.who.int/emt/sites/default/files/MINIMUM%20TECHNICAL%20STANDARDS.pdf?ua=1>

*Minimum Standards for Child Protection in Humanitarian Action*, Child Protection Working Group, 2019 <https://spherestandards.org/resources/minimum-standards-for-child-protection-in-humanitarian-action-cpms/>

*Factors associated with common mental health problems of humanitarian workers in South Sudan*. Strohmeier H., Scholte W. 10, s.l.: PLoS One, 2018, Vol. 13.

*Mental health and psychosocial support: who cares for the volunteers?* Dinesen C. s.l.: Humanitarian Practice Network, 2018.

*Thematic analysis of aid workers' stressors and coping strategies: work, psychological, lifestyle and social dimensions*. Young T. K., Pakenham K. I., Norwood M. F. 19, s.l.: Int J Humanitarian Action, 2018, Vol. 3.

---

## CHAPTER 3

### CHAPTER 3: EARLY REHABILITATION PATIENT ASSESSMENT AND TREATMENT - THE BASICS

#### **AIMS:**

By the end of this chapter, you should be able to:

- Understand the importance of infection prevention and control in conflicts and disasters and the role of a rehabilitation professional in this
- Have the knowledge to undertake a generic early rehabilitation assessment
- Understand why assessment and treatment approaches may differ in conflict and disaster settings
- Be aware of general key clinical management themes, including pain management, wound infections and missed injuries



## CHAPTER 3: EARLY REHABILITATION PATIENT ASSESSMENT AND TREATMENT - THE BASICS

### INTRODUCTION

---

#### CASE STUDY

You are working in a hospital during a conflict, and in the past week there have been repeated airstrikes in heavily populated areas. You have prioritised seeing a 24-year-old woman. She has a new transfemoral amputation (unclosed – for delayed primary closure) to her right leg and an external fixator with a large open wound to her left lower leg. She has also lost three fingers from her right hand. She has a number of other minor shrapnel wounds. On handover from the medical team, she is now medically stable. The team are concerned that she is not engaging with them at all, and explain that when she came in, she was screaming about her two children. She is unaccompanied. You don't have a psychologist or social worker in your team, and the surgeon has asked that you assess her.

As in any major trauma setting, those we work with have often experienced incredibly harrowing events. In disaster and conflict settings though, this is often more profoundly felt, with the impact not just being on the individual. Frequently, patients will have lost family members and friends, homes and livelihoods. In some cases, their injuries may even be of secondary concern to them when compared to the other losses they have experienced. In the early days of a response, rehabilitation professionals are often among the few professionals to spend extended time with patients and, as part of our assessments, will uncover often distressing realities around a patient's circumstances. This chapter introduces some of the challenges of assessing and treating patients under such conditions.

As seen in Chapter 2, even when working in a disaster or conflict setting, it is essential to maintain minimum standards of patient care and to be able to identify common complications. While elements of this chapter may seem basic, it is the experience of the authors that in emergency contexts, it is often a failure to adhere to the basics that creates the greatest risk.

It is recognised that rehabilitation professionals will have received different levels of training in different contexts, and so the aim of this chapter is to create a common understanding about what basic standards of rehabilitation assessment and treatment are in emergency settings. This is essential before progressing on to condition-specific management in the following six chapters. Basic elements covered here will not be repeated in the clinical chapters.

---

#### Infection prevention and control (IPC)

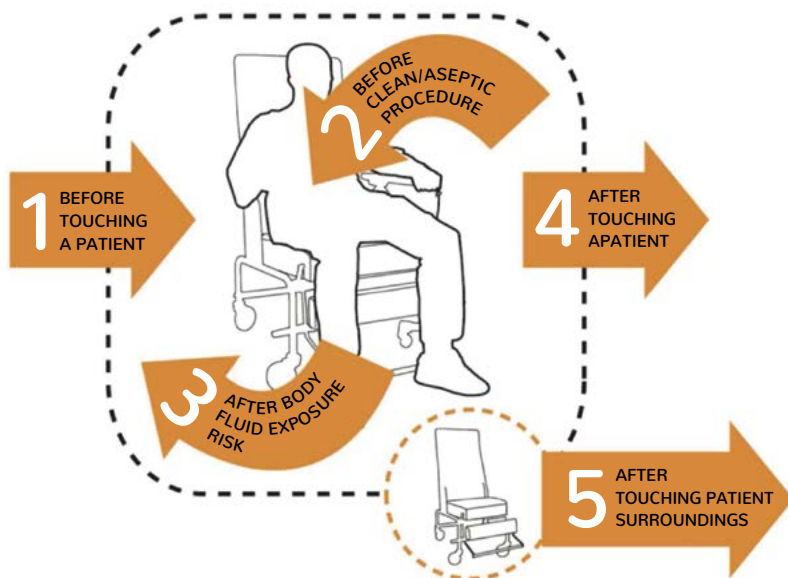
Before seeing a patient, it is worth remembering the principles of infection prevention and control (IPC) are of paramount importance in emergency settings. Limited resources, including access to clear (potable) water and medical consumables, can create challenges, but IPC remains essential to protect yourself and your patients. While the 'open' nature of traumatic injuries increases the risks of infection, sub optimal surgical environments, as well as insanitary conditions post disaster or in camps, can create a perfect storm for infection – both for infectious diseases and wound infection.



**Basic IPC precautions for rehabilitation professionals include (but are not limited to)**

- Hand hygiene
- Use of personal protective equipment such as gloves, masks or aprons where indicated
- Sterilisation and medical device decontamination
- Healthcare waste management
- Patient placement (including isolation if required)
- Respiratory hygiene and cough etiquette
- Environmental cleaning
- Prevention of injuries from sharp instruments and post-exposure prophylaxis
- Transmission-based precautions
- Aseptic technique and device management for clinical procedures (where within scope of practice)

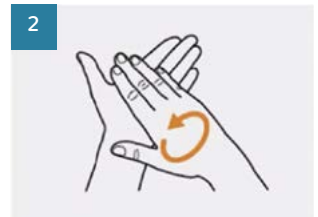
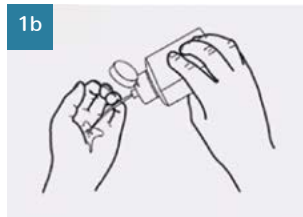
**Hand hygiene** is the cornerstone of IPC. While some specific procedures or infectious diseases require additional precautions and PPE, the basic principles continue to apply in emergencies (images and guidance from WHO [https://www.who.int/gpsc/5may/Hand\\_Hygiene\\_Why\\_How\\_and\\_When\\_Brochure.pdf](https://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf) )

**When****How**

- If your hands are not visibly soiled, clean them by rubbing them with an alcohol-based formulation (such as an alcohol gel)
- Wash your hands with soap and water when hands are visibly dirty, visibly soiled with blood or other body fluids or after using the toilet

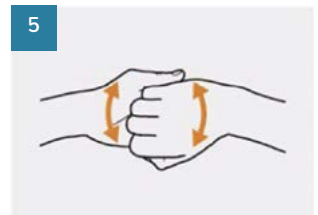
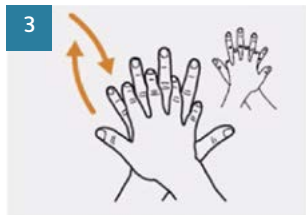
**Rub hands for hand hygiene! Wash hands when visibly soiled**

Duration of the entire procedure: 20-30 seconds



Apply a palmful of the product in a cupped hand, covering all surfaces;

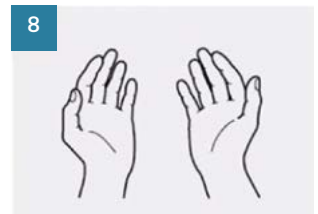
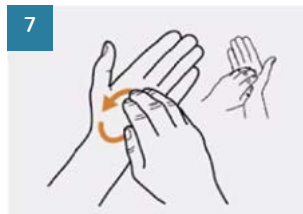
Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;

Palm to palm with fingers interlaced;

Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;

Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

Once dry, your hands are safe.

**Use of gloves**

- Gloves are often used inappropriately in emergency settings. Even if in short supply, gloves are single use and should be disposed of safely after patient contact and not be reused.
- Examination gloves are only indicated in situations where there is a risk of direct exposure to blood, body fluids, excretions or items that are soiled with such materials.
- Gloves are not required for routine patient contact where there is no risk of contact with blood or body fluids, or a contaminated environment

**Note on IPC and infectious diseases**

If you are working in an area where infectious diseases (e.g. cholera, diphtheria, Ebola, Middle East respiratory syndrome (MERS)) are an identified risk, additional IPC precautions will be in place. Make sure that you have had specific training and have been provided with additional PPE as required.

**PATIENT ASSESSMENT**

While it can be challenging, making time to carry out a thorough assessment of a patient will be highly valuable to rehabilitation professionals in an emergency setting, can save time and avoid duplication later. Whilst each profession (and in some cases each clinical condition) may have their own specific assessment protocols, there are several core elements to each:

**Database**

If not otherwise recorded by your team, be sure to document the patient's name, date of birth (or age), telephone number, main diagnosis and address or likely discharge destination (if known). Refer back to Chapter 2 for more information on maintaining a database. Do not document information that may place a patient at risk.

**Initial subjective assessment**

Before seeing a patient, obtain as much information as you can from their medical file and from medical colleagues (if available) and document this. Family members can also provide information where patients remain unwell. Remember that patients may have experienced extremely traumatic events and already faced repeated questioning from medical staff. Avoid asking unnecessary questions, but if a patient wants to talk about their experience, try to allow them time and listen to them, even if you are under pressure. Take note of their mental state – signs of confusion, low mood, anxiety or delirium.

Don't forget to introduce yourself and your role (in simple language) – some patients may not know what a rehabilitation professional does. Initial introductions with patients should also identify what their expectations of rehabilitation and their recovery are.

*Note*

*Note:* It is not unusual in emergency settings to find that patients have not had their diagnosis or prognosis explained to them. For patients with life-changing injuries, if they are not aware of the implications of their injury, try to work with the wider medical team to determine the best way to inform and educate the patient.

**Key points to document**

- **History of presenting condition (HPC)** – Date and mechanism of injury, extraction and pre-hospital care, medical and surgical management to date, including where the management took place, the results of investigations and any plans for further management or precautions, such as weight-bearing status. *Be wary in conflicts of documenting any information that may place a patient at risk.*

- **Past medical history (PMH)** – does the patient have any other known health conditions or previous unrelated surgeries? Pay particular attention to anything that might impair their recovery.
- **Drug history (DH)** – what medication is the patient using? Were they previously taking anything that was disrupted by the emergency, and do they have any known allergies?
- **Social history (SH)** – in conflicts and disasters, this can be particularly challenging. In some contexts, sensitive information (for example, loss of family members, and destruction of homes) should be taken from the patient file or other sources. It may be important to confirm languages spoken and literacy. Other factors to document include if anyone is accompanying them, if they have to care for anyone (e.g. children or older relatives) or if they have people able to care for them and if they know where they can go after leaving the hospital. Other standard questions include: what the patient did for work or in their leisure time, their religion and if appropriate any smoking/drug/alcohol use (as this may impact upon recovery times)



**Picture 1: HI rehabilitation staff completing assessments in a disaster setting, Nepal 2015**

© Dominique Pichard/Handicap International

## Objective assessment

What you assess is determined by the clinical presentation of the patient, but also by your training, role and the protocols of the organisation that you work for. Different organisations will take different approaches to assessment. As such, we will not prescribe any one approach here, but will introduce key components of assessment below. During the early stages of disasters, it may not be realistic to use comprehensive assessment tools, and objective assessments will need to be very focused. However, the basic findings of any assessment must be always documented. Depending on your training, common objective assessments to use might include:

Objective	Simple measures used	Notes
<b>Observation</b> of patient, including: distress, posture, deformities, external fixation, surgical sites or wounds and dressings	You can document injuries and observations on a body chart if available as part of your record Check x-rays or other imaging <i>if you are trained to interpret results</i>	Try to coincide rehabilitation with dressing checks. Do not undress a wound yourself unless you are trained to redress it or a colleague is available to do so.  Signs of wound infection: redness, warmth, swelling, purulent discharge, delayed healing, new or increasing pain, malodour

Objective	Simple measures used	Notes
<b>Neurological disability</b> – consciousness/ pupils/neuro exam	Consciousness can be measured using AVPU <a href="https://en.wikipedia.org/wiki/AVPU">https://en.wikipedia.org/wiki/AVPU</a> or (more detailed) Glasgow Coma Scale (GCS) <a href="https://www.physio-pedia.com/Glasgow_Coma_Scale">https://www.physio-pedia.com/Glasgow_Coma_Scale</a>	AVPU: is the patient Alert, Verbally responsive, Pain responsive or Unresponsive This is a useful way to identify changes in consciousness
<b>Vital signs</b>	Heart rate, blood pressure, respiratory rate (including work of breathing). Oxygen saturation levels and temperature (see ranges in the vital signs box below).	This should only be done if trained and if you can interpret the results. See the vital signs box below for normal ranges. Vital signs can also be checked from the medical record if present and regularly monitored. Vital signs can be used to spot complications and check whether a patient is appropriate for rehabilitation Note signs of sepsis (blood infection): a fever above 101°F (38°C) or a temperature below 96.8°F (36°C), resting heart rate higher than 90 beats per minute, breathing rate higher than 20 breaths per minute
<b>Cognition</b>	Quick check orientation to: person/place/time/situation	Orientation check: <i>what's your name, do you know where you are, do you know what day (or season) it is, do you know what happened to you?</i> More detailed assessments are possible – see the brain injury chapter for examples
<b>Respiratory assessment</b>	Auscultation, palpation, chest x-ray review	Only if competent to carry this out and interpret it. This will identify complications and guide any respiratory treatment
<b>Pain:</b> Type, intensity, timing, severity, and irritability	Visual Analogue Scale (VAS) <a href="https://www.physio-pedia.com/Visual_Analogue_Scale">https://www.physio-pedia.com/Visual_Analogue_Scale</a>	You can also indicate type and distribution of pain on a body chart (see below). This can help identify the cause of pain, and if it is improving or worsening

Objective	Simple measures used	Notes
Passive/active range of motion in affected joints	Measure using a goniometer if appropriate	If reduced range is a concern. Always check active movements first
Muscle strength	Oxford Scale (MRC Scale) <a href="https://physio-pedia.com/Muscle_Strength">https://physio-pedia.com/Muscle_Strength</a>	If weakness is a concern. This can form part of a neurological exam (see clinical chapters for more details)
Muscle tone and spasticity:	Modified Ashworth Scale <a href="https://www.physio-pedia.com/Spasticity">https://www.physio-pedia.com/Spasticity</a>	If neurological injury is suspected
<b>Function:</b> including balance, mobility and transfers, and activities of daily living (e.g. toileting/washing/cooking)	Functional Independence Measure (FIM) <a href="https://www.physio-pedia.com/Functional_Independence_Measure_(FIM)">https://www.physio-pedia.com/Functional_Independence_Measure_(FIM)</a>  AIM-T Berg Balance Score <a href="https://www.physio-pedia.com/Berg_Balance_Scale">https://www.physio-pedia.com/Berg_Balance_Scale</a>  or  WHODAS <a href="https://www.who.int/classifications/icf/WHODAS2.0_12itemsSELF.pdf">https://www.who.int/classifications/icf/WHODAS2.0_12itemsSELF.pdf</a>	You can assess function without using a formal measure. Start with the simplest likely level of mobility (e.g. bed mobility for a patient that has not yet sat up) and work upwards. If time is short, you can quickly document key tasks that the patient can or cannot perform  <i>Note</i> that you are unlikely to have time to use a formal functional outcome measure in the early phase of a response, but these can be useful later
<b>Tissue viability status:</b> skin integrity, pressure ulcers	Pressure ulcer classification <a href="https://physio-pedia.com/Guidelines_on_Prevention_and_Management_of_Pressure_Ulcers">https://physio-pedia.com/Guidelines_on_Prevention_and_Management_of_Pressure_Ulcers</a>	For patients with restricted bed mobility or areas of diminished sensation. Note that stage one pressure areas can be difficult to see on dark skin
<b>Psychological status:</b> depression, anxiety, confusion, delirium		Always consider the wider impact of the disaster on the individual. A distressed, confused or depressed patient is unlikely to want to actively participate in rehabilitation.
<b>Nutritional status</b>	Mid Upper Arm Circumference (MUAC) for malnutrition <a href="https://www.unicef.org/nutrition/training/3.1.3/1.html">https://www.unicef.org/nutrition/training/3.1.3/1.html</a>	Beware of the impact of malnutrition and micronutrient deficiency. Talk to your team if you have concerns.

**Normal vital signs:**

*Vital signs should only be checked and interpreted if you are trained to do so as part of your role.*

Age	Heart Rate	Resp Rate	Systolic BP	Diastolic BP
Preterm	120-200	40-80	38-80	25-57
Full-term	100-200	30-60	60-90	30-60
1 year	100-180	25-40	70-130	45-90
3 years	90-150	20-30	90-140	50-80
10 years	70-120	16-24	90-140	50-80
adolescent	60-100	12-18	90-140	60-80
adult	60-100	12-18	90-140	60-80

Normal temperature: 97.7–99.5 °F (36.5°C to 37.5°C) A fever (a sign of infection) is typically a temperature of over 100.4°F (38°C).

Normal SpO<sub>2</sub>: 96-99%

A basic example of a patient assessment form is below:

Patient Name \_\_\_\_\_ Tel \_\_\_\_\_ Age/DOB \_\_\_\_\_

Address/Discharge Location: \_\_\_\_\_

History of Presenting Condition:

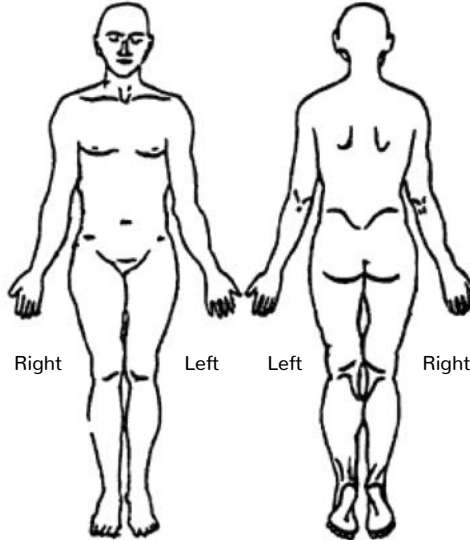
Past Medical History:

Drug History (Medication/Allergies)

Social History (including home and family situation, likely discharge destination)

Precautions or Contra-indications

(post-operative restrictions, metalwork, loss of sensation, open wound, infection etc.)



Clinician Name: \_\_\_\_\_ Org Contact: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



## GENERAL COMPLICATIONS YOU MIGHT ENCOUNTER

Patients may be at a higher risk of secondary complications in conflicts and disasters, due to factors associated with disrupted health systems and issues of access. Many secondary complications arise from inadequate follow-up in emergency situations. Being able to identify and mitigate risk factors for these complications should be prioritised to prevent further impairment.



**Picture 2:** Infected wound following a median nerve injury

### Wound infections

Infected wounds can create problems in the first days of an emergency, but can continue to prevent for months. Open injuries with high levels of contamination (from crush or blast) or at high risk of infection. In situations such as tsunami and flooding, where lacerations come in to contact with untreated water, wound infection is also common. In many settings, access to consumables to maintain adequate wound hygiene and to antibiotics is often restricted, exacerbating risks. Open fractures and prolonged external fixation can all increase the risk of osteomyelitis.

The effects of wound infections can be devastating, creating risks to life and limb. In addition to contaminated wounds, patients with minor burns/wounds and post-operative patients are at risk in many emergency situations. Those who have been displaced from their homes or who are living in insanitary environments with lack of clean water are at higher risk. Patients may have been discharged from overcrowded health facilities where wound care was being undertaken by family members in the absence of adequate community nursing, and may lack the resources or understanding to adhere to high standards of wound, graft or external fixation care.

## KEY POINTS

1. Follow basic infection prevention and control procedures at all times – this includes handwashing and equipment decontamination
2. Therapists should be familiar with the seven overt signs of wound infection (redness, warmth, swelling, purulent discharge, delayed healing, new or increasing pain, malodour) and know what to do when they identify one
3. Therapists should also be aware of warning signs of sepsis (a complication of severe infection) including fever, confusion, slurred speech, a non-blanching rash, increased heart and respiratory rate and diarrhoea. Should sepsis be suspected, seek urgent medical assistance.
4. Discharged patients should be given clear instructions on wound care and signs of infection. Adequate supplies of dressings/cleaning materials must be available and a process established to seek medical attention for possible infections
5. Follow-up of patients should be arranged, even if original care givers move on
6. Access to clean water and adequate nutrition to promote healing should be advocated for these patients

**Missed injuries**

Faced with overwhelming numbers of patients, and often with limited access to medical assessment tools including laboratory, imaging and nerve conduction studies, it is to be expected that some conditions will be missed by medical teams when providing lifesaving care. As therapists may be one of the first members of a medical team to review patients following stabilisation or surgery, they may also become aware of missed injuries or other conditions. Commonly, these may include peripheral nerve injuries, non-displaced fractures or mild-moderate brain injuries. Sometimes these may be identified several days (or even weeks) after the injury occurred. Therapists always need to report any unexplained symptoms to a supporting medical team member, and to be aware of signs of deterioration in their patients.

## KEY POINTS

On initial assessment, it is always worth checking with patients (or their family members) if they have any unexplained symptoms.

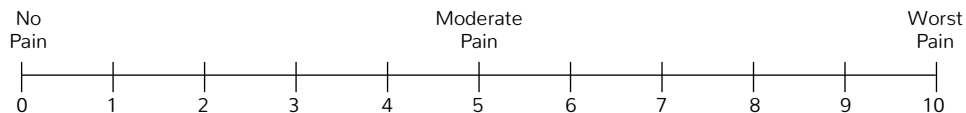
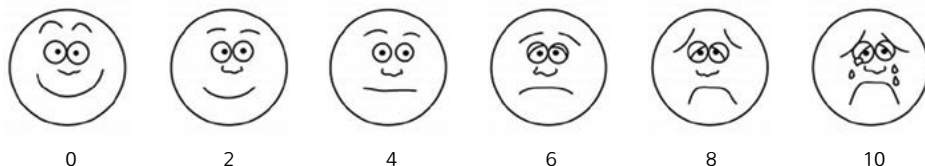
**Poorly controlled pain**

Pain management is frequently neglected in emergency settings. Rehabilitation professionals may be involved in assessing pain, advising on needs for analgesia, as well as delivering non-pharmacological pain treatments. Some therapy treatments (such as after burn injuries) should be timed to coincide with optimum pain management and dressing changes to optimise pain management.

In the first days of a response, or in constrained conflict situations, adaptive approaches to anaesthesia and pain management may be used by the clinical team, as the type and quantity of medications available may be limited. Surgically, nerve blocks and ketamine are commonly used instead of general anaesthesia in conflict and disaster settings. Paracetamol, non-steroidal anti-inflammatories and opioid based analgesics are all on the WHO essential drugs list and so are more likely to be available than other pain medication, as is amitriptyline, which can be used (if appropriately prescribed) for neuropathic pain.

For those responding as part of a classified EMT, your patients should have access to adequate supplies of analgesia. EMT specialist rehabilitation cells are not required to provide medication so should develop links with other local providers. Knowing what drugs are available locally, and if patients need to pay for them, can be helpful. Even if medication is available over the counter in some countries, rehabilitation professionals should not prescribe or advise on medication use beyond their scope of practice. Note that, for extended scope rehabilitation prescribers, you may not be able to prescribe in another country if this is not within the defined scope of your profession in that country.

Visual pain charts can be used to assess pain:

**Visual analogue scale****Visual analogue scale****General types of pain**

Type	Causes	Common Descriptors (examples)
Acute nociceptive pain	Damage to tissues or organs, such as pain from a fracture or wound or new infection	Sharp, aching, throbbing (inflammatory)
Acute neuropathic pain	Damage to the nervous system, such as from a peripheral nerve injury or spinal cord injury	Burning, freezing, shooting, prickly, electrical, often in areas away from the injury and in response to stimuli that would not normally be painful
Chronic pain	Pain that persists after an injury has healed	Dull, aching, non-specific

**KEY POINTS**

1. Staff may be working in facilities where access to effective pain control may be limited. Work with the team to find the best solutions for your patients
2. Maintaining pain control on discharge or in a community setting can be difficult, especially if patients cannot access free/affordable medication. There may be problems with accessing clinics and money for prescriptions, as well as adherence to treatment
3. Cultural beliefs arounds origins of pain, expectations and acceptance of pain will also impact treatment and response to rehabilitation.

### Pressure areas

Many traumatic injuries can increase the risk of pressure ulcers developing, in particular conditions that combine reduced sensation (like spinal or peripheral nerve injuries) with reduced movement (like spinal injuries, brain injuries, or patients on traction). There is evidence of an increase in pressure ulcers in patients, particularly those with spinal cord injuries, in conflicts and disasters. Inadequate pressure relief, staff shortages, lack of education for carers, poor nutrition and hydration, poor bladder and bowel care contributed to preventable pressure ulcers.



**Picture 3: Patient with a pressure ulcer following a spinal cord injury in the Rohingya Camps, Bangladesh 2019**

© Davide Preti/HI

## KEY POINTS

1. Be aware of the risk factors for pressure ulcers, particularly in patients on bed rest, on traction, or with reduced sensation.
2. Promote safe positioning from the acute stage; involve volunteers, nursing staff and the patient's family/caregiver.
3. Promote good bladder and bowel care, and ensure there are adequate supplies of continence products
4. Consider sourcing appropriate mattresses/seat cushions locally, in particular if patients are being managed on the floor. Escalate equipment needs to coordination mechanisms, such as the EMTCC
5. Document pressure risks and pressure areas and seek support from the medical team in their management

### Respiratory complications

There are multiple ways in which conflicts and disasters can affect the respiratory system. There are obvious direct causes, such as flooding and tsunami (aspiration pneumonia was a significant issue following the 2004 Indian Ocean tsunami in Aceh), actual chest trauma, inhalation of smoke or volcanic smog. In situations of displacement, overcrowding and damp, insanitary living conditions, acute respiratory infections are also a major cause of morbidity. Patients who are immobile following injury or surgery are also at risk of respiratory complications, as are those who have suffered neurological injury, such as a spinal cord injury or stroke. Disease outbreaks

like measles can also lead to respiratory complications, such as pneumonias, particularly in children. Finally, recent re-emerging trends in conflicts have included the use of poisonous gases, including chlorine, which can cause respiratory complications

## KEY POINTS

1. Where possible, patients should be nursed in as upright a position as possible to reduce respiratory complications
2. Sitting (medically stable) patients out of bed, early mobilisation, and, for bed-bound patients, using the active cycle of breathing technique (ACBT) or bubble pep may all help reduce post-operative respiratory complications.
3. Where trained, rehabilitation professionals should be prepared to use core respiratory skills for respiratory therapy in conflicts and disasters, including respiratory assessment, positioning, suction (where available), manual techniques, active chest clearance techniques and airway clearance games for children. Acute paediatric respiratory physiotherapy skills are particularly important in outbreaks such as measles (as seen in Samoa in 2019) and influenza.



## BUBBLE PEP



**Picture 4: Demonstration of Bubble PEP in a low resource setting**

© Davide Preti/HI

**Bubble PEP (Positive Expiratory Pressure): A simple tool for respiratory therapy**

Bubble PEP can be used to encourage air movement through the lungs and to support sputum clearance. See <https://www.gosh.nhs.uk/medical-information/procedures-and-treatments/bubble-pep> for detailed instructions. Example of easy to make Bubble PEP is below:

**Basic instructions for bubble PEP:**

- I. Ask your patient to take a breath in and blow out through the tubing, into the water to create bubbles. The breath out should be as long as possible. Aim to get the bubbles out of the top of the bottle each time.
- II. Repeat 6-12 times. This is one cycle.
- III. Ask your patient to huff (1 or 2 times) (forced expiration technique) and cough to clear the phlegm, as taught by your physiotherapist. Encourage your patient to cough the phlegm out rather than swallow it.
- IV. Repeat this cycle (steps one to three) 6-12 times in total

## Malnutrition

The drivers of malnutrition in conflicts and disasters will vary depending on the level of food security, feeding practices and pre-emergency health services, as well as how these structures are now affected. Malnutrition (including micronutrient deficiency) in conflicts and disasters can increase morbidity and mortality and impair recovery. Children under five suffering from severe acute malnutrition are at high risk of suffering long-term cognitive and physical impairments. Stimulative therapy and play involving caregivers are recommended once these children are medically stabilised.

## KEY POINTS

1. Rehabilitation professionals should be aware of the importance of good nutrition post injury, and should work with the team to ensure patients are appropriately nourished
2. Rehabilitation professionals should be able to identify patients suffering from severe acute malnutrition (SAM), including the use (or referral to the medical team) of Mid Upper Arm Circumference (MUAC) as a reference for this. These patients should be referred to specialist centres for nutrition support
3. Severe micronutrient deficiencies (most commonly iron and Vitamin A) can also impact on recovery. It is good to be aware of common deficiencies in the areas where you are working, and how to identify them
4. Malnutrition also includes obesity. In countries where the population has high obesity levels, there are likely to be more patients affected by non-communicable diseases, such as diabetes and cardiovascular disorders.

## Pre-existing health conditions

Whilst conflicts and disasters cause injuries, they also disrupt existing systems and health services. This can lead to exacerbation of chronic conditions (such as diabetes, cardiac and respiratory diseases).

Trauma patients may have pre-existing health conditions that can exacerbate, or be exacerbated by, their injury. Diabetes is of particular concern for wound healing.

People with disability may be disproportionately affected by conflicts and disasters. This is well documented and there is currently more emphasis on the active inclusion of people with disabilities in emergency response. Those with disabilities may be more likely to have been injured or their assistive devices may have been lost; environments may be less accessible and access to regular therapy, medications and care givers may have ceased. Rehabilitation professionals should aim to actively identify these people and work with colleagues, community-based groups or disabled people's organisations to address their needs.

## KEY POINTS

1. Take a full medical history for each patient; consider access to necessary medication or therapy and equipment for chronic conditions
2. Identify and/or collaborate with local healthcare providers to activate a referral pathway for patients requiring follow-up for chronic health conditions
3. Consider the need to replace lost or damaged assistive devices, as well as the need for new devices for people with injuries

## Infectious diseases

Infectious disease outbreaks as secondary consequences of emergencies are often exacerbations of endemic diseases caused by the impact of the emergency – whether damage through contamination of water supplies, destruction of health services or displacement and consequential overcrowding. Outbreaks can also occur in conflicts due to the above, as well as longer-term disruption of vaccination and treatment programmes.

Common communicable diseases seen in emergencies include diarrhoeal diseases (including cholera), acute respiratory infections, measles, and vector-borne diseases (such as dengue fever and malaria). Pulmonary tuberculosis is also a concern. In some conflict affected areas, diseases that were once close to eradication, such as polio, are now re-emerging. Access to safe drinking water, vaccination programmes and rapid case identification and case management are vital to preventing outbreaks.

## KEY POINTS

1. Rehabilitation professionals must be vigilant, firstly in respect to their own personal health and immunisation status, but also in identifying and reporting suspected cases
2. Be aware of the possible need to scale up rehabilitation services to treat survivors of particular outbreaks (see Chapter 1)
3. Be prepared to help spread key public health messages and encourage good practices with your patients

## Paediatric considerations

Though in many countries paediatrics is considered a clinical speciality, in conflicts and disasters all therapists are likely to encounter paediatric patients. Children must be considered as a distinct population. Condition-specific considerations will be mentioned in each chapter, but below are some general considerations:

Children are typically injured alongside family members or friends. This has serious psychological and safeguarding implications, which must be addressed concurrently with medical care and rehabilitation. Managing an injured child's distress should be a priority – don't force rehabilitation.

Children have anatomical and physiological differences to adults. Specifics in relation to injuries will be addressed in the coming chapters. From a respiratory perspective, up to the age of 3, ventilation/perfusion (VQ) matching in children is the opposite to adults: Due to chest wall compliance, the dependent lung is poorly ventilated. To improve VQ matching, position the child with their good lung UP. More information on respiratory therapy in children is contained in the respiratory therapy cheat sheet.

Blast injuries in particular often result in poly-trauma, making early rehabilitation more complex. Younger children in particular are more likely to present with associated head and thoracic injuries, while the presence of certain explosive remnants of war (such as cluster munitions) can increase the likelihood of upper limb injuries in children by being mistaken for toys or objects of interest.

In some contexts, children with impairments may be socially disadvantaged as a result of their injury, resulting in them not attending school, being kept at home or being perceived as being

unable to work or marry later in life. Early education with family members and links to peer support can help mitigate this.

Injured children may have experienced destruction of their communities, deprivation, forced displacement from their homes, schools and communities and separation from, or loss of, loved ones, including parents. While specific agencies often take overall responsibility for child protection and education, keeping children safe is everybody's role in humanitarian response. Refer back to Chapter 2 for information about protecting children in your care.

## KEY POINTS

1. Children will require paediatric-sized assistive devices and other equipment. Access to paediatric-specific equipment (such as wheelchairs, crutches, orthotics and prosthetics) is often limited. Where children require assistive devices over extended periods of time, these need to be re-fitted regularly while the child is still growing
2. Carry some child friendly treatment equipment. Carrying some basic toys as part of a treatment bag (even if just bubbles, balloons, and a mobile phone with music or videos) can be really helpful
3. Treatment approaches need to be modified. Consider distraction, play and age-appropriate, activity-based approaches with younger children
4. Where possible, involve family and caregivers in all aspects of the child's care. This reinforces stability to a child and protects them against further psychological distress. Appreciate who should give consent in a family, according to the specific context
5. For continuity and to enhance feelings of protection and stability, try to keep the same staff and translators involved in a child's care. National staff members may be less intimidating than unfamiliar international staff.
6. Peer support can be invaluable. Children feel more relaxed in the presence of other young people and can offer each other support. Try to group paediatric beds/treatment sessions together and incorporate interactive group games.



**Picture 5:** HI rehabilitation staff providing treatment to a 4 year old, victim of an airstrike, in Yemen  
© ISNA Agency / HI



**Picture 6:** HI rehabilitation staff providing a treatment session to two young girls with amputations after the earthquake in Nepal, 2015  
© Lucas Veuve/Handicap International



## Rehabilitation-based age appropriate play activities

	Type of play	Example	In rehab
6-18 months	Exploratory	Pushing buttons, making noise with instruments.	Use toys that make sounds or actions to encourage movements. Engage with things like bubbles or music.
18 months - 3 years	Active	Running, jumping, building.	Build treatment around fun basic fine and gross motor activities, like building blocks or imitating actions.
3-6 years	Imaginative	Playing doctor, dress up, doing art activities.	Get the child to also play doctor or nurse and help out, or build fine motor activities around art or basic puzzles.
6-9 years	Challenging	Puzzles and games that challenge motor skills.	Use local puzzles or popular sports that will challenge the child's skills. Use group activities.
9-14 years	Team and individual	Team sports, but also individual interests or hobbies.	Use sports or other appropriate play, based on the child's interests.

*Note that the above is just a guide – different children will respond differently to different types of play.*



### REHAB WITH DISTRACTION

A paediatric blast injury field manual is available and contains a chapter on rehabilitation, as well as paediatric rehabilitation considerations for injuries, including spinal cord injuries, burns and fractures: [https://www.savethechildren.org.uk/content/dam/gb/reports/pbip\\_blastinjurymanual\\_2019.pdf](https://www.savethechildren.org.uk/content/dam/gb/reports/pbip_blastinjurymanual_2019.pdf)

## GENERAL TREATMENT APPROACHES

The following six clinical chapters will detail condition-specific approaches to rehabilitation. However, there are some general approaches to treatment in conflicts and disasters that are worth emphasising:

### Education and self-management

Your time with patients in emergencies is often severely constrained, and opportunities to regularly follow patients up may be limited. Educating patients and caregivers and providing them with clear guidance on any restrictions and signs of complications, advice and exercises, and explaining how to progress (and what to do if they don't make progress) is key. Where patients are awaiting definitive management, pre-operative education can make post-operative care much easier.

## KEY POINTS

1. Adapt your use of language to ensure your patient can understand you
2. Check understanding by asking patients or carers to demonstrate or explain what you have just taught them.

### Promoting functional independence

Patients will often leave hospital to return to extremely challenging environments – streets may be blocked, access to essential services (including aid distributions) may be restricted or patients may be living in tents, crowded conditions or remote locations. Promoting early functional independence is, therefore, incredibly valuable. In some instances, you may need to use clinical reasoning to take decisions that best protect a person on discharge in disaster or conflict environments, rather than following what may normally be considered best practice. A good example of this is providing crutches (rather than wheelchairs) for amputees who face early discharge to challenging environments where a wheelchair would leave them stuck in a room or tent.

Though passive modalities are often not useful in acute settings, be aware that in some contexts, 'hands-on' therapy or electrotherapy will be contraindicated or inappropriate, particularly if working in conflict areas with victims of torture.

### Working with family members or caregivers

In conflicts and disasters, it is often family members who provide routine daily patient assistance. This can include support with positioning, dressing changes, mobilising, toileting, eating/drinking and washing/dressing. Therefore, as your own time with patients is also likely to be limited, it is essential to support these care givers on how best to perform tasks safely, whilst also promoting patient independence. Educating patients and caregivers in basic post-operative rehabilitation, including positioning, range of motion exercises, transfers and mobility is often vital.

## KEY POINTS

1. Consider pictorial aids for caregivers and staff, or positioning charts
2. Develop guidance in local languages
3. Remember caregivers may have unseen stressors in addition to the patient care and may therefore need prompts/visual resources to remember instructions.

## Psychological support for patients

### Psychological first aid (PFA)

While rehabilitation professionals may be present during the immediate days and weeks after a conflict or disaster, professional psychological support for patients is often limited in emergencies. Rehabilitation professionals are often the healthcare specialist who spends the most time with patients, in particular those with life-changing injuries. Often, they are in a position to support people, and while many are already well equipped to do this, some may not know what to say or how to help. It is useful to have a framework that advises what you can say that will be helpful, while keeping yourself and those you are helping safe and respecting people's dignity, culture and abilities. PFA does just this; the official description of PFA is that it 'involves humane, supportive and practical help to fellow human beings suffering serious crisis events.'

Providing PFA means being able to:

- Provide practical care and support, which does not intrude
- Assess needs and concerns
- Help people to address their basic needs (for example, food and water, information)
- Listen to people, but not pressure them to talk
- Comfort people and help them to feel calm
- Help people connect to information, services and social supports
- Protect people from further harm (9)

You can read more about PFA and download the official guide for humanitarian field workers here: [https://www.who.int/mental\\_health/publications/guide\\_field\\_workers/en/](https://www.who.int/mental_health/publications/guide_field_workers/en/)

### Peer support

Peer support can be an excellent option for patients who may have experienced life-changing injuries, such as amputations or spinal cord injuries. Peer support simply means 'offering assistance to someone who is at the same level as the supporter'. In conflict and disaster settings this may mean recruiting volunteers who have a pre-disaster impairment as peer supporters. These volunteers, once trained, are able to offer reassurance of life after injury, as well as practical and emotional support. At other times, patients with similar level of injuries can be brought together in an in-patient or clinic setting.

Whilst the aim of peer support is not to replace professional help, it does encourage sharing of emotions, problems and coping strategies in the face of new injuries, whilst alleviating the burden of psychological support from staff.

### Psychosocial support

Psychosocial support helps individuals and communities to heal psychological wounds and rebuild social structures after an emergency or a critical event. It can help change people into active survivors rather than passive victims.

The term 'psychosocial support' indicates the strong link between problems of a social and psychological nature. People affected by the same conflicts and disasters will experience very different psychosocial impacts. They may have pre-emergency concerns, such as being marginalised, having previous disabilities or experiencing mental health issues. Other problems

can arise as a direct result of the emergency, e.g. family separation, destruction of social networks and livelihoods, grief, depression and anxiety disorders. Finally, the aid response itself can pose psychosocial problems due to lack of privacy, aid dependency or anxieties around the distribution of aid.

A short video explaining psychosocial support is available from Save the Children here: <https://www.youtube.com/watch?v=h0L6u68tbI>

Consider the following points when providing early rehabilitation in such settings:

1. Ensure marginalised groups are catered for and can access rehabilitation services
2. Link with agencies to reunite any separated family members of patients
3. Link with agencies providing psychosocial support, community groups and livelihood projects
4. Consider past and future livelihood as soon as possible and integrate into rehabilitation goals (access to work is essential not only for economic security, but also for personal wellbeing and sense of belonging)

## REFERENCES

*Management of limb injuries during disasters and conflict.* Geneva: ICRC, 2016.

*Pain Control in disaster settings: a role for ultrasound-guided nerve blocks.* Lippert SC, Nagdev A., Stone M. B., Herring A., Norris R. 6, s.l.: Annals of emergency medicine, Jun 2013, Vol. 61, pp. 690- 96.

*Medical Rehabilitation after natural disasters: why, when and how?* Rathore F. A., Gosney J. E., Reinhardt J. D., Haig A. J., Li J., DeLisa J. A. 10, s.l.: Arch Phys Med Rehabil, 2012, Vol. 93, pp. 1875-81.

*Disability inclusion and disaster risk reduction: Overcoming barriers to progress.* Twigg, Kett and Lovell. London: ODI, 2018, ODI Briefing Paper.

*Risk factors for mortality and injury post Tsunami, epidemiological findings from Tamil Nadu.* Guhar-Sapir, Debarati, Parry and Degomme. s.l.: PJJSA, 2006.

*Pressure ulcer occurrence Following the great east Japan earthquake: observations from a disaster medical assistance team.* Sato T, Ichioka S. 4, s.l.: Ostomy Wound Management, 2012, Vol. 58, pp. 70-75.

*Lessons from the 2015 earthquake(s) in Nepal: implication for rehabilitation.* Sheppard P. S., Landrey M. D. 9, s.l.: Disabil Rehabil, 2016, Vol. 38, pp. 910-13.

*Natural Disasters and the Lung.* Robinson B., Alatas MF, Robertson A., Steer H. s.l.: Respiriology, 2011, pp. 386-95.

WHO, War Trauma Foundation and World Vision International. *Psychological First Aid: Guide for field workers.* 2011.

## CHAPTER 4

### CHAPTER 4: EARLY REHABILITATION OF FRACTURES

#### AIMS:

By the end of this chapter, you should be able to:

- Understand fracture pathology, fracture classification, and implications for early rehabilitation
  - Complete an assessment of an acute fracture, including identifying complications
  - Plan and deliver early rehabilitation of fractures
- Provide education and advice regarding recovery and secondary complications of fractures



## CHAPTER 4: EARLY REHABILITATION OF FRACTURES

### INTRODUCTION

While fracture rehabilitation is often straightforward, in acute conflict and disaster settings your rehabilitation work may be complicated by a number of factors related to the context. In conflicts and disasters, patients often present with multiple injuries, which can complicate your rehabilitation plan. Rehabilitation professionals working in conflicts and disasters should be familiar with complex fractures, and adapted surgical management techniques in disasters.

Fractures are among the most common injuries seen in conflict and disaster settings, with around half of all patients seen in conflict settings presenting with at least one fracture. Be aware that, due to the sudden surge of demand for health services and inpatient beds during an acute emergency, patients who present with non-life threatening fractures may be discharged very quickly or may have to wait for definitive management. Patients may be immediately discharged after the application of Plaster of Paris (POP), thermoplastic orthoses, or even shortly after orthopaedic surgery. You will need to maintain close contact with the nursing or medical team in order to be alerted to any cases presenting with fracture, so that you can assess them before inpatient discharge.

There is a higher risk of wound infection in conflict and disaster settings, as field management of conflict wounds may be carried out by untrained individuals or with unclean materials, and slow extrication in the case of emergencies like earthquakes or typhoons results in prolonged exposure to potential sources of infection, such as dirty water. The mechanism of injury is also relevant as a blast mechanism is likely to force dirt, debris and other contaminants into an open wound, which may require extensive or multiple debridements. The presence of wounds or other injuries may significantly impact the rehabilitation plan for a patient with a fracture. Medical notes may be missing, and post-operative instructions may not be relayed by the medical or surgical team. If there is any uncertainty about safety considerations, such as weight-bearing status or treatment progression, rehabilitation professionals should use their clinical judgement and only work within their scope of practice and experience.

### ANATOMY

It is necessary to have a basic understanding of anatomy and bone physiology to understand the implications of a fracture for function and rehabilitation; of weight-bearing versus non-weight-bearing, or fracture through the epiphysis or joint capsule. Below is a basic outline of fracture types, recovery time and implications for medical and surgical management. For more detailed information on fracture types, see the Fracture and Dislocation Compendium <https://ota.org/research/fracture-and-dislocation-compendium>. For fracture management in emergency settings, see WHO Disaster Management Guidelines <https://www.who.int/surgery/publications/EmergencySurgicalCareinDisasterSituations.pdf>

## Common types of fractures

Different classification systems for fractures exist; however, in an acute conflict and disaster setting it is not necessary to know all these classifications in detail in order to deliver safe and effective care. At a minimum, you should be aware of some common features to understand implications for rehabilitation and recovery.

It is important to check the following:

- Ensure you have information about the location of the fracture; is it through the bone shaft, into a joint or are there multiple fractures along the bone?
- Assess for deformity; is the bone in alignment, does it have continuity or did the bone emerge from the skin/soft tissues?
- Are there any associated injuries? Is the fracture open or closed and what is the condition of the surrounding soft tissues? Check the surgical notes and enquire with the medical team for damage to blood vessels or nerves, as they may impact rehabilitation
- What was medical or surgical management? Are there any precautions or restrictions following management?

### Basic fracture descriptions:

- **Stable (or non displaced) fracture:** the broken ends of the bone line up
- **Displaced:** Fractured portions of bone are separated or misaligned.
- **Closed fracture:** the bone has not pierced the skin
- **Open (or compound) fracture:** the skin may be pierced by the bone or by a blow that breaks the skin at the time of the fracture. The bone may or may not be visible in the wound
- **Greenstick:** a fracture in a young, soft bone in which the bone bends and breaks
- **Transverse:** the break is in a straight line across the bone
- **Spiral:** the break spirals around the bone; common in a twisting injury
- **Stress/hairline:** small crack or severe bruising within a bone
- **Oblique:** diagonal break across the bone
- **Compression:** the bone is crushed causing the broken bone to be wider or flatter in appearance
- **Comminuted:** the break is in three or more pieces and fragments are present at the fracture site
- **Segmental:** the same bone is fractured in two places so there is 'floating' segment of bone

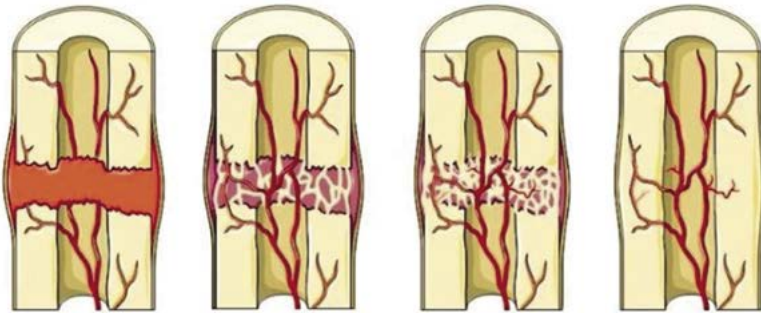
Be aware that certain fractures (such as pelvic fractures) are associated with high-energy trauma, such as crush or blast injuries, and are more complex to manage. High-energy trauma injuries are also often associated with significant blood loss and poly-trauma. In conflicts and disasters, these patients may be less likely to survive. If they do survive, they are likely to have substantial associated injuries, such as spinal cord injury or severe soft tissue and organ damage. This may limit early rehabilitation, or your involvement for rehabilitation may be delayed. If you are unsure about assessment or treatment of these patients, first seek out the medical team for information about relevant precautions and always remain within your own scope of practice. For more information about scope of practice, please refer to Chapter 2.

### Fracture healing and timeline of recovery

When dealing with simple fractures, generally; paediatric fractures will heal most quickly (approximately 3-6 weeks) and adults upper limb fractures will heal faster (approximately six weeks) than lower limb fractures (approximately 8-12 weeks). After the initial bleeding and inflammation phases, which take around 4-6 days, new cells will begin to proliferate. Remodelling and strengthening of this new bony material will occur over the coming weeks and months.

Remember that, while it is helpful to understand approximate timescales of recovery for different fracture types, every patient will be different. In conflict and disaster settings, patients may be more likely to heal slowly. This may be due to multiple injuries, late or suboptimal fracture management, the patient's past medical history (conditions such as diabetes, which affect vascular supply, will slow or limit healing) and nutritional and smoking status. Vascular injuries and infections are also likely to impair fracture healing. Fractures caused by gunshot wounds or blast mechanism, and which leave behind shrapnel close to the bone, may be more likely to suffer delayed or non-union. Blast or crush injuries which cause huge soft tissue damage are likely, (if the limb is salvaged) to heal slowly, due to impaired blood flow, and there is a high likelihood of long-term peripheral nerve injury (PNI).

### Diagram 1: Bone healing



Bone strengthens in response to the load it experiences, therefore once safe limits are set by the medical team regarding weight bearing; your rehabilitation treatment should include progressive weight bearing. As this guide is focused on the acute phase of rehabilitation, you should prioritise guiding the patient on the safe limits of weight bearing for the initial phase of their recovery and offer them basic advice on when and how they can start to increase their weight bearing at home (see the patient information leaflet).

## PAEDIATRIC FRACTURES

When paediatric patients fracture their bones, their bones heal differently to adults. As the ligaments of children are stronger than their bones, they are more likely to experience sprains or greenstick (where the bone bends but does not break) fractures. However, as paediatric bones are still growing, fractures which cross the growth plate (epiphysis) can cause deformity by impacting the growth of the bone.

Nevertheless, children may heal more quickly than adults (as fast as about four weeks for some fractures) and they have better opportunity to remodel any deformity. As with adults, healing may be delayed or impaired by poor nutrition, the physiological load of multiple injuries or health issues.



### Medical and surgical intervention

In an ideal situation, fracture patients will have seen the medical or surgical team who will have recorded precautions and contraindications for rehabilitation before the patients is examined by the rehabilitation professional. However, in conflicts and disasters, this may not be the case and post-operative/medical notes may be limited or not available at all. Wherever possible, always try to get as much information from the medical team as you can before you see the patient. If you are unsure about anything, ask, and never do anything in your assessment or treatment which has been contraindicated by the team. Below is a brief explanation of some of the most common fracture management strategies. Keep in mind that during surgical management, delicate structures such as nerves or tendons can be damaged, or pins can be accidentally placed into these soft tissues. A loss of movement or sensation post-operatively is an indication that this may have occurred and the patient should be reviewed by the surgical team.

#### 1. Plaster of Paris (POP) cast:

Frequently referred to as POP casts, these are normally cheap and readily available and are used to immobilise and protect a fractured bone while it heals. They consist of cotton bandages coated in wet gypsum, which can be moulded to the shape of the person's limb, before drying into a hard, protective shell. The patient should avoid getting the POP wet or putting anything inside it, which patients sometimes do to try and relieve itching. Itching could cause a sore and lead to infection. The fit should not be too tight to eliminate blood-flow and you should only apply, or assist in applying a POP cast if this is within your scope of practice.



**Picture 1: POP cast used in conflict and disaster settings**

© Davide Preti/HI

#### *What to watch out for in conflict and disaster settings:*

compartment syndrome (refer to the complications table below), open fractures or wounds inappropriately managed by POP, undiagnosed nerve injuries (refer to the PNI chapter).

## 2. Internal fixation:

Metal plates are surgically inserted and used to hold the bone in place while it heals. The surgeon may or may not remove the rods once the bone is healed. Internal fixation may be contraindicated in conflicts and disasters, due to the risk of infection, suboptimal operating conditions and challenges with long-term follow-up. These surgeries should only take place in fixed facilities; therefore, you are less likely to encounter them in a field hospital/tented facility.



**Picture 2:** Internal fixation of humerus

© Davide Preti/Hi

**What to watch out for in conflict and disaster settings:**

infection, failure of fixation, undiagnosed nerve injury.

## 3. External fixation:

Metal pins or K-wires are surgically inserted through the skin to hold the broken bone in a corrected position for healing and are attached to an external rod or frame which holds them in place. The external fixator should be removed once the bone is healed. They may be used on fractured bone which has fragmented into multiple pieces, or used to temporarily stabilise a patient with multiple injuries until they receive definitive orthopaedic surgery. External fixators may also enable earlier weight bearing compared to a cast; however, you should always check with the surgical team.

**What to watch out for in conflict and disaster settings:**

pin site or wound infection, insufficient stability from the fixation, undiagnosed nerve injury, pins inappropriately placed through tendon or nerves.



**Pictures 3 & 4:** Examples of external fixators used in conflict and disaster settings

© Davide Preti/Hi

#### 4. Traction (skin and skeletal):

Traction is widely used for the management of fractures and dislocations (including neck of femur fractures, femoral shaft fractures, displaced acetabular fractures and some pelvic fractures) in conflicts and disasters. It is usually used because the fracture/dislocation cannot be treated with POP casting, or as a temporary measure until definitive treatment is provided. Skin traction may be used as a short-term measure for adults with a femoral fracture, or may be the definitive treatment for paediatric patients. Skeletal traction is less effective for adults as a definitive treatment, but is effectively used for children with hip fractures.

#### *What to watch out for in conflict and disaster settings:*

the development of pressure areas, urinary tract infections, chest infections, foot drop contractures (if the foot is positioned in equinus), peroneal nerve palsy, pin tract infection and thromboembolic events (e.g. deep venous thrombosis [DVT] or pulmonary embolism). These complications stem from a lack of patient mobility, muscle atrophy, weakness and stiffness that result from a fracture. Therefore, bed exercises and basic respiratory treatment (refer to Chapter 3) can help to minimise these complications; all within the limitations of the fracture and traction.



**Pictures 5 & 6:** Examples of traction used in conflict and disaster settings

© Davide Preti/HI

### ASSESSMENT AND MONITORING

Your assessment for a patient with a fracture in a conflict and disaster setting should follow the same format as a standard rehabilitation assessment. When the patient has other injuries or is affected by post-operative medications or pain, it may be difficult to complete a full assessment in one session. If this is the case it is acceptable to only complete the parts of the assessment that it is possible to do, and limit your treatment plan to what can safely be done until you gather more information. Only assess the components you feel competent to complete, and which fall within your scope of practice.

At the end of the assessment you want to be able to produce a list of problems, develop a treatment

plan that focuses on your problem list; and set goals with your patient or their family/caregiver.

General assessment guidance is provided in Chapter 3 of this handbook; however, specific considerations that might impact your fracture assessment (and treatment plan) within conflict or disaster setting may include:

- **Lack of medical history/complete background information** such as weight-bearing status or post-operative notes, due to the emergency transfer of patient, disrupted services and the potential that the patient has been separated from their family
- **Increased risk of infection** i.e. the mechanism or context of the injury (blast or prolonged exposure to dirty water) could increase the risk of contamination. Poor theatre conditions and a contaminated hospital environment, e.g. an emergency camp with limited sanitation services, can also increase the risk of infection. Disrupted care will make continuity of treatment difficult, leading to extensive or hard to treat infections

## SUBJECTIVE ASSESSMENT

In addition to your standard subjective patient history (refer to Chapter 3), some information is especially important for prioritising the patient's problem list and creating a safe and effective treatment plan. Important fracture specific information to consider for each section is listed below.

### History of Presenting Condition (HPC):

- A timeline of the injury and treatment to date
- The mechanism of injury; was it high- or low-energy? Was there any twisting? These answers will indicate the extent of the associated soft-tissue injuries, any possible additional injuries and the risk of complications
- Is the treatment definitive or is further surgery required? Note any post-operative instructions (such as weight-bearing status) from the operation notes or the orthopedic team

### Previous Medical History (PMH):

- Co-morbidities that will negatively impact fracture healing include diabetes, any vascular disease, prolonged use of steroids or conditions affecting bone integrity (such as osteoporosis)
- The use of non-steroidal inflammatory drugs may impact the inflammatory phase in acute fracture healing. Smoking and poor nutrition will impair healing overall
- Special consideration should be given to frail, older patients and others with baseline co-morbidities that increase their risk of complications, e.g. baseline respiratory or cardiovascular disease, malnutrition, fragile skin or pre-existing pressure ulcers, falls history or cognitive impairment

### Social History (SH):

- Daily activities that the patient needs to complete for independence; i.e. will the patient need to manage with one hand? Will the patient have to use stairs? Will the patient be able to self-propel a wheelchair (considering environmental and personal factors)? What will the patient sleep on?

**Pain:**

- Is the pain controlled to allow the patient to move and mobilise (as allowed by the weight-bearing status)?
- Is the pain proportionate to the injury and in the expected location?
- Is the pain coming from an undiagnosed injury or might it indicate a serious complication?

**Sensation:**

- High-energy injuries are more likely to cause nerve (and vascular) injuries, especially fracture dislocations. Pressure from splints and surgical repair can also cause nerve injuries. Note that surgical procedures, such as application of an external fixator, may cause nerve injuries and you should assess your patient's sensation and movement post-operatively (for more information on assessment and treatment, refer to the PNI chapter). Below are some of the most common fracture types which can result in nerve injuries.

**Table 1: Injuries resulting in nerve injuries**

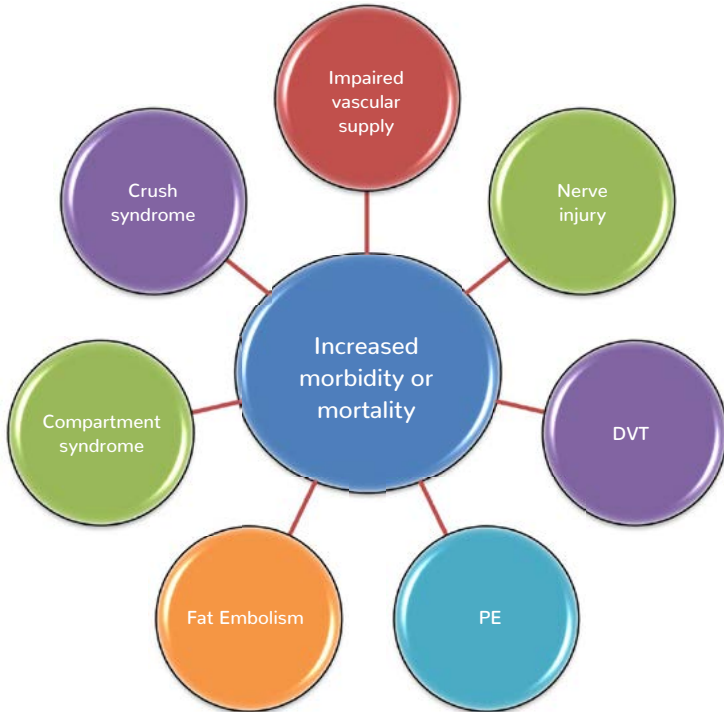
Injury type	Nerve commonly affected	Clinical signs
Shoulder fracture dislocation	Axillary	Deltoid weakness (reduced shoulder abduction and flexion) and loss of sensation over lateral aspect of upper arm (sargeant's patch)
Humeral fracture: proximal or shaft	Radial	Wrist drop and loss of sensation in first web-space
Humerus fracture - supracondylar (more common in paediatrics)	Median – anterior interosseus branch	Loss of thumb IP flexion, i.e. Unable to perform 'OK' sign.
Radial head dislocation +/- ulna/radial fracture 'Monteggia'	Radial – posterior interosseus branch	Loss of wrist and MCP joint extension all digits
Fibular head fracture knee dislocation	Common peroneal	Foot drop
Hip/acetabulum/pelvis fracture	Sciatic nerve (posterior) Femoral nerve (anterior)	Foot drop Decreased hip flexion/knee extension power

**OBJECTIVE ASSESSMENT**

The first role as rehabilitation professionals is to identify any current or potential complications. A quick neurovascular screen is a good starting point. It can be done very quickly if there are no worrying findings.

**Remember the 5P's**

1. **Pain** – is there unexpected pain to light touch and/or with passive stretching of the associated muscles? Is there tenderness surrounding a wound or pin site?
2. **Paraesthesia** – any unexplained sensation changes? If so, assess the peripheral nerve fields distal to the fracture (see nerve injury chapter)
3. **Paralysis** – any unexplained weakness? Assess movement/muscle activity of the limb
4. **Pallor** – is the colour of the limb equal to the other side? Is it grey and dusky or bright red around a wound? Assess capillary refill (normal = refill in less than two seconds)
5. **Perishing cold** – is the temperature equal to the opposite limb? Assess the pulses

**Diagram 2: Acute fracture complications:**

**Table 2: Acute fracture complications, red flags, and actions to take**

Complication	Signs and symptoms (red flags)	Action to take
<p><b>Rhabdomyolysis (or crush syndrome)</b></p> <p>Risk factors: Crush injury (resulting in muscle damage with byproducts damaging the kidneys)</p> <p>Timeframe: usually occurs in the very acute phase (around 1-3 days) post-injury</p>	<p>Significant muscle pain/swelling</p> <p>fever</p> <p>vomiting</p> <p>confusion</p> <p>tea-colored urine</p> <p>irregular heartbeat</p>	<p><b>Requires immediate action from the medical team</b></p> <p>Management includes fluid resuscitation and the management of associated renal failure</p>
<p><b>Compartment syndrome (acute)</b></p> <p>Risk factors: Tibial or forearm fractures, high-energy wrist fractures crush injuries</p> <p>Timeframe: usually occurs in the very acute phase, post-injury</p>	<p>Pain out of proportion to the associated injury and pain on passive movement of the muscles of the involved compartments</p> <p>Severe swelling</p> <p>Neurovascular changes – 5P's</p>	<p><b>Requires immediate action. Inform the surgeon immediately.</b></p> <p>Remove any cast, splint of circumferential dressing and elevate limb to heart level. May require emergency fasciotomy</p>
<p><b>Fat embolism or Pulmonary Embolism (PE)</b></p> <p>Timeframe: occurs in very acute phase post-injury</p>	<p>Increased respiratory rate, shortness of breath, confusion, lethargy, rash on chest/neck (fat embolism), chest pain (PE)</p>	<p>Inform the medical team urgently. Check observations; administer oxygen if required and if this is within your scope of practice</p>
<p><b>Deep Vein Thrombosis (DVT)</b></p> <p>Usually in the calf but can also occur in upper limbs. This can progress to a PE (see above)</p> <p>Timeframe: Patient is most at risk in the acute phase and first three months post-injury</p>	<p>A swollen, hard, painful limb that is tender to touch. Heat and discoloration (usually red but can be blueish-grey)</p>	<p>Inform the medical team. Check whether the team is happy for the patient to mobilise</p>
<p><b>Infection</b></p> <p>This can be from a surgical wound, open fracture or pin sites</p>	<p>New or increasing pain, heat, redness, swelling, green or cloudy oozing/ discharge or tenderness</p>	<p>Inform the medical team</p>



**Picture 7:** Left, infected metal implant



**Picture 8:** Right, post fasciotomy to relieve compartment syndrome

## COMPARTMENT SYNDROME

Compartment syndrome is a **MEDICAL EMERGENCY**. Pressure builds up within muscles, which can decrease blood flow and prevent nourishment and oxygen from reaching nerve and muscle cells. If compartment syndrome is not treated immediately, it can cause permanent muscle damage, tissue death and infection. If compartment syndrome is suspected (see table above for signs), all tight bandaging and casts should be removed, and an emergency fasciotomy (skin and fascia incisions to relieve compartment pressure) may need to be performed.

After completing the basic neurovascular assessment and ruling out any red flags, assess the following (observing any instructions/limitations, post-operative or otherwise):

**Range of movement (ROM)** – assess active ROM and passive ROM unless otherwise indicated. For example, for a post tendon repair, start with active ROM so that the patient is in control and pain can be monitored. If the patient lacks full active ROM that is not due to pain, then passive ROM can be gently assessed, taking into consideration any soft-tissue structures that will be affected.

**Strength** – Assess the strength of the affected body parts using Oxford Muscle Grading Scale/ Manual Muscle Testing (see Chapter 3 and Chapter 5), starting with isometric testing and progressing to movement against gravity if permitted. Resisted movements should be avoided in an acute fracture.



**Function** – consider how the patient will manage transfers, e.g. lying to standing, and consider whether they will need any mobility aids for this. Plan how the patient will perform daily activities while adhering to weight-bearing restrictions. Other functional considerations may include the patient’s use of a latrine, bed pan and positioning to relieve skin pressure if they are on bedrest (see positioning guidelines in ABI chapter and guidelines on avoiding respiratory complications).

### **Other considerations for objective assessment**

**Cast/splint/dressing** – check that these are not too loose or too tight due to swelling during the acute phase of a fracture. Ensure that joints (fingers and toes!) aren’t immobilised unnecessarily. Unless there is an emergency, do not remove a dressing unless you can safely (and competently) re-apply one. If you suspect an infection, seek support from the nursing or medical team.

**External fixator** – check all pin sites for signs of infection. Check that all wires and pins are solid and secure. Check that each nut and bolt is tight. Do this systematically, i.e. from top to bottom, left to right and do it/teach the patient to do it the same way each time, using clean hands. In addition to potential infections and neurovascular complications, pin sites can impale tendons or muscle bellies, causing reduced and painful movement.

**Use of x-rays** – x-rays (and other imaging) if available can be useful as part of an assessment if it is within your scope of practice as a rehabilitation professional to read them. If not, ask a qualified colleague and do not attempt to interpret them yourself.

**Fracture blisters** – these usually occur in areas with little subcutaneous tissue such as, the ankle, tibia and elbow. Blisters are either clear (filled with serous fluid) or haemorrhagic (filled with blood). Leave the blisters alone, elevate the limb to reduce swelling and inform the medical team.

**Outcome measures** – outcome measures in this setting should be quick and simple to administer. Outcome measures frequently used in the acute phase of fracture rehabilitation include manual muscle testing, ROM and functional goals.

## **TREATMENT**

The treatment section in this chapter relates to upper and lower limb fractures. For spinal fracture management, please refer to Chapter 8 for more information, for information regarding pelvic fractures, see the box below. At all stages, consider any spinal precaution instructions before commencing rehabilitation. If the patient is allowed to mobilise in a spinal brace, ensure correct fit of the brace (educate family/caregiver) before moving them.

Acute fracture rehabilitation aims to safely maximise function and support fracture healing while maintaining function and decreasing complications. Rehabilitation treatment should start with gaining the patient’s trust, providing basic education and advice and adding exercises for movement and function, as allowed by the medical team and tolerated by the patient.

**For specific considerations that might impact your treatment in conflicts and disasters, please refer to Chapter 2.**

## PELVIC FRACTURES

Pelvic fractures may be stable or unstable, and their presence is usually confirmed by the use of imaging. Unstable fractures in particular are usually associated with high-energy trauma, such as crush or blast injuries, and are likely to be accompanied by other injuries, including to the abdomen and urinary systems, and significant blood loss. The medical team may apply a binder, which you should not remove during treatment or without first discussing with them. Patients with stable pelvic fracture and limited other injuries may be treated with bed rest.

Rehabilitation may be slow but follows the usual principles; avoiding complications such as pressure sores, minimising weakness and muscle shortening, gradually building strength and ROM through gradual increase in functional tasks and weight bearing (in accordance with the instructions from the medical team). Consider implications of other injuries for the use of assistive devices (e.g. upper limb injury, limiting use of crutches) and include caregivers to maximise independence in daily tasks, such as toileting, that will be impacted by limited mobility.

### Priority list

Priority for treatment of the fracture depends on meeting standards of basic wound and fracture care revolving around the following surgical objectives:

- Adequate wound debridement
- Soft tissue coverage
- Stabilisation of the bone to allow satisfactory bone healing

### Rehabilitation treatment goals

Early active mobilisation of trauma patients has been shown to improve patient function and outcome. All rehabilitation should include written information and family/carer education in order to maximise treatment carryover. The use of a diary for patients to record their daily exercises and mobility/sitting out time has been shown to improve adherence to their rehabilitation programme.

Your treatment plan should focus on:

- Early patient mobilisation
- Maintenance of joint range of motion
- Maintenance of strength
- Return to optimal function
- Discharge planning (including outpatient/community follow-up)

For simple fractures without affected ROM, and where a patient can mobilise safely, you can provide patients or caregivers with basic information to maintain strength and ROM, and minimise pain during the fracture healing period (see the patient information leaflet). Advise patients to seek rehabilitation services once their fracture has healed (usually when the cast or external fixator is removed) if they have any ongoing problems, as this may not be automatically offered. Do not undertake wound or pin site care if this is not part of your normal practice (see

information on scope of practice in Chapter 2 for more information), but make sure that the patient knows what to do and has the resources to do this, e.g. their own dressings, access to soap and clean water and knowledge of where to seek help with this if they need to.

## REHABILITATION TREATMENT

Every injury is different, and in conflict and disaster settings you are likely to see complex patients with many injuries. It can be best to focus on the joints and muscles that are required for initial functional movements and getting out of bed. Consider what the most important movement that the patient needs to be able to do is. Ensure that pain is controlled prior to starting any rehabilitation treatment; please refer to Chapter 3 for more information on pain management.

Beware of potential complications and red flags, which may not become clinically apparent until the patient begins to move.

### Oedema management

Protect, Rest, Ice, Compress and Elevate (PRICE) principles are a good way to minimise acute phase oedema, use an elasticated bandage if available. Slings for upper limb fractures should be alternated with PRICE and gentle exercises to reduce swelling. Oedema management is important in fractures of the hand and wrist. If oedema is not minimised it can result in stiffness, decreased ROM, increased pain and long-term deformity/impairment. Elevated positioning and regular mobilisation (avoiding disruption of the fracture healing) are essential and can be taught to the patient.

### ROM and resistance exercises

Active ROM and/or resistance exercises for uninjured limb(s) should be taught, in order to maintain and increase the patient's strength, avoid stiffness and reduce the risk of pressure ulcers. For example, if a patient is immobilised in a below-the-elbow cast for a wrist fracture, you should provide exercises for the shoulder, elbow and fingers. Overall, for the joints above and below an immobilised joint, active or passive ROM should be encouraged.

The patient should progressively improve their strength, moving from isometric to anti-gravity to resisted-range exercises. In the acute stages, however, weight bearing may be contraindicated and only isometric exercises may be allowed; always confirm with the medical team.



## EXERCISES

### Bed mobility

The first priority (once safe to do so) is for the patient to sit fully upright in the bed, and to teach caregivers the manual-handling techniques to facilitate this. This will help reduce the risk of pressure ulcers, postural hypotension and improve respiratory function, especially for those patients on traction and bed rest. Encourage the patient to assist with this as much as they are able to. Use available tools, such as a rope tied to the end of the bed, to allow the patient to assist and to promote independence with bed mobility.

## Weight bearing

Always check the weight-bearing status with the medical team. If you cannot obtain this information in the acute phases it is safer to assume the patient is non-weight-bearing until this can be clarified. If some weight bearing is allowed, always consider whether the patient has the capacity to understand instructions, and to comply with them. If the patient is non-weight-bearing, check the patients understanding and compliance with this. Focus on teaching good transfer and manual handling techniques that enable the patient and family to continue non weight bearing when transferring without your help, or once discharged.



### WEIGHT-BEARING

Progression for transfers can be done in this order:

- Sitting balance to sliding board transfer (if available)
- Sit to stand
- Pivot transfer using a mobility aid (walking or gutter frame)
- Ambulation (with/without walking aid) whilst respecting the weight-bearing status of each limb

Sliding boards are short in length, made of smooth wood and allow a person to transfer to and from a wheelchair. In conflict and disaster settings, you are unlikely to have sliding boards available but these can be manufactured locally. When planning transfer practices during rehabilitation treatment, remember that the patient may be transferring to the floor at home, especially if they are living in a tent, or sit on the floor for meals. Therefore, it is important to practice transfers according to the patient's home set-up.

Assistive devices for walking aids could include gutter/walking frames or elbow crutches/walking sticks. If these are not available, choose the device that best protects the patient's weight-bearing status, even if it restricts their mobility. In the early rehabilitation stage, it may be beneficial to use several people to assist with manual handling and mobility; this will ensure safe transfers, limit the duration of bed rest and reduce potential complications. Progressive standing exercises (e.g. weight transfer, stepping, gait and balance (static and dynamic) can also be performed during transfers.

A sling can be a helpful reminder for the patient to keep the upper limb non-weight-bearing while doing transfers. (see video of bilaterally non-weight-bearing slide board transfer – edge of bed, on board and in chair with staff member in front and behind).



### TRANSFERS AND MOBILITY

### Cardiovascular fitness and strength

Cardiovascular fitness and strengthening is important to avoid overall deconditioning. It can be achieved by: increasing sets and/or repetitions of sit to stand practice, sitting out of bed duration, and mobility practice. Pacing during this process is important as it can cause fatigue, therefore several short walks and sitting out more often for shorter durations to start with are recommended. Sitting out of bed for meals/dressing changes should also be encouraged.

### Electrotherapy

Electrotherapy is contraindicated in the presence of metal implants and practical challenges, such as limited electricity or single-use pads. A focus on active, functional rehabilitation and education to help the patient to self-manage at home is preferable. If there is a strong expectation that electrotherapy may form part of rehabilitation treatment in your setting, work with your patient to evaluate the limited benefits versus a more active treatment approach and jointly agree a plan.

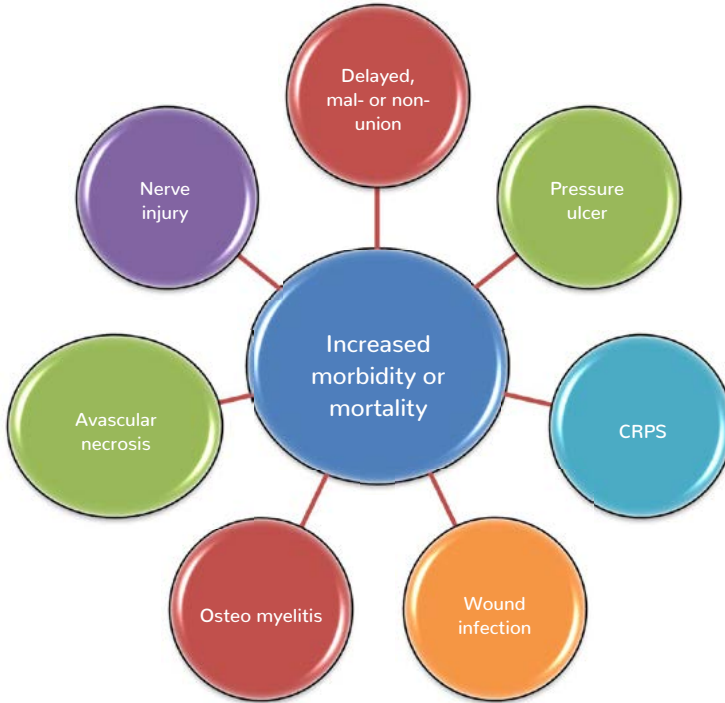
### Multidisciplinary team (MDT) communication

MDT communication is important for the management of fracture patients, therefore consider the following for your rehabilitation treatment:

- Join daily ward rounds and handovers with the orthopaedic team/nursing staff if they occur
- Give feedback to the orthopaedic team and ward staff after treatment sessions
- Plan the timing of rehabilitation sessions when the patient has received their pain medication, not during meals!
- Give feedback to the ward staff if pain medication seems too high or low for your rehabilitation activities
- Speak with family/caregivers present to increase carryover and adherence
- If possible, combine rehabilitation sessions with MDT duties, such as dressing changes, and encourage other team members to support the patient's rehabilitation treatment plan (e.g. encourage completion of exercises)

### Psychological considerations

It is important in conflicts and disasters to gather information on the mechanism of injury, including information about self-harm attempts, whether the incident involved fatalities and any signs of post-traumatic distress. In patients displaying or reporting emotional distress or psychological difficulties, consider onward referral to inpatient or outpatient mental health services, if available. Please refer to Chapter 3 for more information about psychological first aid.

**Diagram 3: Sub-acute or delayed presentation complications**

### Note



Note: You should always be aware of conditions in your patient that can masquerade as fracture complications regardless of the context, such as tuberculosis or cancer.

**Table 3: Sub-acute or delayed presentation complications**

Complication	Signs and symptoms (red flags)	Action to take
<b>Osteomyelitis</b> (infection of the bone)	<ul style="list-style-type: none"> <li>— Fever</li> <li>— Lethargy, malaise (or irritability in children)</li> <li>— pain, swelling, redness and a warm sensation over an area of bone</li> <li>— loss of range of movement</li> </ul>	Inform the medical team of your concerns.
<b>Malunion</b> (the bone heals out of alignment)	<ul style="list-style-type: none"> <li>— Deformity</li> <li>— Reduced functioning in the affected area</li> <li>— Discomfort</li> <li>— Pain</li> <li>— Swelling</li> </ul>	In cases where surgical patients are not followed up by surgical teams (which can occur in many conflicts and disasters) then arrange for orthopaedic review of the patient
<b>Non-union</b> (the fracture does not heal)	<ul style="list-style-type: none"> <li>— Continued movement at the fracture site beyond expected healing times</li> <li>— Reduced functioning in the affected area</li> <li>— Discomfort</li> <li>— Pain</li> <li>— Swelling</li> </ul>	In cases where surgical patients are not followed up by surgical teams (which can occur in many conflicts and disasters) then arrange for orthopaedic review of the patient
<b>Complex Regional Pain Syndrome (CRPS):</b> abnormally severe pain and reduced function that develops following injury. Type 1 (following injury or immobilisation without nerve injury) or type 2 (injury with nerve injury)	<ul style="list-style-type: none"> <li>— Continuing pain, allodynia, or hyperalgesia in which the pain is <b>disproportionate to any known inciting event</b></li> <li>— oedema, changes in skin blood flow, or abnormal sudomotor activity (sweating, abnormal hair or nail growth) or reduced range of movement in the region of pain</li> <li>— The exclusion of other conditions that would otherwise account for the degree of pain and dysfunction</li> </ul>	Consult the medical team and develop a joint treatment plan
<b>Avascular necrosis</b> – the death of bone due to loss of blood supply. Most commonly seen in sub capital hip, neck of talus and waist of scaphoid fractures.	<ul style="list-style-type: none"> <li>— Gradually worsening pain, in particular on weight bearing</li> <li>— Reduced range of movement in the affected joint</li> </ul>	Arrange urgent orthopaedic review

### Discharge planning or ongoing rehabilitation

While a complete discharge plan is unlikely to make up part of your acute rehabilitation of a fracture patient, it is still something to plan for from your very first assessment. Will the patient need onward referral, or assistive devices? These can take longer to organise and obtain in conflicts and disasters, so plan ahead. Consider the need for:

- Mobility aids, including wheelchairs (if appropriate to provide in the terrain you are working in)
- Home exercise programmes
- Family education and support
- Follow-up rehabilitation and orthopaedic outpatient appointments

If a patient needs to use crutches or a walking frame, ensure they are safely able to mobilise with them at the prescribed level of weight-bearing. If upper limb injuries are also present, be sure to check weight-bearing status before using walking aids. If the injuries are at the wrist or hand, modified gutter crutches may be suitable. Ensure the patient can safely stand up and sit down with crutches, can turn and can climb up and down at least three steps (more if appropriate). Keep in mind that not all assistive devices and walking aids are helpful in the environments you will be working in. If a splint is being used, check the section on splinting in the PNI chapter for relevant care and precautions.

## CASE STUDY

### Past Medical History

Mr Abukhair is a 34-year-old male who presented to the emergency room (ER) following an explosion, where he was thrown around 100m from the blast site. He was semi-conscious when he was brought to the ER after three hours of injury, with massive blood loss. He was immediately admitted to the intensive care unit (ICU) following initial conservative management. On investigation, a CT head scan revealed no abnormal findings, but AP, lateral and oblique x-rays confirmed multiple fractures: displaced pelvic fracture, bilateral femoral fractures and left tibial fracture. The patient's neurovascular exam was normal.

While in ICU, his treatment included:

- blood transfusions
- intramedullary (IM) nails of both femurs
- left tibia external fixation
- conservative management of pelvic fractures

After 18 days in the ICU, Mr Abukhair was transferred to the orthopedic ward. Bed rest was advised for six weeks, due to the pelvic fracture, with no movement at the hip joint permitted. He did not receive any rehabilitation treatment during his stay in the ICU.

**Social History:** Chronic smoker for 12 years and chews khat (a local stimulant).

**Family History:** 6 children. His brother is his main carer while he is in hospital.

### Physical examination

#### Pain assessment

**Numeric Pain Rating Scale:** 7/10 (in rest), 9/10 with slight movement

**Aggravating factor:** any movement in lower limb



**Relieving factor:** rest in supine position with slight abduction and external rotation of hip and medication

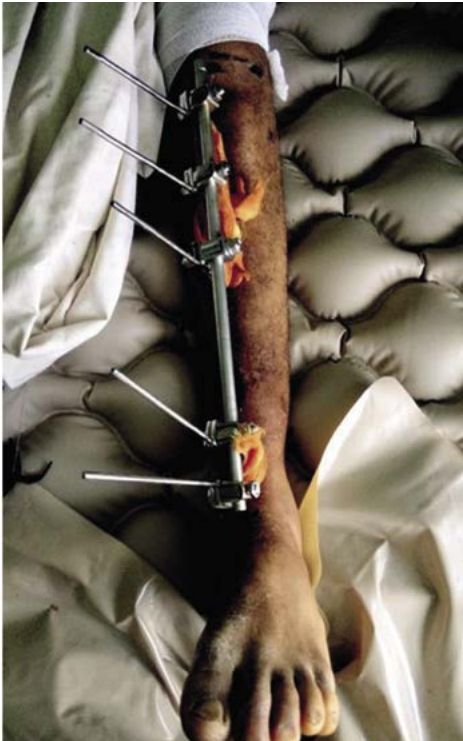
**Location of pain:** at the hip joint, knee and over the buttock areas

### Observations

- Lying in supine position with head slightly elevated, IV cannula and urinary catheter in-situ
- Long scar running along lateral site of bilateral thighs, bilateral quadriceps muscles wasting
- Bilateral lower limb swelling (from toes to knees), external fixator left tibia
- Obvious pain on movement of toes and ankles
- Dry, broken, pale skin over foot and ankle

### On examination

- Slight limitation in passive ROM in bilateral ankle and toes due to pain
- Dorsi flexors 3+/5 plantar flexors 4/5
- Active ROM, complains of pain but can attempt slight movement, not full range
- Unable to perform isometric quadriceps contraction due to pain 1/5
- Knee flexion; right 20 degrees, left 35 degrees



**Picture 9:** Patient with an external fixation



**Picture 10:** X-ray to show nails through bilateral femurs

## KEY POINTS OF THE CHAPTER

- Fracture rehabilitation in conflicts and disasters are frequently complicated by a complex poly-trauma presentation
- It is important to be aware of complications and red flags, which can arise alongside even simple fractures
- A thorough assessment, which includes a social history and joint goal setting with the patient, will enable you to prioritise your rehabilitation plan appropriately
- During immobilisation, whether because of traction, external fixation, POP or thermoplastic orthoses, the focus should be on maintaining strength, ROM and as much independent function as possible
- Provide advice to your patient regarding their return to activity and using the affected limb within the weight-bearing limits set by the medical/surgical team. These are likely to be conservative in the acute phase

### Core recommended text

*AO/OTA Fracture and Dislocation Classification Compendium* AO Foundation and Orthopaedic Trauma Association 2018. Available at: [https://www2.aofoundation.org/AOFileServerSurgery/MyPortalFiles?FilePath=/Surgery/en/ docs/A\\_OOTA%20Classification%20Compendium%202018.pdf](https://www2.aofoundation.org/AOFileServerSurgery/MyPortalFiles?FilePath=/Surgery/en/ docs/A_OOTA%20Classification%20Compendium%202018.pdf)

Management of Limb Injuries in Conflict and Disaster. ICRC 2016. <https://icrc.aeducation.org/>

## REFERENCES

*Physical agent modalities* (2nd ed.) Bracciano, A. 2008 Thorofare, NJ: SLACK Incorporated

*British Orthopaedic Association Standards for Trauma and Orthopaedics (BOAST)* (including diagnosis and management of compartment syndrome of the limb)  
Available at: <https://www.boa.ac.uk/standards-guidance/boasts.html>

*Fundamental of hand therapy: Clinical reasoning and treatment guidelines for common diagnoses of the upper extremity* (2nd ed.) Cooper, C. 2014 St. Louis, MO: Mosby

*Introduction to orthotics: A clinical reasoning and problem-solving approach* (5<sup>th</sup> ed.)  
Coppard, B. M. and Lohman, H. L. 2020 St. Louis, MO: Elsevier

*Fractures due to gunshot wounds: do retained bullet fragments affect union?* Riehl, J.T., Connolly, K., Haidukewych, G. and Koval, K., 2015. The Iowa orthopaedic journal, 35, p.55.

## CHAPTER 5

### EARLY REHABILITATION OF PERIPHERAL NERVE INJURIES

**AIMS:**

By the end of this chapter you should be able to:

- Demonstrate a basic understanding of peripheral nerve injury (PNI) pathology and classification
- Perform an assessment for a patient with a PNI
- Develop a problem list and a treatment plan for a patient with a PNI
  - Develop a realistic timeline of recovery and avoid secondary complications for a patient with a PNI



## CHAPTER 5

# EARLY REHABILITATION OF PERIPHERAL NERVE INJURIES

### INTRODUCTION

PNI are a very common presentation in situations of disaster or conflict and are one of the leading causes of long-term impairment. However, in conflicts and disasters, PNIs may be missed by the medical or surgical team as they prioritise working to save limb or life. Therefore, rehabilitation professionals may be the first to notice a PNI and should always look for this in their assessment of a patient injured in conflicts and disasters.

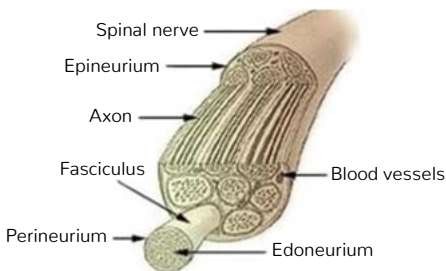
Patients with complex multi-trauma often present with PNIs as part of their injuries. Nerves can be injured in a variety of ways and to different levels of severity. In conflict and disaster settings, nerves may be compressed when a person is trapped under rubble, sliced by a knife wound or flying debris, or damaged by a blast. Note that a PNI can also be caused by viral infections, and as they require similar rehabilitation management, they will not be described separately in this chapter.

### Anatomy

Nerves can be motor nerves supplying muscles, or sensory nerves providing an area of skin with sensation, or mixed and doing both jobs. Injuries to peripheral nerves, therefore, will cause problems with power and sensation in the muscles and in the area supplied by that nerve. For example, injury to the nerves of the hand may make feeling and gripping delicate objects difficult, while injury to nerves in the leg may weaken or disable the dorsiflexion needed to lift one's foot off the ground when walking.

In conflicts and disasters, patients rarely present with only a PNI, and often have multiple injuries, most frequently fractures. Bony or vascular injuries must be treated and stabilised, e.g. immobilising a fracture, before the PNI is treated. Specific nerve repair or grafting surgery may be unavailable in conflict and disaster settings, but early rehabilitation management and advice to the patient can minimise complications and maximise their independent function.

A nerve consists of the axons of peripheral neurons, bundled into groups called fascicles. Each axon is covered in a protective layer called the endoneurium, and each fascicle, or bundle of axons, is covered in a further protective layer called the perineurium. The entire nerve is like a cable consisting of multiple fascicles and is covered by an outer layer of connective tissue called the epineurium. Nerves are also bundled along with protective fluid, and blood vessels which provide energy and nutrients to the nerve. It is worth noting that sensory information is transported in the outer layer of the nerve tissue, and so in compression injuries sensation is often more impacted than power or motor function.



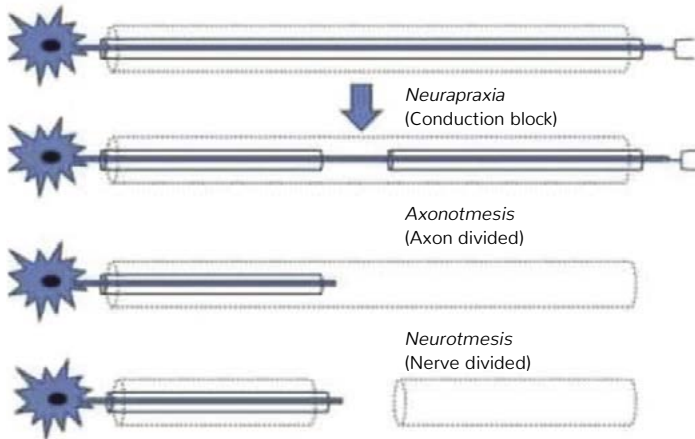
**Diagram 1:** Peripheral nerve anatomy

**Table 1: Common methods of injury to a peripheral nerve**

Compression	Laceration/cut	Traction/stretch
Compression injury may occur to the nerve when a person or a limb is crushed, e.g. trapped under debris in a collapsed building, or in compartment syndrome (see Fractures chapter), e.g. compression of the radial nerve with crushed/swollen arm	A laceration or cut (either fully or partially) to the nerve may occur if the person is injured by flying debris or a gunshot, or stab wound.  Nerves may also be accidentally cut during surgery, e.g. a misplaced fixator pin cutting the peroneal nerve	The nerve may be injured by being stretched beyond its limit if a person is pulled by the limb through rubble or a narrow space after a building collapse. E.g. brachial plexus during a difficult birth

### Classification of a PNI

Having some understanding of the level of injury to the nerve is necessary to predict the duration and extent of healing. There are two main systems of classification. Seddon's system divides nerve injuries into three broad categories, according to the level of damage, starting with injury to the 'lining' of the nerve tissue, progressing through to the nerve being completely severed.

**Diagram 2: Grades of Nerve Injury** (Seddon 1942)

Sunderland developed a classification system which added more detail. However, in conflicts and disasters it is unlikely that you will have the tests available to obtain enough information to apply Sunderland's classification.

**Table 2: Sunderland's classification**

Seddon	Sunderland	Nerve	Potential for recovery
Neuropraxia	1st degree	Usually caused by compression, the nerve is not permanently damaged. Patient presents with incomplete paralysis	Good likelihood of full recovery within eight weeks
Axonotmesis	2nd degree	The nerve has been partially damaged, with a larger portion of nerve fibres still working and a portion not working	Good likelihood of full recovery
Axonotmesis	3rd degree	Around half of the fibres of the nerve have been damaged and around half are still working	Potential for recovery, but will likely be slow, with less than 100% recovery. Surgery may be required
Axonotmesis	4th degree	The nerve has been partially permanently damaged, with the majority of nerve fibres not working and a small number still working	Requires surgical intervention
Neurotmesis	5th degree	Usually caused by laceration. Nerve is completely severed, and patient experiences complete paralysis and loss of sensation	Requires surgical intervention

### Nerve Recovery

For first-degree/neuropraxic injuries, the nerve has good potential to recover and conduct normally again with restoration of movement and sensation. With second-degree injuries, healing may be possible but slower, as the damaged nerve fibres need to repair and new nerve fibres must grow before movement and sensation can return to normal. For injuries of third degree and higher, surgery is required for recovery of sensation and motor function.

### Surgical intervention



#### Note

Note: Surgery to repair damaged nerves is highly specialised and may not be available in conflicts and disasters, or the available, limited surgical resources may be prioritised for life saving interventions

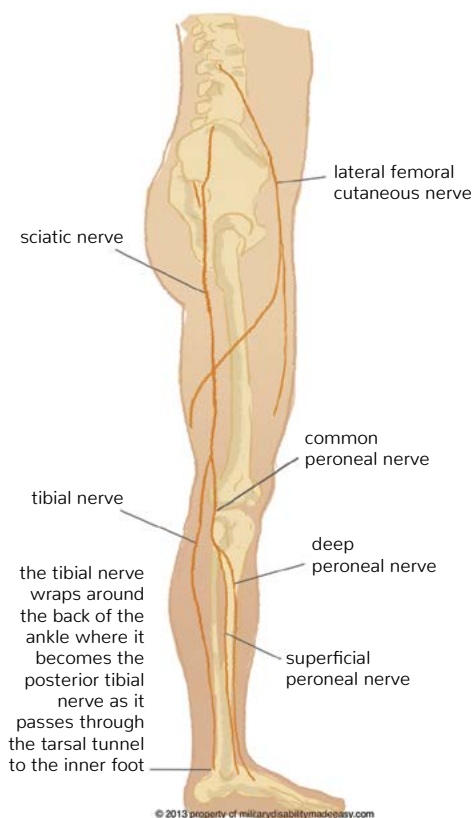
**Primary repair (end to end)** This approach connects the two ends of a severed nerve and is the ideal surgical option; however, this should be completed within the first few days of injury and without any stretch or tension through the repair site.

**Nerve grafting (to bridge gaps in nerves)** This approach can also be used. Autografts, whereby healthy nerve tissue is transplanted from elsewhere in the patient's own body, come in several forms, such as cable (several sections of small nerve grafts bundle into parallel lines), trunk (mixed motor and sensory nerves, often of larger diameter) and vascularised (sensory nerve donor, such as sural). Allografts (commercially processed scaffold) may also be used. Grafting can occur at a later date than primary repair, but must still take place within two years of the initial injury.

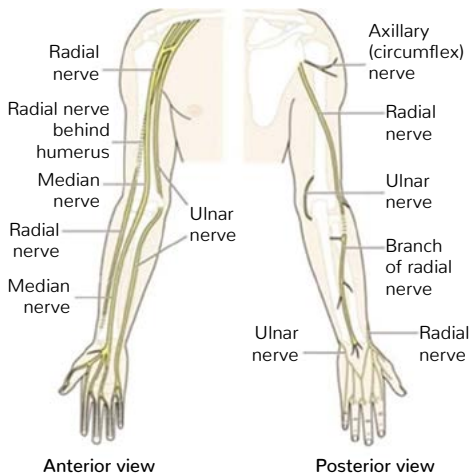
### Timeline of recovery

For neuropraxic injuries, (e.g. first degree) recovery will take place within six weeks on onset, or once the source of compression is removed. For example, in a limb with extensive swelling, once the swelling is resolved and this pressure on the nerve is released, the nerve should function normally again. For more significant injuries, such as second degree or higher, once the affected nerve is in continuity it will regenerate at roughly 0.5mm to 2mm per day. This regeneration will occur from the site of injury and moves distally. It will continue for roughly a maximum of two years, no matter what level of injury. This is important when planning how often you should reassess the patient, and when telling patients what to expect after discharge.

**Diagram 3: Lower Limb Nerves**



**Diagram 4: Upper Limb Nerves**



## Secondary complications

Secondary complications of PNIs are also a significant issue, some of which are discussed in greater detail in the opening chapters. Before discharge, or as a key part of treatment, the patient and their caregiver should be made aware of the following potential complications and how to avoid or minimise them:

**Loss of function** – PNIs can reduce the patient’s ability to complete basic daily activities, such as washing, dressing, cooking etc. Use of equipment, such as splints, or compensation strategies can help

**Swelling** – Due to reduced blood-flow and lymphatic drainage, limbs can become swollen and take a long time to resolve, leading to potential further neuropraxias and pain. Keeping the limb in a comfortable, elevated position and regular passive range of motion (ROM) and/or active ROM, as able, will help

**Contracture** – Due to muscle imbalance around a joint, contractures or fixed muscle shortening can occur within days. Keeping the limb in a neutral resting position through the use of a prefabricated or custom thermoplastic orthosis, and regularly moving the joints through their full ROM will help

**Burns/lacerations** – Patients with decreased sensation can easily burn or injure themselves through contact with hot surfaces or water or not using protective clothing, e.g. shoes. Test water with the opposite, or sensate limb, and always wear covered, supportive shoes if foot sensation is reduced

**Pressure ulcer** – Patients with limited sensation as a result of a PNI are at risk of pressure ulcers, which are harder to see on dark skin. Keeping skin dry, regular position changes and regular skin checks (use a mirror if necessary) will help

**Neuroma** – A non-cancerous thickening of nerve fibres made of non-conducting tissue which stops the signal from being sent along the nerve. Neuromas are a potential, limiting complication of nerve recovery which can cause pain or hypersensitivity; they usually do not develop until at least six weeks post-injury.

**Pain and hypersensitivity** – Can be bothersome and potentially lead to complex regional pain syndrome (CRPS) (see references below). Starting re-sensitisation training will help reduce the risk of this complication

**Slow healing wounds** – PNIs slows down the healing of skin; extra care must be taken with any other injuries in the affected area

**Mental health impact** – Depending on the severity of the nerve injury, the very slow healing or permanent loss of function can significantly impact your patient’s mental health as they adjust to life post-injury. Refer your patient to local mental health services if available and appropriate.

## Factors affecting recovery

You should be aware and inform the patient of certain factors or behaviours which can negatively affect the healing of a PNI.

**Diabetes** – Will significantly slow the recovery of a nerve. Consider this when planning re-evaluations and timelines of recovery

**Excessive pain reaction to a gentle stimulus (allodynia)** – Re-sensitisation training using materials the patient can access at home should be started early to try to minimise this complication, which limits rehabilitation

**Burns/fragile skin** – Creates difficulty in handling and moving the affected area and carrying out manual techniques, as well as increasing the risk of infection. Keep clean hands and be guided by the medical team



**Smoking** – Will significantly reduce blood flow and potential healing of the nerve

**Nutrition** – The patient should try to maintain a healthy diet and hydration with sufficient protein. This may be difficult in conflict and disaster settings.

## ASSESSMENT

The assessment of a patient with a PNI following a sudden onset disaster should follow the same format as a standard rehabilitation assessment. Part of the assessment specific to the peripheral nerve is to ascertain whether a muscle or area of skin is neurally intact, i.e. has a normal nerve supply to it, or neurally affected, i.e. the nerve supply to it is damaged. Due to possible multiple injuries, it may be difficult to complete a full assessment. If this is the case it is acceptable to complete only the parts of the assessment that are possible to do and which fall within your scope of practice.

At the end of the assessment you want to be able to produce a list of problems that your treatment will focus on, develop a treatment plan and be able to set some goals with your patient or their family, if possible.

More details for what should be included in your general subjective and objective assessment can be found in Chapter 3; the information below is specific to PNIs.

### Subjective assessment

**History of Presenting Condition (HPC):** If possible, find out how the injury was sustained, the mechanism of injury and previous treatments obtained, including any surgery

**Past Medical History (PMH):** Try to find out if the patient has had any previous surgery or medical conditions and any ongoing medical conditions; this may influence the rehabilitation outcome

**Social History (SH):** This is vital for a comprehensive rehabilitation plan. Consider:

- Who is their main caregiver or the most appropriate family member to involve?
- What was the patient's previous lifestyle, including work, housing and leisure?
- Do they have somewhere to be discharged to?

### Pain

Pain level assessment and treatment is essential, in order to make treatment more comfortable and meaningful. Medications for pain generated directly by the nerve include amitriptyline, gabapentin and pregabalin. You should be aware that these medications can take time to have a pain-relieving effect. Using a Visual Analogue Scale, where the patient rates their pain out of ten, is easy and repeatable, although it may be difficult to isolate pain related only to the nerve injury in a patient with multiple complex injuries. More information about general pain management can be found in Chapter 3.

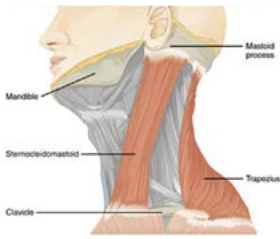

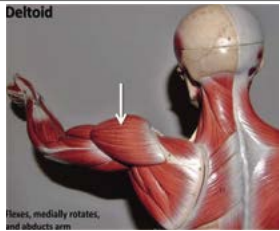
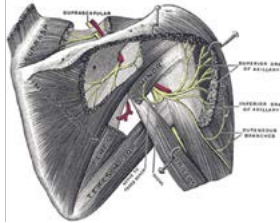
### Specific things to ask a patient with a PNI also include

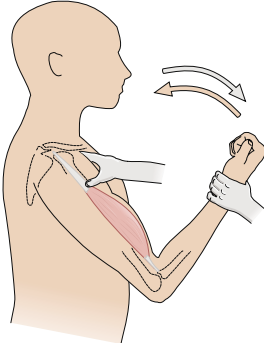


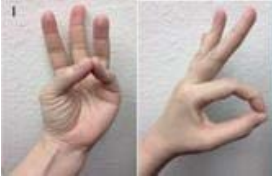
**Function:** Ask the patient how their function is affected, e.g. dressing, washing, working and caring for dependents. Hand dominance is important in hand and arm injuries and will influence the impact of any upper limb injury

**Sleep:** Ask the patient whether their sleep is affected by pain or their ability to get into a comfortable position at night. If sleep is impacted, finding a comfortable sleeping position should be an early treatment goal

**Sensation:** Ask about the presence of pins and needles, numbness and reduced sensation/feeling

**Table 3: Common Nerve Injuries and Their Clinical Presentation**

Common nerve injuries and their clinical presentation		
Nerve	Muscle/action affected	Test/positive sign
Spinal accessory nerve	Affects trapezius	 <p>Posture – scapula drops down and away from spine. Assess abduction. Test: hand behind back and lift hand away from back. (Can still shoulder shrug as levator scapulae is still operational)</p>
Long thoracic nerve	Affects serratus anterior	 <p>Scapula moves towards spine at rest. Scapula wings on movement</p>
Axillary nerve Commonly injured with shoulder fracture dislocation	Deltoid	 <p>Unable to maintain/create resisted abduction at 90 degrees</p>
Suprascapular nerve	Affects infraspinatus and supraspinatus	 <p>Assess glenohumeral joint external rotation</p>

Common nerve injuries and their clinical presentation			
<p><b>Musculocutaneous nerve</b></p>	<p>Biceps</p>	<p>MUSCLE TEST: BICEPS</p> 	<p>Inability to produce elbow flexion</p>
<p><b>Ulnar nerve</b></p>	<p><b>High level –</b> Ulnar flexor digitorum profundus, flexor carpi ulnaris</p> <p><b>Wrist level –</b> hypothenar, interossei, adductor pollicis</p>		<p>Inability to cross second and third finger and poor grasp and release</p>
<p><b>Radial nerve</b> Commonly injured with humeral fracture</p>	<p>High level – Triceps</p> <p>Wrist and digit extensors</p>		<p>Wrist drop is present</p>
<p><b>Median nerve</b> Commonly injured with supracondylar humeral fracture</p>	<p>High level – flexor pollicis longus, flexor digitorum superficialis</p> <p>Wrist level – thenar muscles</p>		<p>'OK' and pinch test</p>

Common nerve injuries and their clinical presentation

<p><b>Gluteal nerve</b></p>	<p>Gluteus medius</p>		<p>Trendelenburg sign</p>
<p><b>Femoral nerve</b> Commonly injured with hip, pelvic, acetabular fracture</p>	<p>Quadriceps</p>		<p>Difficulty straightening knee, or climbing stairs if subtle</p>
<p><b>Tibial nerve</b></p>	<p>Weak gastrocnemius</p>		<p>Inability to walk on toes</p>
<p><b>Peroneal nerve</b> Commonly injured with knee dislocation or fibular head fracture</p>	<p>Weak tibialis anterior</p>		<p>Inability to walk on heels</p>



## PNI SPECIAL TEST

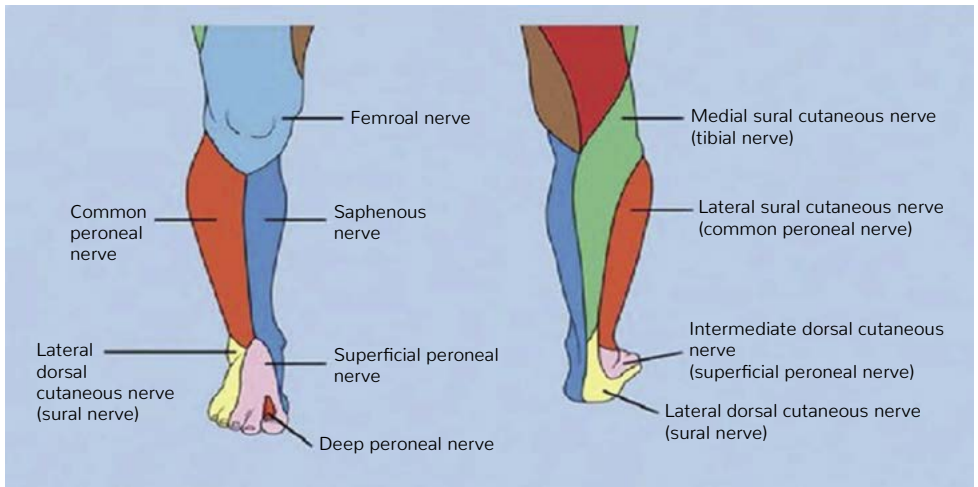
### Objective assessment

The primary aim of the objective assessment is to determine which structures are neurally affected and which are neurally intact, as well as identifying any secondary problems.

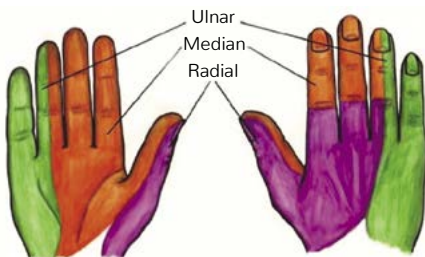
**Sensory testing:** As sensory information is carried on the outer, and therefore most vulnerable, circumference of the nerve, it is often the first area to be injured. A sensory test can serve as a quick check for nerve damage, in a setting where a full examination is difficult, e.g. in the presence of multiple fractures and an external fixator. See this video of a therapist examining a patient's ability to differentiate different sensations: <https://www.youtube.com/watch?v=JjibJqTppyg>

Testing by dermatome, that is, the area of skin sensation supplied by a particular nerve root or nerve, can give you specific information about which nerve is damaged. Note that there is some individual variance in dermatome and nerve supply across individuals.

### Diagram 5: Lower limb dermatomes



### Diagram 6: Ulnar, median and radial nerve distribution in the hand



## Motor testing

Major peripheral nerve injuries usually lead to severe muscle weakness and consequential atrophy, which can start 72 hours after injury. The neuromuscular junction undergoes significant changes after nerve injury and is the most critical point for functional recovery, even after proper nerve regeneration.

Beside the manual muscle testing examination, there are motor nerve function tests that can detect muscle weakness of upper and lower limb peripheral nerve injuries. Pick one muscle for each peripheral nerve, e.g., infraspinatus for suprascapular nerve. Use the Oxford Muscle Grading Scale to record strength. If the motor nerve is not conducting, the muscle will not activate properly, affecting the active movement, muscle tone and posture of limb. Check ROM in the joints above and below the affected area, as well as at the affected joint.

Choose at least one functional movement for the affected area, such as putting on a piece of outer clothing, brushing hair, sit to stand, getting in and out of bed. For lower limb nerve injuries, a timed walk test or Berg balance test are both quick and reliable. Videoing the gait on your phone or the patient's phone can be very useful for reviewing and referring back to at a later date. In an area with absent or reduced active movement, also assess the passive movement. If movement is present but weak, repeat a movement up to ten times to assess for fatigue. Lack of co-contraction at a joint causes instability and reduced eccentric control, e.g., reduced plantarflexion control with a drop foot.

Neural mobility, i.e. how much the peripheral nerve moves within the tissues, can be assessed by considering the path of the nerve and what limb movement will put it under stretch. The important factor is that the nerve glides backwards and forwards during a limb movement, and there are no sticking or tension points which can cause pain or restricted recovery. These sticking points are usually at a joint or when the nerve passes through soft tissue. Be careful to avoid over-stretching or tensioning the nerve (pins and needles will appear).

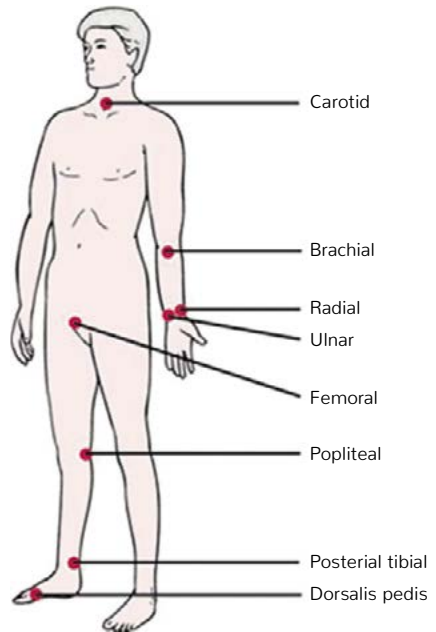
Assess the soft tissue through your handling of the area – palpate the tissues, feeling for tighter parts, spasm, shortening or flaccidity. Palpate all the soft tissues in the area, not just the neurally affected tissue.

Remember other structures may be involved, and be aware of any contraindications to movement when doing these tests.

## Peripheral Pulses

Peripheral pulses can be used as a valuable clinical tool for a suspected PNI, the diagram above illustrates the peripheral pulse sites:

**Diagram 7: Peripheral Pulse Sites**



**Table 5: Red Flags for PNIs**

**Red flags:** The following red flags are specific to PNIs only. You should always be aware of non-condition-specific red flags in your patient, such as infection. Refer to Chapter 3 for more information.

Signs or symptoms	Possible underlying condition	Action to take
Red, hot swollen limb, patient complains of severe pain which is worsened with passive movement	Compartment syndrome	Stop treatment, alert the medical team
Red, hot, swollen limb with lack of pulses. Patient complains of pain and shortness of breath at rest	Deep venous thrombosis or pulmonary embolism	Stop treatment, alert the medical team
Patient complains of severe pain; you may notice malalignment at the joint or abnormal bony movement or shape	Unstable fracture which has not been diagnosed, or immobilised	Stop treatment, alert the medical team
Bilateral pins and needles and numbness, weakness bilaterally in hands/feet, headaches and numbness around the head, severely reduced neck ROM. Fatigue inability to maintain head posture. Multisegmental weakness and multisegmental sensory changes	Unstable cervical spine	Stop treatment, alert the medical team

### Facial nerve damage

The facial nerve supplies the facial muscles, allowing for facial expression and movement. It does not supply sensation to the face. The facial nerve can be damaged by an injury to the face, head or neck. The facial nerve is the VII cranial nerve. It arises from the pons of the brainstem and exits the brain behind the ear. It lies next to the VI cranial nerve, which supplies the abductor muscles of the eye and the VIII cranial nerve, whose function is hearing and balance.

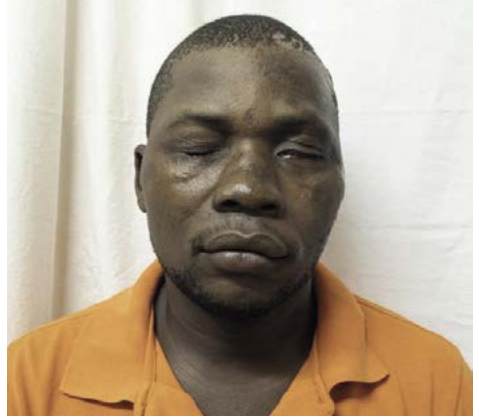
The facial nerve has four branches which supply the face; these are the forehead, eye, cheek and chin branches. If the facial nerve is damaged, one whole side of the face will droop. This is different to a stroke when only the lower half of the face drops. The facial nerve also supplies sensation to part of the tongue and the small bones of the ear.

If you suspect damage to the facial nerve, you can test the function by assessing the facial movements by asking the patient to:

1. Raise the eyebrows – if damaged the forehead will not raise/wrinkle
2. Close the eyes –if damaged the eye will not close or only partially close
3. Smile – if damaged the affected cheek will not lift
4. Push the lower lip forwards – the affected side will not move



**Picture 1: Patient with a facial nerve injury,**  
unable to lift the affected cheek when smiling  
© Davide Preti/HI



**Picture 2: Patient with a facial nerve injury,**  
unable to fully close the eye on the affected side  
© Davide Preti/HI

The patient with facial nerve damage will have difficulty in eating, drinking, talking, closing the eye to blink and sleep and showing facial expression.

Treatment in the early stages should include:

1. Eye care – teach the patient to tape the eye shut and use eye gel to protect it and prevent drying out
2. Support the cheek for talking drinking and eating, to assist the necessary muscle function, prevent drooling or slurring of speech
3. Avoid over activity in the unaffected side to decrease imbalance
4. As recovery occurs, gentle graded facial exercise to encourage normal movement to maintain muscle strength and ROM



## REHABILITATION TREATMENT

Rehabilitation treatment has two main aims in PNIs: restoring as much independence as possible and educating the patients and their caregivers about realistic expectations and management strategies. The process of rehabilitation should start from basic activities, such as ROM exercises, and then progress, e.g. applying a splint, re-sensitisation exercises. As long-term rehabilitation may not be possible in conflicts and disasters an important principle of effective PNI rehabilitation is supporting the patient with knowledge and exercises to independently continue their rehabilitation, after discharge.

### Aims of treatment

- Maintain active ROM and passive ROM of affected and surrounding soft tissues (agonist and antagonist) and joints
- Avoid movements or positions that could overstretch and traction the affected nerve
- Minimise neuropathic pain
- Minimise compensatory and abnormal movements, but allow function
- Minimise internal scar tissue
- Restoration of sensory and motor function
- Appropriate advice and education are essential for both patient and caregiver
- Prevent secondary complications

### Treatment

- Mobilise affected area frequently (4-6 times a day) with active and passive movements, with appropriate analgesia to reduce risk of contracture. Avoid this if there are injury-related contraindications, e.g. recent reconstructive surgery or un stabilised fracture
- Protect neurally affected area with splint, support or stick – to avoid further damage and reduce pain and maintain joint alignment
- Find comfortable position for rest and sleep
- Neural mobilisation – nerves are mobile tissue but should not be stretched to the point of inducing paresthesia (feeling a tingle). When mobilising the limb, think about gliding the nerve in a smooth movement
- Weight bearing – once fractures are stable, fixed or immobilised, weight bearing should be started as soon as possible for both arm and leg, to stimulate motor control and neural pathways
- Teach patient or caregiver to take over some elements of treatment if they can safely repeat it without your supervision (always check first). Patients should repeat treatment multiple times per day, in order to be effective, and be able to continue post-discharge
- Electrical stimulation/electrotherapy may be used in the treatment of a PNI, but only if it sits within your scope of practice, units specific to the treatment of a PNI are available and the patient can continue this treatment regularly, and under supervision. It is also not recommended for use in the acute phase of rehabilitation in conflicts and disasters

**Advice for caregivers**

- Do not ignore the area; stimulate and support the affected limb or area, but take care to avoid doing too much as stretching and overuse can cause pain and further damage
- Remember a PNI includes potential sensory loss, creating a risk for burns and pressure sores, which can appear within hours after the initial injury. Check the skin regularly
- Do not pull/drag on an affected limb, the traction can further damage a nerve
- Maintain passive ROM to avoid joint contractures and/or tissue shortening. It is important to find a comfortable resting position for the limb for sleep
- In the case of shoulder nerve damage, support the arm proximally, i.e. close to the body. Take particular care of areas with swelling
- When using splinting, ensure they are safe and competent with donning, doffing and skin care
- When washing, avoid water that is too hot and dry the skin area thoroughly afterwards, paying extra attention to skin folds between the fingers and toes
- Temperature and skin care in general: the person should always wear a shoe, avoid heat/cold (e.g. ice packs) in insensate/decreased sensation areas
- Be careful of small scratches which may not be felt or noticed, e.g. scratches from pets/thorns, which can develop into bigger wounds/infections if not noticed and quickly cleaned and protected

**The role and importance of splinting**

Using splinting to treat a peripheral nerve injury is important, but often challenging. All injuries to peripheral nerves result in possible motor loss and subsequent muscle imbalance creating the potential for further loss of function as surrounding tissues contract.

The objectives of splinting include protection of injured tissues, enhancement of a healing environment, prevention or minimisation of contracture formation, compensation for lost motor function and facilitation and enhancement of functional daily activities.

The prescription, fabrication, and fitting of a custom orthosis requires:

1. A strong understanding of the basic mechanical principles of splinting
2. Knowledge of the mechanical properties of splinting materials
3. Knowledge of deep and surface anatomy
4. Knowledge of the impact of compressive, tensile, and shear forces on the tissues
5. A thorough understanding of the pathophysiology, diagnostics, and treatment of a PNI

Therapists who use splinting should strive to practice with a 'minimalistic' approach, with emphasis on simplicity, cost accountability, flexibility and sustainability in the attainment of splint effectiveness. This method of practice promotes patient satisfaction and compliance. Splinting can be applied in many situations: while external fixation or traction is still used after primary surgery; while awaiting nerve suture/healing or recuperation after repair and as a compensatory measure for a permanent injury.

You may be required to provide splinting in both phases of recovery, acute repair and protection, and prevention or contracture and aiding function.

Splints for **acute repair and protection phase** should be simple.

In the acute phase, a severe nerve injury should be immobilised with easily available material, such as:

- A well-padded Plaster of Paris (POP) slab to prevent wrist drop for radial nerve palsy
- Arm sling in case of a brachial plexus injury to prevent subluxation
- A small improvised aluminium finger splints to prevent clawing of the fingers in ulnar nerve lesions
- Adhesive tape to hold the thumb in apposition during the night for median nerve lesions
- Night splints to hold the foot at right angles in sciatic and lateral peroneal nerve lesions.



### Note

Note: in certain settings, prefabricated wrists splints or ankle-foot orthoses (AFO) are available, such as:\

- POP volar wrist splint
- Prefabricated hand orthosis
- POP posterior foot slab or prefabricated ankle foot orthosis

### Splint for preventing contracture and aiding function

If at a later stage, an orthosis or cuff-shoulder sling is needed, where possible, patients should be referred to an existing centre, which can assess them and provide them with a custom-made orthosis and follow-up. Orthoses should be comfortable, fabricated from lightweight materials, easy to don and doff, aesthetically pleasing and convenient to use while remaining functional and applying the guiding principle of 'less is more'.



**Picture 3:** Example of a splint in neutral wrist position, and first web abduction to prevent contracture



AFO FITTING

Although orthoses for PNIs can be made anywhere with any available material, the process is extremely time-consuming, and the results may be poor. If a physical rehabilitation centre exists in the area, both dynamic and static splints should be manufactured there.

### How to care for a splint

The below information can help you in reviewing the patient and their splint, but educating the patient on the below principles of care must form part of your treatment.

**Checking:** When removing a splint, check for any red marks. If the marks fade within half an hour this is fine, but if they persist, the splint will need adjusting. If the hands are stiff after removing the splint, exercise each joint for a few minutes. Exercising the hand in warm water may also help.

**Washing:** If the splint is made of heat-sensitive materials, don't put it in hot water or leave it near heat sources, such as a radiator or on a sunny windowsill, because it will change shape. It is important to clean the splint using cold or lukewarm water with washing-up liquid or gentle soap.

**Adjusting:** If there are any problems with a splint you did not make yourself, then do not try to alter or adjust it. Contact the therapist or centre that delivered the splint. For children and teenagers, the orthosis needs to be adapted to their growth and patients should be followed up every three months.

When a patient receives a splint or an orthosis, you must advise them on a wear schedule (i.e. when and for how long to wear it). This is related to the severity of the nerve lesion and especially to the muscular activity. Although the aim of a splint is to support function, therapists need to be aware that often, splinting does not encourage active movement of the affected part.

Instructional video for application of POP wrist splint:

<https://icrc.aoeducation.org/videos/foot-and-anklefractures-and-sprains-lower-leg-backslab-splint.html>

Instructional video for lower leg POP posterior slab:

<https://icrc.aoeducation.org/videos/metacarpal-and-phalanx-thumb-spica.html>

### REHABILITATION TREATMENT OUTCOMES

Recovery after a PNI can be difficult to predict. Particularly in the first 7-10 days, it may be difficult to know the exact level of damage to the nerve, making it impossible to give exact timescales of recovery or non-recovery. The table in the classification section provides basic guidance on the likelihood of nerve recovery in an ideal situation. This does not take into account other factors which may reduce the recovery potential of a peripheral nerve. These additional factors should be kept in mind when you are assessing and advising your patient. Factors which may limit, or slow potential nerve recovery are often very similar to any other health factor which will affect tissue healing, particularly diabetes, vascular conditions, advanced age, reduced immunity and poor nutrition or smoking. In addition to these factors, recovery following a PNI will also be affected by delayed treatment, poor patient understanding of the injury and poor adherence or access to an ongoing rehabilitation plan. To provide the best possible chance for maximum recovery, early identification of a PNI (first 7-10 days) and, if possible, re-assessment every six weeks should be planned to ensure early identification of injury, early patient education and effective monitoring of progress or complications.

## CASE STUDY: LOWER LIMB

### Background

Ahmed, 22 years old, presents with a gunshot injury to his right lower limb from an exploding sniper bullet from a distance of about 200m. He has an open wound with a displaced, comminuted, medial shaft tibia and fibular fracture and there was no information about possible nerve or vascular injury. Ahmed came to the emergency department with temporary immobilisation and primary wound care was administered. The initial medical plan was to maintain immobilisation until surgical wound debridement and application of external fixator is possible.

### Rehabilitation assessment

**Subjective assessment:** Ahmed is married and a father of three children; his wife is currently seven months pregnant. He arrived at the hospital unaccompanied by any family member or friends. Ahmed lost his job as a first-aid provider four months ago and has now been given the opportunity to start a part-time job as a health assistant in two weeks' time. He lives with his family and parents-in-law, both older and partially dependent on him. He lives in a fourth-floor flat of a roughly finished building (shared shower on the ground floor, plastic sheets on the windows, no stairs, and handrail). Ahmed regularly helps his brother-in-law to cultivate a small piece of earth, where the family grows vegetables to support their difficult economic situation.

**Objective assessment in emergency room:** Ahmed is lying in bed with no mobility aid available; he is conscious and alert and consents to assessment. Noted open wound on the back of the right leg. Swelling (toes, dorsal aspect and malleolus and skin area surrounding the wound) and pale skin colour of the toes are also noted. There is a lower temperature of the toes and dorsal part of the foot, as compared to the other side.

- Sensation: loss of light touch sensation on the sole and lateral part of the foot, decreased sensation on the top part of the foot
- Toes active flexion: M0, toes active extension: M2, ankle dorsal flexors and plantar flexors unable to test due to fracture immobilisation
- PROM toes: complete, but with pain. ROM ankle and knee unable to test due to fracture immobilisation
- VAS of injured site: 7/10
- Possible vascular compromise, further investigation needed once stabilised

### Objective assessment 24 hours later, after surgery with wound debridement and tibial

**external fixator application:** Ahmed lying in bed, no mobility aid available. Conscious and alert, consents to assessment. Noted increased oedema throughout right lower leg and pale skin colour of the toes ( no change after 24 hours)

- Sensation: loss of light touch sensation on the sole of the foot, strong sensation of pins and needles on the lateral part of the foot
- Toes active flexion: M0, toes active extension: M2, ankle dorsal flexors: M2, ankle plantar flexors: M0, foot inversion: M0, foot eversion M2
- Pedal pulses and capillary normal bilateral lower limbs.

- PROM toes: full range but with pain. PROM ankle and knee: full ROM
- VAS of injured site: 5/10
- Red flag: vascular injury excluded after surgical evaluation

### Clinical impression

22-year-old patient with comminuted right side tibia/fibula fracture treated with external fixator. Suspected partial tibial nerve injury and potential partial peroneal injury, with more severe involvement of the tibial nerve. (Complete nerve injury not suspected due to maintenance of at least some sensation). Nerve damage resulting in lack of ability to heel raise/push-off when walking. Lack of plantar flexion and inversion affecting stability of the ankle, resulting in risk of further soft-tissue injury. Ankle movement allowed with position of external fixator. Wife and caregiver will help with facilitating treatment and follow-up/care at home.



**Picture 4:** Patient with External fixation right tibia/fibula; right ankle swollen and patient unable to plantar flex right toes

### Treatment goals

\* Do not use electrical stimulation in the presence of an unhealed fracture or metal work

- Make the patient aware of implications of the ongoing loss of sensation on the foot
- Begin to normalise the hyperesthesia (tingling) on the lateral part of the foot and toes (may take up to the next eight weeks)
- Prevent ROM limitation in ankle and toes, prevent muscle weakness of leg (immediately)
- Decrease pain and adequate pain management
- Being able to walk with two elbow crutches in and outside with weight bearing (as per post-op instructions) for at least 300m independently within seven days in order to safely discharge home
- To be able to climb up and down stairs with elbow crutches twice daily in order to safely discharge home

### Long-term goals (within six months)

- Regain significant improvement to full power in plantarflexion, inversion and toe flexion, plus normal sensation
- Return to walking independently without aids
- Return to work as a health assistant
- To be able to care for new baby, help brother with food provision and take care of family duties
- Reassessment of injury to determine severity of nerve injury, i.e. neuropraxia or neurotmesis

### Treatment approach

- Desensitisation and re-sensitisation techniques with different materials
- Adapt shoe (padding or foam) to wear on the affected foot
- Passive ROM and active ROM exercises, including strengthening glute and core exercises, e.g. bridging
- Transfers training and progressive safe gait training ensuring heel-toe walking pattern and retraining on different surfaces, e.g. uneven gravel, grass etc., practising stairs
- Intrinsic foot exercises, e.g. picking up a tissue with toes

### Education

- Explanation of recovery timing of a neuropraxia or axonotmesis: good possibilities to recover but not 100% assured. Re-evaluation of the symptoms after eight weeks will give a better picture of the final outcome and degree of lesion
- Positioning of the foot during lying (no heel contact, use pillow) and sitting position (ankle 90 degrees) with foot on the ground and padded shoe
- Importance of foot ground contact while walking, respecting medical prescriptions on weight bearing
- Regularly check the skin of the foot on the top and plantar part, with special attention to the heel
- Wash the foot in lukewarm, clean water daily and drying it well. Keep pin sites dry and clean, monitor for signs of infection (heat, swelling, redness, pain)
- Continue three times daily with active and passive ROM and neural mobilisation exercises, as per instruction received

### Outcome

On discharge (after seven hospitalisation days), Ahmed has good active ankle mobility in dorsiflexion (M3+) but needs to improve his active plantar-flexion (M1+), for which he received a home programme. He is also following the instruction on daily exercises for passive ROM to maintain ankle and toes mobility with the help of his wife, who has been trained accordingly. Ahmed is independently mobilising with two crutches, but from time to time he walks barefoot, which he has been told is a dangerous habit. He knows that he has decreased sensation on the sole of his foot and because of this, he is very susceptible to injuries, especially when he goes to the field with his brother-in-law. He has been informed that improvement/normalisation of sensation

and muscle activity might take a long time and encouraged to continue to adhere to the advices and the home programme. He is able to climb stairs independently and safely, which allows him to be independent in reaching the shower and to go out of his house (see pictures)



**Picture 5:** Patient completing strengthening exercises with external fixator in situ

## CASE STUDY: UPPER LIMB

### Background

Ten days ago, twenty-six-year-old Mahmoud sustained a penetrating wound to the back of his right arm when he was hit by a piece of metal roofing during storm-force winds in a cyclone which hit his island community. He was able to access initial medical treatment at the central hospital where the wound was cleaned and an external fixator was applied to stabilise a multi-fragmentary, midshaft humeral fracture. As he was otherwise medically stable, he was discharged and asked to attend rehabilitation as an outpatient the following week for wound assessment and rehabilitation.

### Rehabilitation assessment

**Subjective assessment:** Subjective assessment is difficult, as Mahmoud is in severe pain and distressed that he has been unable to locate his wife or two children since the cyclone. He is currently living in a temporary shelter set up by an international NGO and attends the clinic alone. Prior to the cyclone, he supported his small family by providing a taxi service in the local area. Mahmoud is left-handed with no past medical history or mobility issues. Mahmoud reports severe pain (VAS 10/10) along the back of his arm, combined with numbness to the top of his hand, around the thumb area. The pain is particularly bad at night and he experiences difficulty sleeping. Since his injury, he has experienced difficulty moving the right arm but reports that this has become more isolated to extending the wrist and digits since the surgery. Although it is difficult, Mahmoud reports he has been using only his left arm as he has been worried about the symptoms and thinks something has gone wrong with his right arm.

**Objective assessment:** Patient seated with right arm supported by left across his body (protective posture). External fixator to right humerus with clean pin sites and healed wound with no evidence of infection. Slight swelling present to right hand but normal temperature and colour to skin throughout right arm

**Sensation:** Total loss of sensation to top of right thumb. All other areas sensate but hyperalgesia present active movement: full movement of neck and unaffected left upper limb. Right shoulder movement limited by stiffness and pain but motor function intact. Elbow extension, forearm supination, wrist extension, finger and thumb extension M0. All other muscles throughout the right upper limb M4 limited by pain

**Passive movement:** Stiff end ROM of elbow, wrist, finger and thumb extension

**Function:** Unable to position right hand to grip any item with pressure

### Clinical impression

26-year-old, right-hand dominant patient with multi-fragmentary, open, midshaft humeral fracture managed with external fixator. Suspected radial nerve injury potentially sustained at time of initial injury or intra-operatively. Neurotmesis suspected due to location and mechanism of injury, total numbness and motor loss in radial nerve distribution. High pain levels limiting rehabilitation options currently with ongoing potential to significantly impact function and mental health. Lack of active wrist, finger and thumb extension limiting ability to position hand to grasp objects, despite ability to flex digits. Significant risk for secondary joint contracture, allodynia and long-term reduced function.





**Picture 6:** Patient with external fixator to right humerus

### Treatment goals

**Short-term:** Decrease pain and adequate pain management to aid sleep, improve ability to accurately assess patient and improve patient's ability to follow a treatment plan. Improve patient's understanding of peripheral nerve function and why he is experiencing his current symptoms to improve trust and allow him to participate in his rehabilitation without fear of further harm. Make the patient aware of the safety implications of the loss of sensation to the back of the hand. Regain full passive ROM at all joints in the right arm. Provide a splint to improve wrist position and allow functional grip. Encourage patient to use right hand/arm without fear of harm. Organise re-assessment in the next six weeks to review any evidence of radial nerve recovery; i.e. neuropraxia or neurotmesis.

**Long-term:** Resolve or manage nerve pain effectively if this pain has continued. Prevent flexion contractures at the elbow, wrist, fingers and thumb to maintain any function and improve outcome if secondary surgery is available within the next two years, as neurotmesis suspected. Maintain splint to assist in function.

### Treatment approach

- Advice on positioning for comfort with arm supported and hand elevated to reduce potential for swelling. Patient not to sustain this protected position for long periods, as flexion contracture is a risk
- Advice to take nerve pain medications as prescribed, to improve ability to sleep, manage rehabilitation and use his hand and arm
- Desensitisation techniques, once nerve pain medication started
- Wrist extension splint with advice to remove regularly to prevent loss of wrist flexion ROM and power. Teach functional grips with splint on and encourage use of right arm
- Passive ROM and active ROM exercises to treat initial stiffness, prevent contracture and build strength in unaffected muscles. Link with medical team to communicate evidence of radial nerve injury
- Establish plans for timescales for removal of external fixator

**Education:**

Explanation of radial nerve injury and nerve pain as patient only aware of fracture. Re-evaluation in 6-8 weeks important to determine neuropraxia or neurotmesis, but patient should be aware that the chances of long-term injury are high. Accessing nerve pain medication extremely important to manage sleep and ability to comply with rehabilitation. This medication may not work immediately but the effects will build up over time.

Regaining passive movement and preventing flexion contracture at elbow, wrist, fingers and thumb. Maintaining full ROM and power of unaffected muscles will not cause harm. Use of a wrist splint to assist with function and help prevent contracture. Advice regarding regular removal of splint to monitor any pressure areas (particularly at numb base of thumb) and to allow full active wrist flexion. Continue exercises at least three times daily.

**Outcome**

After the rehabilitation session, Mahmoud understands the two parts of his injury; the humeral fracture and the radial nerve injury. He understands the nerve pain he is experiencing and has a plan of how to source specific nerve-pain medication with the medical team. Mahmoud will work on his ROM himself, now he is no longer worried about causing more damage and wants to prevent any further complications. He is able to put his wrist splint on himself and can see that he is now able to make a fist and grasp objects. He understands he needs to return to the clinic for another assessment to see if his nerve is showing any signs of recovery, but he is aware there is a significant chance he will be unable to actively extend his elbow, wrist, fingers and thumb long-term.

---

## KEY POINTS

---

- Investigations to diagnose the severity or type of PNI are often unavailable in conflict and disaster settings and education and treatment to preserve function should be started immediately in all nerve injuries. Reassessment at six weeks will show improvement in the case of neuropraxia, otherwise regeneration of nerve healing is slow (max 2mm per day) while lacerations require surgical repair
- PNI's may be missed in the case of poly-trauma, and as the rehabilitation professional, you may be the first to assess and treat a PNI
- Treatment of a PNI should include information and education to the caregiver and patient about potential risks arising from impaired power and especially sensation

**Core recommended text**

Further information related to CRPS is available at: <https://www.mayoclinic.org/diseases-conditions/complex-regional-pain-syndrome/symptoms-causes/syc-20371151>

## KEY REFERENCES

*British Orthopaedic Association Standards for Trauma and Orthopaedics (BOAST) (including diagnosis and management of compartment syndrome of the limb)* Available at:

<https://www.boa.ac.uk/standards-guidance/boasts.html>

*Fundamental of hand therapy: Clinical reasoning and treatment guidelines for common diagnoses of the upper extremity* (2nd ed.) Cooper, C. 2014 St. Louis, MO: Mosby

*Peripheral Nerve Injury. An Anatomical and Physiological Approach for Physical Therapy Intervention* Stephen J Carp, 2015. F.A. Davis Company

*Occupational therapy for physical dysfunction* (7th ed.) Radomski, M. V. and Trombly Latham, C. A., 2014. Philadelphia, PA: Wolters Kluwer/Lippincott Williams and Wilkins

*War surgery. Working with limited resources in armed conflicts and other situation of violence* Giannou G., Baldan M., Molde A. Vol. 2

---



## CHAPTER 6

### CHAPTER 6: EARLY REHABILITATION OF AMPUTEES

**AIMS:**

By the end of this chapter, you should be able to:

- Gain an understanding of an amputation
- Carry out an assessment of a patient with an amputation (pre- and post-amputation phase)
- Understand the complications associated with amputations
- Provide early rehabilitation for a patient with an amputation



## CHAPTER 6: EARLY REHABILITATION OF AMPUTEES

### INTRODUCTION

In conflicts and disasters, limb amputations are usually performed due to conflict-related trauma (i.e. weapon-related injuries) or disasters (i.e. crush injuries). The decision to amputate, as opposed to attempt salvage, will be based on person-related factors (i.e. the affected limb's vascular, neurological, soft tissue and bone condition, the person's general health, etc.) and on environment-related factors (the facility, level of post-operative and rehabilitative care, accessibility of prostheses and/or wheelchair services, etc.). General indications for amputation include severe tissue damage, vascular injuries (in the absence of vascular reconstruction capabilities) and overwhelming infection. Of note, non-communicable diseases, including diabetes, are just as much of an issue in conflicts and disasters as in other contexts – and continue to contribute directly to amputations.

Lower and upper limb amputations are defined by the level at which they occur.

**Diagram 1: Lower and Upper Limb Amputations**

#### UPPER LIMB

SD/Shoulder  
Disarticulation

ED/Elbow  
Disarticulation

PH/Partial Hand  
(transcarpal)

Forequarter  
(Amputation of the arm,  
scapula and clavical)

AE/Above Elbow  
(Transhumeral)

BE/Below Elbow  
(Transradial)

Hand and Wrist  
Disarticulation

#### LOWER LIMB

HD/Hip Disarticulation

KD/Knee Disarticulation

AD/Ankle Disarticulation

PF/Partial Foot  
(e.g. Chopart)

Hemipelvectomy  
(Amputation of the  
leg and pelvis)

AK/Above Knee  
(Transfemoral)

BK/Below Knee  
(Transtibial)

Syme's

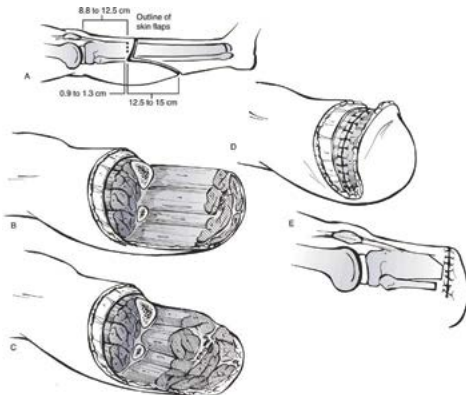
### Factors that are considered when selecting the level of amputation:

- The potential for healing of the stump
- Patient's general condition
- The risk of additional surgeries
- The fitting of the prosthesis (if the patient is likely to be a candidate for prosthetic rehabilitation)
- The probable functional outcome
- Length of viable tissue and bone
- The age of the patient

### For an optimal use of a prosthesis, it is important that the stump is:

- Sturdy and well-padded with ample muscular soft tissue to distribute the shearing stresses of weight bearing evenly
- Muscularly balanced, so that agonist and antagonist muscle groups counteract each other to prevent joint deformity or contracture
- Not affected by any deformity or contracture
- Free of pain

In conflict and disaster settings, the incidence of lower limb amputations is typically higher than that of upper limb amputations. Of lower limb amputations, transtibial amputation is the most common procedure performed, followed by transfemoral amputation. For upper limb amputation, transradial amputation is most commonly performed, followed by transhumeral amputation. In general, the level of amputation should be at the lowest possible level of viable tissue. For lower limb amputations, for each joint and muscle lost through amputation and subsequently replaced by prosthetic components, there will be a greater loss of function, a greater degree of impairment and the energy expenditure and oxygen consumption required to mobilise will increase. Although a longer stump is better for the patient's prosthetic gait, length should not be gained at the expense of compromising stump healing. In the case of paediatric patients, knee disarticulation is preferable to transfemoral amputation wherever possible, as this will preserve the growth plate at the distal end of the femur, allowing for more proportional bone growth and preventing terminal bony overgrowth.



Picture 1: Transtibial amputation (long flap)



Picture 2: The residual limb (stump)

In conflicts and disasters, wounds tend to be contaminated by a variety of environmental organisms and foreign matter, with crushed and devitalised tissue providing a medium for bacterial growth and infection. When amputation is needed, the most successful surgical technique is often based on a staged approach that includes repeated debridement and delayed primary closure (DPC) of the wound, in order to minimise infection and sepsis. In such cases, DPC and concurrent injuries (very often, patients sustaining amputation will also sustain other injuries), will have a major influence on the treatment plan and timescale for rehabilitation.

In conflicts and disasters, guillotine amputations are still occasionally seen. The guillotine amputation is a procedure in which all the tissues are cut at the same level. This type of amputation eventually requires a closed amputation performed at a higher level. Further management will depend on timing and the state of the wound. Guillotine amputation is not recommended, due to the need for further surgical revision in order to achieve wound closure, which inevitably requires further shortening of the limb. Exceptional circumstances which may demand a guillotine amputation include when the procedure is required for extraction (i.e. to enable a person to be removed from underneath collapsed structures).

## MYOPLASTY AND MYODESIS

It is important that the rehabilitation professional is aware of which surgical technique has been used in reference to the muscles, as this will also affect early rehabilitation priorities.

**Myoplasty:** The agonist and antagonist muscles are sutured together to maintain some of the muscle function.

**Myodesis:** Muscle fascia is sutured to bone through drill holes, which provides a very stable stump. From a rehabilitation perspective, myodesis is far better for improved control and less redundant soft tissue in the adductor region. It is the preferred surgical technique, but a lengthier procedure.

Providing rehabilitation for amputees in conflicts and disasters is challenging. Therapists will face issues including limited clinical experience, limited multi-disciplinary team (MDT) input or support, a lack of equipment, and, in many cases, a lack of access to specialist services, such as prosthetic services. Physical therapists (PTs) and occupational therapists (OTs) can, however, greatly influence the patient's independence and safety on discharge, and prepare them for potential prosthesis use.

### Rehabilitation for patients with amputations

Rehabilitation is focussed on preventing complications and optimising functional independence and mobility. For patients sustaining amputation, the rehabilitation process is divided into four phases:

- Pre-amputation phase
- Early rehabilitation phase (divided in post-amputation and pre-prosthetic stages)
- Prosthetic rehabilitation phase
- Post-rehabilitation phase.

This chapter will focus on the first two phases. However, some basic information will be given at the end of the chapter on the prosthetic rehabilitation and post-rehabilitation phases.



Rehabilitation after an amputation is a complex task, and to ensure the best outcome it is important to:

<b>Adopt a person-centred care approach</b>	Patients and caregivers should be equal participants in the rehabilitation process in order to ensure rehabilitation services are responsive to the individual's needs, environment and preferences
<b>Adopt a MDT approach</b>	Team members should share goals and overlap practice. The ideal core team would include the surgeon, physical therapist, occupational therapist, mental health professional, prosthetist, a nurse and the patient and their family/caregiver. In conflicts and disasters such MDT work is a challenge. Input from all professionals may be limited – but there are often particular shortages of professions, such as mental health professionals and occupational therapists. Where possible, therapists should seek out such support, but should be aware of some basic skills and strategies they can utilise in their absence
<b>Make the correct decision about long-term prosthetic use, based on the individual's circumstances</b>	The decision of whether or not a prosthesis is suitable for the patient should be made at the correct time (not too soon), with all available information and the consent of the patient. If the patient is not ready for prosthetic gait training as soon as the amputation has healed, for whatever reason, then the pre-prosthetic phase continues until a definitive decision is made. Availability of prosthetics in conflicts and disasters may be limited or unclear in the first weeks and months of the emergency, with backlogs for fitting (where they are available) being common. Note that service provision can change following an emergency, with organisations such as HI and ICRC being skilled in rapidly expanding services
<b>Facilitate and emphasise self-management</b>	Provide the patient with the rehabilitation education and self-management skills needed for optimal long-term functional outcomes and to minimise complications. This is particularly important in conflicts and disasters, where professional input can be limited. It should be focused on self-management in conflicts and disasters.
<b>Ensure proper care of the stump</b>	The principal function of the stump is to serve as the lever to control the prosthesis. Therefore, it is critically important to ensure proper care of the stump and to prevent any contractures that may prevent the use of a prosthetic
<b>Manage the emotional response</b>	An amputation drastically alters an individual's life and causes permanent physiological change, as well as psychological and emotional distress. The psychological impact of a traumatic amputation can cause the victim to display some, or all, of the stages of grieving: denial, anger, bargaining, depression and acceptance

At times, therapists involved in early rehabilitation will only see patients with amputations until the time of their discharge from acute surgical wards, meaning they may not be involved in the later rehabilitation phases. Rehabilitation follow-up may be uncertain. Despite these challenges, PTs and OTs have a critical role in these settings and can significantly influence patient outcomes, even if a dedicated rehabilitation unit or prosthetic service is unavailable. By focussing on safe mobility, preparing the stump for prosthesis use and minimising complications, PTs and OTs can influence the patient's independence and safety on discharge, and prepare them for potential prosthesis use. This chapter is therefore structured to support therapists through the early phases of the rehabilitation process, regardless of where their interventions with patients might end.

## Pre-amputation phase

It is now recognised that, in conflict and disaster settings, the decision to amputate following severe limb injury, where there is no immediate threat to life, can be delayed. Delaying amputation can save vital theatre time in the midst of an emergency and allows time to ensure the right decision is taken, that the procedure is planned appropriately using all available environmental and contextual information (including availability of local prosthetic and rehabilitation services) and completed with the patient's and family/caregiver's informed consent. PTs and OTs must be actively involved in the pre-amputation phase wherever possible. The objectives of the pre-amputation phase are:

1. To contribute to the MDT surgical planning process
2. To complete a holistic baseline assessment of patient
3. To prepare the patient for what they can expect and help to alleviate anxieties about post-operative treatment and long-term rehabilitation
4. Observe the patient's psychological/emotional status and refer for support if required
5. Ensure familiarity with locally available services which the patient (or family and caregivers) will require (prosthetic, wheelchair, psychological, psychosocial, etc.)

Completing a comprehensive initial assessment will support goal setting, aid early identification of potential barriers to use of a prosthesis and provide an insight into the patient's acute stress response and coping style. Discharge planning should, if possible, commence pre-amputation, in order to ascertain if the patient will face significant environmental obstacles upon leaving the hospital or health facility.

## ASSESSMENT

Refer to Chapter 3 for details of a generic assessment. Amputation specifics are as follows:

### Subjective assessment

- **History of Presenting Condition:** mechanism and date of injury, other injuries, surgical procedures or surgical plans and any restrictions or precautions
- **Past Medical History:** pre-injury function, pay attention to diabetes and other factors that may impair healing, and physical ability/fitness, as this will have an impact on ability to use prosthetics
- **Social History:** pre-injury occupations and responsibilities (i.e. work, leisure activities, family roles), hand dominance (i.e. right- or left-handed) for upper limb amputees, discharge destination and details regarding accessibility/supports available/proximity to health and disability services
- **Medication History:** it is important to establish effective pain control as early as possible and to check that the patient has access to medication needed for other health conditions
- Other specific things to consider:
  - Psychological/emotional response to current situation, understanding of amputation procedure and what will happen to them
  - Attitudes and beliefs (cultural considerations), particularly regarding amputation and disability
  - Patient's own priorities for their recovery and rehabilitation

## Objective assessment

The following must be considered:

- Age of the patient (i.e. potential for further physical growth and considerations for level of amputation, need for frequent prosthetic reviews)
- Medically stable and psychologically ready to begin active rehabilitation
- Other injuries (i.e. soft-tissue injuries, fractures, traumatic brain injury)
- Status of remaining limbs (i.e. strength, ROM, sensation)
- Pressure injury risk, compartment syndrome (see fractures chapter)
- Psychological status (i.e. evidence of acute stress response, coping style)
- Nutritional status (i.e. risk of malnutrition, need for dietary support)

If time and the clinical setting permits, clinical progress and outcomes can be measured through the use of functional outcome measures (see Chapter 3) and a combination of objective measures, including range of movement, manual muscle testing, circumferential measurements of stump size/oedema and visual analogue scales for pain. These measures should not interfere with focussing on observations of functional ability and goals, however, as achieving optimal functional independence must take priority in early rehabilitation in conflicts and disasters.

## Other key pre-operative aims include:

Aim	Achieved by:
Contribute to the MDT surgical planning process	Considering the following factors that may influence amputation level decision-making: <ul style="list-style-type: none"> <li>— Co-morbidities that would make the patient unable to tolerate prosthesis</li> <li>— Age: (including the considerations of knee disarticulation versus trans-femoral amputation)</li> <li>— Cognitive impairments that preclude learning to use a prosthesis</li> <li>— Impaired sensation, chronic pain or arthritic conditions affecting remaining joints</li> <li>— Upper limb impairment</li> <li>— Types and availability of prosthetic technology and/or wheelchair services nearby</li> </ul>
Address pre and post-amputation pain management plan	Understanding, through discussion with the surgical team, how the patient's pre- and post-operative pain will be managed – this will inform planning and timing of the initial post-operative review and treatment sessions  Remember the patient's pain might be both wound pain and neuropathic (nerve) pain and may also include pain from other injuries
Address surgical closure/wound management plan	Requesting clear instructions (ideally documented in the patient's case notes) about what the patient is and is not allowed to do in the first days following amputation  The patient's wounds may restrict mobility post-operatively, DPC, wound drains or a difficult closure can preclude certain types of mobilisation, as can other injuries sustained

Aim	Achieved by:
Begin to map locally available services as soon as possible	Mapping (including contacts and referral information) of: <ul style="list-style-type: none"> <li>■ Rehabilitation and mobility device services</li> <li>■ Community-based rehabilitation (CBR)</li> <li>■ Psychological and psychosocial support</li> <li>■ Local amputee/disability support services and organisations for the patient and their family/caregiver, where available</li> </ul>
Ensure the availability of required post-operative materials and equipment	Ensuring the following materials and equipment are available: <ul style="list-style-type: none"> <li>■ Elastic bandages for compression bandaging</li> <li>■ Walking aids/wheelchair</li> <li>■ Stump board (for wheelchairs)</li> <li>■ Positioning devices for elevation of residual limbs where appropriate (i.e. pillows, foam pieces, towels) – though note not to use under the knee). Assistive devices to facilitate locally appropriate bathing and toileting (e.g. commodes, shower chairs – though these are not appropriate/available in many settings)</li> </ul>
Provide detailed education to the patient and family/caregiver  At this stage, it is important to judge the amount of new information that the patient is able to accept and absorb	Providing detailed education about: <ul style="list-style-type: none"> <li>■ Post-operative pain management plan and importance of the patient communicating when pain is not well managed</li> <li>■ Phantom sensation and phantom pain</li> <li>■ Post-operative mobility plan and reasons why it is important the patient to mobilise quickly after surgery (or adhere any mobility restrictions)</li> <li>■ Phases of amputee rehabilitation and how rehabilitation may progress, what could be the functional outcome of the amputation and how mobility devices may be used to optimise the patient's functional ability</li> <li>■ Potential onwards destinations (if known) and referrals</li> <li>■ Members and roles of the MDT</li> <li>■ Demonstration of mobility devices; this can support education and allow the patient and their family to ask any questions they may have about these devices</li> <li>■ Role of nutrition in wound healing; consider a high protein diet if possible</li> </ul> Be careful not to promise a patient a prosthesis, as this can create expectations that may not be met if a prosthesis is not suitable for the patient post-operatively, or if there are difficulties procuring one

### Early rehabilitation phase (post-operative)

The objectives of the post-operative phase are:

1. To promote recovery from surgery
2. To promote healing of amputation
3. To treat concurrent injuries
4. To provide a wheelchair or crutches
5. To conduct on-going assessment for prosthetic provision
6. To ensure the patient is already known by the closest national prosthetic services provider
7. To continue treatment started in pre-operative phase (if possible)

**Post-operatively, there can be a number of complications that you should be aware of:**

- **Wound infection:** discoloured or foul-smelling discharge, pus, increased warmth (compare with contralateral limb), oedema, increased erythema (redness to skin) around wound, increased pain
- **Deep vein thrombosis (DVT):** will most commonly occur in the calf, however can develop in any limb. Signs include: significant pain, swelling, warmth, redness, cramping, worsening pain on movement, bluish or whitish skin discolouration to affected limb, a heavy aching sensation in affected limb. DVT can also occur with minimal or no signs or symptoms
- **Delayed healing:** wounds should demonstrate signs of progressive healing (discharge and oedema reduces, wound pain settles, wound edges close together to eventually form a scar). In delayed healing, wounds will remain moist, oedema will persist and wound edges may not close, or may reopen (referred to as dehiscence). Infection or poorly controlled oedema are common causes of delayed healing
- **Pain:** wound pain, neuropathic (nerve) pain and/or phantom limb pain or sensation and may also include pain from other injuries. Consider using a simple visual analogue scale to support standardised monitoring of pain across treatment sessions
- **Heterotrophic ossification (HO):** HO is the development of bone inside soft tissues where bone should not exist. The first sign of HO is usually loss of joint range or mobility, which can limit limb function. Swelling, reddened skin, warmth, localised pain, a palpable mass and development of contracture can also indicate the formation of HO. Differential diagnosis is important as these symptoms may also indicate multiple other complications, including infection and DVT. HO mostly commonly, but not always, forms in joints closest to the site of trauma
- **Bone spur:** also called osteophytes; these are bony prominences that form at the distal end of the residual bone. Bone spurs can be painful on palpation or when pressure is applied over the area, which can make prosthesis use uncomfortable or intolerable. In severe cases, the bone spur can cause skin breakdown or ulcers



**Picture 3:** Heterotrophic ossification following a transfemoral amputation, seen on x-ray

- **Neuroma:** neuromas are bundles or masses of sensitive nerve endings that form when the nerve is cut during amputation. Localised sharp or shooting pain or tingling reproduced by palpation over the stump can indicate the presence of a neuroma
- **Pressure areas:** check skin over bony prominences, including sacrum, buttocks, heels, elbows, spine and scapulae for reddened areas. Redness should resolve within 20 minutes of relieving contact/pressure. Areas that do not blanch on touch, or where skin is broken are indicative of developing pressure sores and immediate action must be taken to avoid further progression
- **Compartment syndrome:** observe entire limb for the '5Ps'; pain, pallor (pale skin), paraesthesia (numbness), pulse (no or weak pulse) and paralysis (weak muscle movement)

Post-operatively, it is also important to monitor for respiratory complications, with signs including a productive cough, 'wet' chest sounds, shortness of breath and increased temperature. If you are concerned, liaise with the medical team.

### Post-operative assessment

Following surgery, the patient is assessed, or the pre-amputation assessment is revised, to develop a treatment plan, establish outcome measures and set user goals. The post-operative assessment also provides information that will help inform the decision on prosthetic use. As many patients are likely to be seen for the first time post operatively, we have reproduced the pre-operative subjective assessment, with additions for post-operative care, below:

### Subjective assessment

- **History of Presenting Condition:** mechanism and date of injury, other injuries, time from injury to amputation, surgical procedure including DPC, planned date of closure (if not closed), management of any concurrent injuries, wound care plans, post-operative precautions or restrictions, management plan and expected discharge date. *Is the patient stable/appropriate for early rehabilitation?*
- **Past Medical History and pre-injury function** – pay attention to diabetes and other factors that may impair healing and physical ability/fitness, as this will have an impact on early rehabilitation and ability to use prosthetics
- **Social History:** pre-injury occupations and responsibilities (i.e. work, leisure activities, family roles), hand dominance (i.e. right- or left-handed) for upper limb amputees, discharge destination and details regarding accessibility/supports available/proximity to health and disability services upon discharge
- **Medication History:** is the patient on medication for nociceptive and neuropathic pain, anti-nausea, antibiotics? It is important to establish effective pain control as early as possible and to check that they have access to medication needed for other health conditions
- Other specific things to consider:
  - Contact details of all MDT local health staff involved with patient's care

## PSYCHOLOGICAL STATUS

Before rushing into assessment and treatment, check your patient's psychological/emotional response to their current situation. The loss of limb process is similar to the stages of grief, and patients may have been affected in other ways by the conflict/disaster. Be prepared to discuss prosthetics by ensuring you are aware of the status of local provision. Do not make any promises you cannot keep. Check the patient's understanding of their amputation procedure and why it was carried out, as well as their cognitive status (ability to receive new information and act on it), motivations, depression, anxiety, etc. Ask what are their priorities for their recovery and rehabilitation, as these may be different from your own. Be sure to be aware of local cultural considerations (including attitudes and beliefs), particularly regarding amputation and disability. Ask yourself: Is your patient ready to engage in rehabilitation? If they are struggling, are there local counselling or peer support services available?

For the basics on supporting people in crisis, please refer to the WHO 'Psychological First Aid' manual.

### Objective Assessment:

#### Check the residual limb

Any residual limb/wound checks should be done in collaboration with other members of the clinical team. Do not undress a wound unless you are qualified and equipped to redress it.

- **Residual limb length:** There needs to be enough room for prosthetic componentry
- **Soft tissue:** Ideally no 'dog ears', adequate cushioning and coverage of bone end
- **Bone ends:** Bevelled bone edge, no bony spurs, fibula cut 2cm shorter than tibia. Palpation or x-ray determined
- **No neuromas:** Nerves should be retracted deep inside the soft tissue during surgery so they can't get aggravated near the surface, causing a neuroma (see complications, above)
- **Shape of stump:** Ideal transfemoral shape is conical, ideal transtibial shape is cylindrical. You do not want a bulbous shape as it is very hard to fit a prosthesis



Pictures 4 & 5 above: poor stump shape (L) with short levers, excess soft tissue and scar line across bone. Good shape (R) with cylindrical shape, good muscle coverage, skew flap and healthy tissue

- **Scar line:** This should not be over the end of the bone, check whether you have an adhered scar or mobile one, and whether scar tissue is palpable or tender
- **Wound:** Be aware for any signs of infection (slough, smell, discharge, red, hot, necrotic skin margins), check whether stitches are in/out and be aware that some wounds will be open
- **Vascular supply:** There should be adequate supply for wound healing. Stump should be warm, have sensation, good colour and pulse, etc.
- **Pain/tenderness:** Along scar line, neuroma, soft tissue injury
- **Muscle cover:** Evidence of myodesis and myoplasty with optimal shape. Sufficient muscle cover over the cut end of bone
- **Skin condition:** Be aware of scars, skin grafts, blisters, unhealed skin and dermatological problems, such as eczema
- **Sensation:** You will need to test and check sensation is intact especially over the prosthetic weight-bearing areas, as well at the end of the stump

For more information on **wounds** with amputation please see the video from HI and BACPAR-



### Pain

Not just in the residual limb but more generally. Document type (including phantom pain,) severity and distribution. See pain section below for more details.

### Range of movement (ROM) and muscle power

Including above the level of amputation and in residual limbs. Consider other injuries. In patients with lower limb amputations, pay particular attention to the risk of flexion contracture in the hip and knee.



### Function

**Bed mobility:** In conflicts and disasters, this may even include patients being managed from the floor, so adapt as required.

**Sitting balance/tolerance:** Relevant with transfemoral amputations, especially bilateral. They have short levers and therefore a shift of centre of gravity backwards.

**Transfers:** To/from relevant surfaces. See the BACPAR/HI video on transfers for practical guidance on this.



**Mobility:** For patients who have sustained lower limb amputations, this includes the use of a wheelchair or crutches.

**Seating/pressure/chair requirements:** Especially for people with a bilateral amputation. Don't forget stump boards for patients who have sustained transtibial amputations for sitting.



For cases of lower limb amputation, the post-operative objective assessment must include:

- Contralateral leg, range of movement, strength, concurrent injuries, condition of foot
- Arm strength (i.e. ability to transfer, use wheelchair and walking aids)
- Hand dexterity and grip, which may influence type of suspension of prosthesis

For cases of upper limb amputation, the objective assessment must also include, in addition to the above:

- Contralateral arm (i.e. strength, ability to transfer, hand dexterity and grip, which may influence type of suspension of prosthesis)

## EARLY REHABILITATION: TREATMENT

### Management of oedema

Oedema management can be achieved through a combination of approaches, including active exercise, stump elevation and stump compression. See the Guidance for the MDT on the management of post-operative residuum oedema in lower limb amputees for more information and a review of the available evidence: [https://bacpar.csp.org.uk/system/files/guidance\\_v.8\\_0.pdf](https://bacpar.csp.org.uk/system/files/guidance_v.8_0.pdf)

For more information on oedema management please see the video from HI and BACPAR-

### Stump compression



Description	Pros	Cons
<b>No dressing</b>	<ul style="list-style-type: none"> <li>— No risk of dressing being put on incorrectly</li> <li>— Easy to monitor surgical wound</li> </ul>	<ul style="list-style-type: none"> <li>— No oedema control</li> <li>— Prolonged wound healing</li> <li>— Increased risk of wound infection</li> </ul>
<b>Rigid dressing</b> (A rigid or semi-rigid dressing applied to a transtibial residuum to contain and further prevent formation of post-operative oedema)	<ul style="list-style-type: none"> <li>— Reduction in oedema</li> <li>— Reduced healing time</li> <li>— Reduced time to prosthetic casting</li> <li>— Reduced incidence of fixed flexion deformities at the knee</li> <li>— Physically protects the stump from external trauma</li> <li>— Removable rigid dressings permits regular residuum inspection</li> <li>— Able to apply earlier than other modalities, such as stump shrinkers</li> </ul>	<ul style="list-style-type: none"> <li>— Require significant expertise to apply</li> <li>— Non-removable versions not suitable in conflicts and disasters, due to higher risk of infection</li> </ul>

Description	Pros	Cons
Compression sock (stump shrinker)	<ul style="list-style-type: none"> <li>— Reduced oedema</li> <li>— Improve vascularity to the stump, increasing speed of wound recovery</li> <li>— Can reduce phantom pain</li> <li>— Easy to put on/remove</li> </ul>	<ul style="list-style-type: none"> <li>— Expensive/not available</li> <li>— Requires measurement and fitting</li> <li>— May require re-fitting/ replacement as stump shape changes</li> </ul>
Compression dressing (stump bandaging)	<ul style="list-style-type: none"> <li>— Reduced oedema</li> <li>— Improve vascularity to the stump, increasing speed of wound recovery</li> <li>— Can reduce phantom pain</li> <li>— Patient/caregiver can apply independently once taught</li> <li>— Cheaper/more widely available</li> </ul>	<ul style="list-style-type: none"> <li>— If donned incorrectly, can lead to poor healing and poor stump shape</li> <li>— Wound needs to be checked regularly, therefore bandage donned and doffed regularly</li> <li>— Clean bandaging not always widely available</li> </ul>

*Stump compression is frequently seen in conflicts and disasters, due to its availability and ease of application.*

For more information on oedema management, including a demonstration of how to apply a stump bandage, watch the videos from BACPAR and HI:



*Avoid using clip or pins to fasten a bandage – use tape used for dressings instead.*

Diagram 2: Bandaging for a below knee amputation

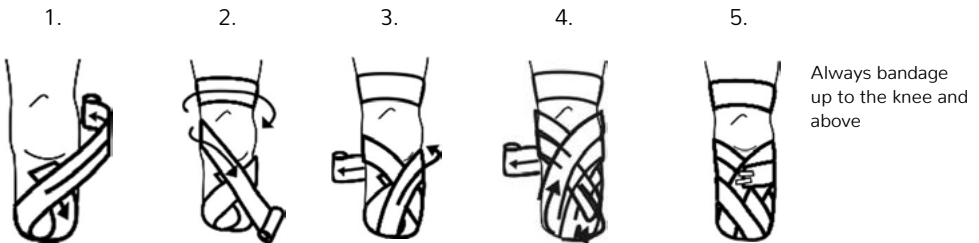
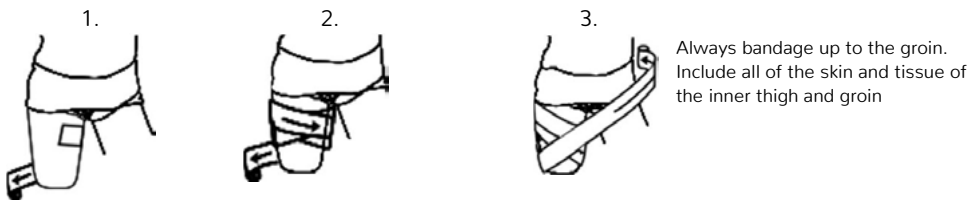


Diagram 3: Bandaging for an above knee amputation





**Picture 6:** Bandaging for a below knee amputation

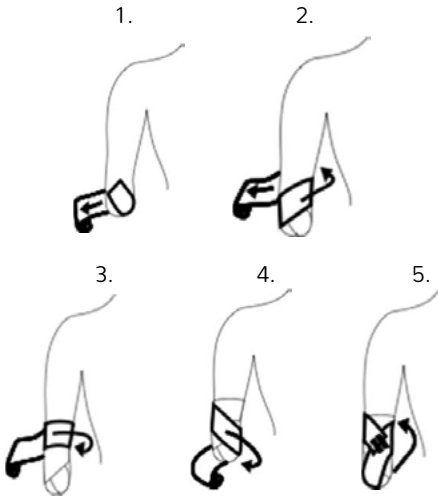
© Davide Preti/HI



**Picture 7:** Bandaging for an above knee amputation

© Davide Preti/HI

**Diagram 4:** Bandaging for a below elbow amputation



Always bandage above the elbow

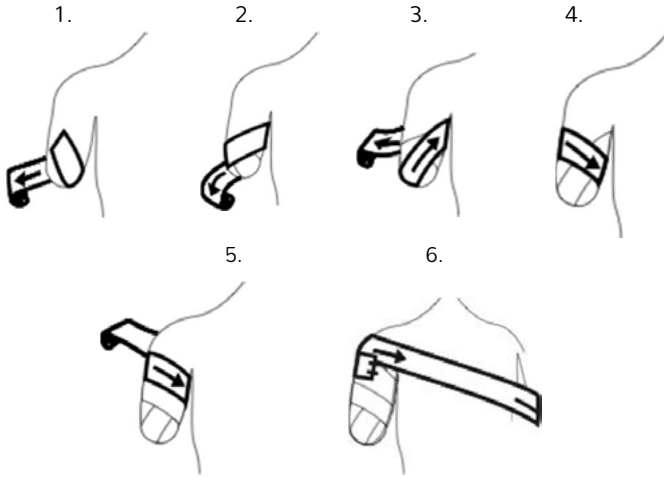


**Picture 8:** Bandaging for a below elbow amputation

© Davide Preti/HI



Diagram 5: Bandaging for an above elbow amputation



Always bandage above the elbow

### Positioning

Positioning aims to prevent contractures and reduce oedema, as well as reduce the risk of other complications, such as pressure ulcers and respiratory problems. Teach the patient and caregiver positions in both sitting and lying to help prevent contractures in the joints above the amputation level.

Do...



keep the knee positioned in extension while in bed

Do Not...



place a pillow under the knee while in bed

Do...



keep the knee positioned in extension when sitting

Do Not...



keep the knee in a flexed position when sitting

## NEVER PUT A PILLOW DIRECTLY UNDER THE KNEE JOINT

- For patients with a transtibial amputation, it is crucial to prevent knee flexion contractures
- For patients who have sustained a transfemoral amputation, it is important to prevent hip flexion and abduction contractures
- Avoid prolonged flexion/abduction/external rotation

For lower limb amputation, prone lying can be useful to achieve sustained full knee extension and to achieve neutral hip extension (to prevent flexion contractures in either joint). You will need to consider how to accommodate concurrent injuries.

### **Pain management**

Pain is an inevitable consequence of amputation and for many, pain will not just result from the trauma of the surgery, but may also include a neuropathic presentation known as phantom limb pain. Pain can also be complicated by additional injury to the same limb or other parts of the body. For the rehabilitation professional involved in the early stages of rehabilitation, the challenge is determining the nociceptive and neuropathic causes of pain (see Chapter 3) which require attention, in order to manage the patient and so enable effective rehabilitation to occur. Effective pain management requires a collaborative, multi-disciplinary approach.

**Post-amputation pain:** Nociceptive post-amputation pain at the wound site. This is normal following surgery; however, if this persists or increases it can be a sign of infection, therefore medical advice should be sought. Pain at the wound site should be distinguished from pain in the residual limb and phantom limb pain. After amputation, all three may occur together.

**Residual limb pain (RLP):** Pain or sensation in the areas near to the amputated body part. This is known as residual limb or stump pain and its intensity is often positively correlated with phantom limb pain.

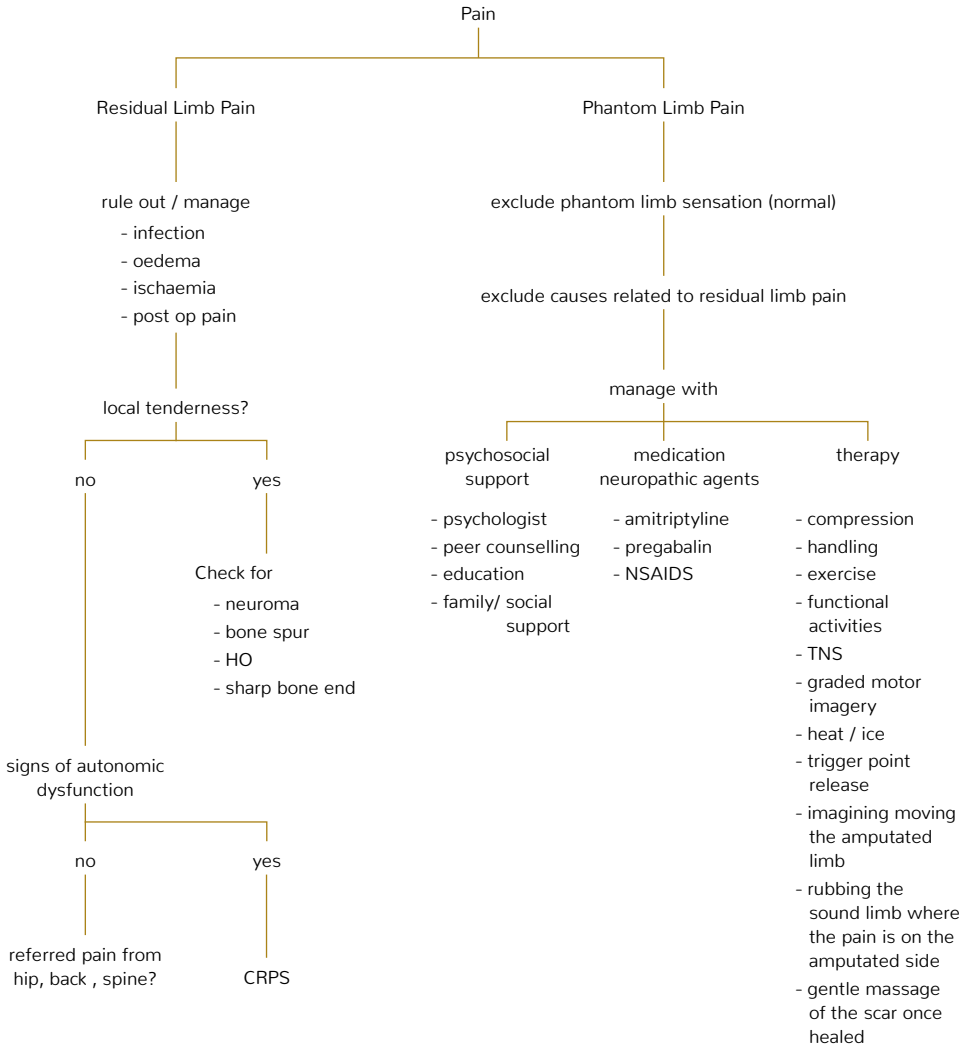
**Phantom limb sensation:** This is a normal experience for the majority of amputees, but it is not a noxious sensation, nor is it described by the patient as painful or unpleasant. It can include feeling that the limb is still there, following sensations like itching. In such cases, education (pre- and post-operatively) and re-assurance are key.

**Phantom limb pain (PLP):** Classified as neuropathic pain, whereas RLP and post-amputation pain are classified as nociceptive pain. PLP is often more intense in the distal portion of the phantom limb and can be exacerbated or elicited by physical factors (pressure on the residual limb, time of day, weather) and psychological factors, such as emotional stress. Commonly used descriptors include sharp, cramping, burning, electric, jumping, crushing and cramping. PLP assessment should seek to establish the principle drivers. These may be centrally driven adaptations, peripheral sensitisation, psychological/social factors and musculoskeletal factors. Treatment can then target these drivers.

### *Note*



*Note:* Graded motor imagery (GMI) should only be carried out by a therapist with relevant experience. Details can found on this website: <http://www.gradedmotorimagery.com/>



For more information on pain in amputation, watch this short video from HI and BACPAR:



Refer to the UKEMT oedema and pain leaflet for more guidance for patients



### Teach stump care

Promote healing through good hygiene, scar massage, desensitisation and handling of the stump. Massage can be helpful in reducing hypersensitivity; from day one, gentle touch of the residual limb is advised and can gradually increase as healing takes place. This is also useful to improve awareness and acceptance of limb loss.

Refer back to the section on complications to identify common issues with the residual limb.

### Promote healing by

- Liaising with nurse regarding dressing change
- Oedema control
- Ensuring adequate nutrition
- Prevention of falls by education, safe transfers and safe use of wheelchair
- Correct positioning
- Checking for infection, additional tissue damage
- Scar management, including donor sites for skin grafts
- Encouraging psychological wellbeing of patient.

### Teach care of the remaining limb

This is particularly important for patients where diabetes has been a contributing factor in the decision to amputate. Discuss the importance of caring for the remaining limb by preventing falls, ensuring good skin care and wearing appropriate footwear.

### Treat concurrent injuries and/or co-morbidities

Severe limb injuries that require amputation are considered 'distracting injuries', which means other, less obvious injuries, such as head injuries, fractures to small bones or soft-tissue injuries, may only be properly identified after some delay. Persistent pain or weakness should be investigated as a potential indicator of a missed injury. All identified concurrent injuries should be reviewed and managed appropriately alongside an amputation. Prioritise treatments as appropriate, identifying those likely to delay or prevent prosthetic rehabilitation.

---

## CASE STUDY

A six-year-old child presented to an EMT for closure of a below-knee guillotine amputation, wearing a full leg cast on their other leg. On further investigation, it was revealed that this cast was hiding an open tibial fracture, with an associated peroneal nerve injury. The management of injuries to the non-amputated side was vital for the child to be able to walk using a prosthetic. To complicate matters, the child was distressed by their injury and terrified of health staff. They were accompanied by a relative (not their parents). Managing their distress and educating them and their caregiver became an essential part of early rehabilitation – building trust before any physical rehabilitation could begin.

### Active exercise

Active exercise aims to improve muscle strength and mobility, reduce oedema, reduce muscle atrophy, aid transfers and functional independence and aid psychological adjustment. Start active exercises for residual limb and whole body as soon as possible, taking appropriate precautions with any other injuries.

For detailed information on exercise and amputation, watch the video from BACPAR and HI:



### Core exercises

Core stability exercises are especially important with multiple limb injuries/patients with higher level amputations

These exercises can start early, even on bed rest. Postural awareness is key, and continues its importance through to prosthetic gait education. Kneeling is especially good for bilateral transtibial amputations, including four-point kneeling in later stages. Hip extension and trunk stability exercise can also be helpful in earlier stages.

### Lower limb amputation exercises

It is important that the patient maintains their strength and range of movement, post-amputation. The patient and their caregivers should be advised to keep all remaining joints moving throughout their full available range, especially the joints above the amputated site (hip and knee) to prevent contractures.

The following exercises are good basic strengthening and ROM.

#### Straight leg raise

- Put your legs out in front of you
- Tighten your thigh
- Lift your leg off the bed
- Hold for ten seconds
- Slowly lower
- Repeat ten times

Repeat the above with the other leg



#### Hip flexor stretch

- Lie on your back, preferably without a pillow
- Bring your thigh towards your chest and hold with your hands
- Push your opposite leg down flat on to the bed
- Hold for 30 – 60 seconds, then relax
- Repeat five times

Repeat the above with the other leg





### Bridging

- Lie on your back with your arms at the side
- Place a couple of firm pillows or rolled-up blankets under your thighs
- Pull in your stomach, tighten your buttocks and lift your bottom up off the bed
- Hold for five seconds
- Repeat ten times

To make this exercise more difficult, ask your patient to place their arms across their chest, as shown in the picture



### Hip abduction in side lying

- Lie on your side
- Bend the bottom leg
- Keep hips and top leg in line with your body
- Slowly lift your top leg up, keeping your knee straight
- Slowly lower
- Repeat ten times

NB Do not to let the patient's hips roll forwards or backwards

Repeat the above with the other leg



### Hip extension in prone

- Lie flat on your stomach for ten minutes, three time per day
- Lie flat on your stomach, keeping your hips flat on the bed left your leg off the bed
- Hold for five seconds
- Repeat ten times



### Upper limb amputation pre-prosthetic exercises

Function, range and power of the upper limb are often neglected, but are key to good outcomes and quality of life. Scapular range is very important if using upper limb for greater function, e.g. following bilateral lower limb amputation, or a patient sustaining a triple amputation needing to achieve getting on and off the floor independently. Also note that pectoral major/minor tightness is very likely, due to greater sitting time, and needs to be counteracted.

All these exercises should be completed through your patient's full available range, unless indicated otherwise.

<b>Neck</b> (to be completed gently and within the patient's range) – if these exercises cause any dizziness/double vision/fainting, stop them immediately and liaise with the medical team	<ul style="list-style-type: none"> <li>— Rotation to the left and right x5</li> <li>— Side flexion to the left and right x5</li> <li>— Extension x5</li> </ul>
<b>Trunk rotation</b>	<ul style="list-style-type: none"> <li>— To the left and to the right x 5</li> </ul>
<b>Shoulder girdle</b>	<ul style="list-style-type: none"> <li>— Shoulder elevation x10</li> <li>— Shoulder protraction x10</li> <li>— Shoulder retraction x10</li> </ul>
<b>Shoulder</b>	<ul style="list-style-type: none"> <li>— Flexion x10</li> <li>— Extension x10</li> <li>— Abduction x10</li> <li>— Medial rotation x10</li> <li>— Lateral rotation x10</li> </ul>
<b>If below elbow</b>	<ul style="list-style-type: none"> <li>— Flexion x10</li> <li>— Extension x10</li> </ul>

For more information on upper limb functional rehabilitation, refer to the short video from HI and BACPAR:



### Improve mobility and independence

By teaching bed mobility, safe transfers and safe use of wheelchair or other mobility devices.

**Bed mobility:** Rolling: This is useful in both directions and is an excellent early core exercise that is often underused.

**Lie to sit:** People with a transfemoral amputation experience a change of centre of gravity, especially those with a bilateral amputation, due to their lack of counterbalance. The lie to sit transfer will need to be re-educated. Blocks or locally made equivalents can be useful in practising this.

**Up and down the bed:** Beware of sliding and shearing forces if the patient has any wounds or vulnerable skin. Slide sheets may or may not be available, therefore you will need to consider how to reduced shearing forces and friction. During pre- or immediately post-wound closure, greater protection of the wound may be necessary.

**Sitting balance:** Start with sitting balance while sitting upright in bed.

**Standing:** Progress from sitting to sit to stand (with and without support). Work on standing balance at the bedside with support present – educate the patient that they may be off-balance due to their limb loss, or may still automatically try to use their amputated limb.

Patients with an amputation are at higher risk of falls, due to possible phantom sensations; readjustment of centre of mass after loss of body part and loss of strength; additionally when standing, the lower limb stump is hanging down, which may increase oedema and pain.

## Transfers

When teaching transfers, this should be adapted for both the hospital and discharge environment:

- Beds are less likely to be height-adjustable and this must be considered
- Where patients may be sleeping at floor level (or are at risk of falling), transfers from the floor should be taught
- If a patient has stairs in their discharge environment, safe mobility on stairs must be taught
- Where patients are required to squat to use the toilet, this must be included
- Consider buttock wounds and avoidance of shearing forces in all transfers
- Sideways transfers: whilst common, are not always appropriate depending on other injuries
- In patients with bilateral or triple amputations, consider forwards/backwards transfer for initial assessment. They are much safer to apply, easier to assist the patient and more straightforward to stop and return to bed if any issues
- Warn the patient about phantom limb sensation and mobility. When they may be disorientated, especially at night time, they may forget about the residual limb and try to stand and walk

For demonstrations of safe transfers for patients with an amputation in conflicts and disasters, see the video from HI and BACPAR:



## Temporary mobility device prescription

Wheelchairs are essential during early rehabilitation for people with a bilateral lower limb amputation. However, their use in cases of unilateral lower limb amputations in disaster settings attracts some controversy.

Controversy: In high-income settings, the use of crutches for unilateral amputees is discouraged, with wheelchairs preferred, followed by the use of devices such as pneumatic post-amputation mobility aids (PPAM aids) and then prosthetics. However, in conflict and disaster settings, PPAM aids may not be available, length of stay in hospital may be short and the conflict/disaster environment may not be suitable for wheelchair use. Patients may also face severe waits for prosthetics. The use of crutches may still be judged to be appropriate – therapists need to consider both options for their patients.

## Pros of using a wheelchair

Safer due to:

- Reduced risk of falls
- Reduced chance of hitting/banging (and damaging) the stump on surrounding environment
- Protects the sound leg (in the presence of other injuries or diabetes) – it will reduce the repetitive pressure of the sound leg, and therefore reduce chance of secondary injury to that foot and leg, which could result in a second amputation

### Cons of using a wheelchair

- Unable to negotiate steps and uneven or soft ground, potentially limiting access to essential services, or increasing dependence on others
- May be in short supply and prioritise for those who cannot otherwise mobilise
- Wheelchair needs to be maintained in full working order to be beneficial



### If the use of walking aids cannot be avoided (i.e. if a wheelchair is not appropriate or the patient is self-selecting crutches)

- Ensure that walking aids are properly adjusted
- Teach the patient how to use the walking aids safely
- Give education on preventing falls
- Explain to the patient the dangers of the stump hanging down (i.e. may increase oedema, pain and healing time)

**People with a transtibial amputation should use a stump board when sitting in a wheelchair or chair**

### Provide ongoing psychological support and education

Those who have had an amputation may experience significant fluctuations in their psychological and emotional state; delayed responses to a traumatic event are common. Therapists must observe each patient's mental state during every treatment session and respond appropriately if issues are identified. By remaining alert to signs of psychological or emotional distress and responding appropriately, therapists can promote positive coping strategies and improve engagement in rehabilitation. Providing ongoing education will ensure the patient has an accurate and realistic understanding of the phases and timeframes of post-amputation rehabilitation, thereby minimising anxieties and potential disappointments. Involve family and friends in rehabilitation where possible.

### Goal setting in early rehabilitation

Goal setting in early rehabilitation requires therapists to find a balance between the priorities demanded by the setting in which they are working, and the person-centred goals expressed by the patient and their family/caregiver. Clearly, early rehabilitation will not be able to meet all the rehabilitation requirements or goals of patients with an amputation. Constraints such as time, limited resources and facilities and high demand for services limit the scope of the goals that can be set with patients. This does not mean disregarding the perspective and priorities of the patient and their family/caregiver, however. In fact, understanding the patient's home environment, previous medical and functional history and goals for recovery is vital to working collaboratively and can be pivotal to understanding their motivations and psychological responses to their injury. The following tips can support effective goal setting in early rehabilitation:

- Provide clear, accurate and consistent education to the patient and their family/caregiver throughout all interactions. For example, about length of admission, the recovery process, pain management and the priorities and limitations of available rehabilitation services
- Be honest and truthful at all times, even when this may be difficult. For example, about suitability for prosthesis use, availability of prosthesis services and likelihood of achieving a return to specific activities. If you are unsure, it is better to state this, rather than being vague or misleading. Effective and compassionate communication skills are required. Sensitivity to the timing of these conversations is important and involvement of psychosocial or psychological supports should be arranged wherever possible
- When setting small functional therapy goals, it is important to explain how these activities will build towards more significant achievements. For example, explaining how transfer practice will facilitate the achievement of independent toileting/showering, or how strengthening exercises contribute to successful use of crutches or a prosthesis
- Goals should be relevant to the patient's context. Ask the patient to describe their home and community environment to ensure their rehabilitation contributes towards building skills that are useful following discharge. For example, teaching wheelchair skills to a patient who lives in an area that is inaccessible in a wheelchair is not appropriate, whereas teaching safe use of crutches on sloped surfaces and uneven terrain, or on stairs, will be important
- Regularly check the patient and their family/caregiver's understanding of the rehabilitation programme and goals of treatment. Be prepared to repeat explanations and instructions. Use written and pictorial resources wherever possible and make time for questions. Engage the use of an interpreter where possible if there is a language barrier

### **Pre-prosthetic stage**

This should be continuous from the post-operative phase and start as soon as your patient can take on board the appropriate and relevant information this setting part contains

The objectives of the **pre-prosthetic phase** are:

1. To assess for prosthetic provision or not
2. To prepare for prosthetic use (until decision to proceed or not is taken)

Aims; continuing treatment started in pre- and post-operative phase, following revision of treatment plans and goals

- Oedema management/compression
- Pain management
- Prevention of contractures
- Promotion of healing
- Treating concurrent injuries as necessary
- Increase range of movement and muscle strength
- Improve posture/balance/mobility/function
- Promote activities of daily living and independence, including on/off floor
- Education of patient and family; psychological support
- Issue of equipment and teaching safe use
- Liaison with MDT and prosthetic centre re ongoing treatment plan and goals
- Preparation for discharge to rehabilitation unit or community

Pre-prosthetic training continues and progresses with strengthening exercises, ROM and stretching exercises for the whole body, as well as specific stump strengthening exercises started post-operatively. It also introduces balance and coordination exercises and functional activities. Please see the following links:

Transfemoral exercises: [https://bacpar.csp.org.uk/system/files/?file=pirpagexercisestransfemoral\\_0.pdf](https://bacpar.csp.org.uk/system/files/?file=pirpagexercisestransfemoral_0.pdf)

Transfemoral exercises: [https://bacpar.csp.org.uk/system/files/documents/2018-09/pirpagexercisestransfemoral\\_1.pdf](https://bacpar.csp.org.uk/system/files/documents/2018-09/pirpagexercisestransfemoral_1.pdf)

### **Assessment for suitability of prosthetic provision for lower limb amputation**

During the pre-prosthetic phase, the MDT will determine, along with the patient (family/caregiver), if the use of a prosthesis is the most suitable solution for the patient.

#### **Factors impacting prosthetic provision**

- Living environment
- Level of amputation or presence of a double amputation
- Cognitive issues: difficulties learning, retaining and using new information
- Patient's own goals and motivation
- Physical condition and ability
- Concurrent injuries/co-morbidities
- Availability of prosthetic services
- The presence of significant hip or knee contractures
- The presence of open wounds or other stump complications

#### **For lower limb amputation**

If the prosthetic solution is suitable:

- Liaise with prosthetic service for planning prosthetic provision
- Participate in the MDT discussion about for the selection of prosthetic type, socket design, components and materials for the manufacturing of the prosthetic
- Update the treatment plan and goals if necessary

If the prosthesis is not suitable:

- Liaise with relevant provider to see if there is a service for the provision of a permanent wheelchair
- Participate in the MDT discussion about the most appropriate mobility option is for your patient - Wheelchair versus crutches (see below)
- Update the treatment plan and goals if necessary

#### **For upper limb amputation**

In conflicts and disasters, prosthetic devices for people with an upper limb amputation may be more limited than for those who have sustained a lower limb amputation and may be restricted to passive (cosmetic) prostheses or static terminal devices

- Liaise with rehabilitation unit for planning prosthetic provision process

- Participate in the discussion among the team for the selection of the prosthetic type, socket design, components and materials for the manufacturing of the prosthetic
- Update the treatment plan and goals if necessary

### Prosthetic rehabilitation phase

Prosthetic rehabilitation starts at the time of prosthetic fitting and should provide your patient with a good understanding of how they can achieve the most with their prosthetic. Close teamwork with the prosthetist is vital, and they will be able to help you understand how the prosthetic works. The objective of the prosthetic rehabilitation phase is to achieve the highest level of mobility and independence.

Aim	Achieved by:
Understand the different types of prosthetics and prosthetic suspension available for your patient	<ul style="list-style-type: none"> <li>— Understand the pressure tolerant areas of the stump</li> <li>— Work closely with the prosthetist</li> </ul>
Continue exercise programme	<ul style="list-style-type: none"> <li>— Understand appropriate exercises to teach patients who are new to their prosthesis</li> </ul>
Teach patient how to use and take care of their prosthesis	<ul style="list-style-type: none"> <li>— Hygiene</li> <li>— Pressure areas</li> <li>— Maintenance of the prosthesis</li> <li>— Be able to teach a patient how to correctly don and doff their prosthesis</li> <li>— Understand the specific sit to stand techniques needed for patients with transtibial and transfemoral amputations</li> <li>— Recognise when adjustments to the prosthesis may be needed – as the stump volume decreases, due to reduced swelling or muscle atrophy – to ensure a good socket fit and alignment of the prosthesis</li> </ul>
Gait training	<ul style="list-style-type: none"> <li>— Understand how different levels of amputation will affect what prosthetic components are needed, and how the prosthetic componentry used will affect their gait</li> <li>— Teach your patient to laterally weight transfer</li> <li>— Teach your patient anterior and posterior weight transfer</li> <li>— Understand principles of gait re-education for someone using a prosthesis</li> <li>— Understand and recognise basic gait faults following amputation</li> <li>— Understand how a patient can go up and down stairs if they have a transtibial or transfemoral amputation</li> </ul>

PTs and OTs should ideally be present during fitting sessions, as it is useful to know how the patient stood in their new prosthesis, what changes have been made, how the prosthesis is suspended (attached to the patient stump) and what prosthetic components have been used. Training with the prosthesis starts at the first fitting, although necessary adjustments may be made subsequently, due to fluctuation of stump volume or muscle atrophy.

All rehabilitation activities should be focussed on supporting the person with an amputation to participate in their meaningful functional activities. All exercises should therefore contribute to the patient's ability to complete their ADLs as independently as possible. Integrating functional activities into rehabilitation is vital to the patient's long-term outcomes. Examples of this could include practising showering or dressing, recreating housework tasks, integrating long-distance walking if the patient needs to reach distant places, or cycling, driving, gardening or farming. Assistive devices can be used to support functional independence where retraining or prosthesis use is not sufficient to allow task completion. This is of particular relevance for amputations in upper limbs, which will likely always leave the person with some degree of functional impairment.

In conflicts and disasters, priority should always be given to establishing safe and independent functional skills that contribute to safe discharge over the more discrete clinical goals that might be addressed in rehabilitation settings in higher-resource environments.

#### **Permanent Mobility Device Prescription:**

Many patients will need to use walking aids, prosthetic devices or wheelchairs (also referred to as 'mobility devices') for the rest of their lives. These devices should therefore meet the user's requirements and environment, provide a proper fit, alignment and support that meets sound biomechanical principles and be safe, durable, affordable and maintainable in the country of use. They and should always be provided alongside appropriate physical rehabilitation and training. Mobility devices for long-term use are thus best provided by local services that can adapt them to the local context and remain available for follow-up, including maintenance and/or replacement.

#### **Wheelchairs**

Wheelchairs can be used to enhance mobility and independence until:

- The person receives their prosthesis
- As a complement to prosthetics for use in different situations and activities of daily life
- If the person is unlikely to be a candidate for prosthetic rehabilitation

For users (temporary and permanent), the wheelchair should be safe, durable and provide proper fit and postural support, including a stump board for patients with a transtibial amputation and a pressure relief cushion. In the early rehabilitation phase, use of a wheelchair for mobility should be encouraged and walking aids discouraged, unless unavoidable. Wheelchair skills should therefore be taught to all patients who have sustained an amputation as part of their rehabilitation programme.



### Wheelchair fitting and user training

For permanent wheelchair users, it is important that the fitting of the wheelchair is completed properly before completing the user training (which is more comprehensive at this stage than wheelchair user training provided in the early rehabilitation phase). Please see the following links: Wheelchairs considerations for amputees: <https://www.motivation.org.au/limesquare/wp-content/uploads/2018/01/FJ-Wheelchairs-for-Amputees-REVA.pdf> and WHO WSPT Basic Level Reference Manual for Participants: [https://apps.who.int/iris/bitstream/handle/10665/78236/9789241503471\\_reference\\_manual\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/78236/9789241503471_reference_manual_eng.pdf)

#### Check the following during wheelchair fitting:

- That the wheelchair is the correct size, and all necessary modifications and adjustments have been made, i.e. provide a stump board for patients with a transtibial amputation. Patients with high level or double amputations may also require the rear wheel axis to be positioned behind the level of their shoulders to reduce the risk of the wheelchair tipping
- That the wheelchair and cushion support the wheelchair user to sit upright; and
- That the wheelchair effectively relieves pressure

#### Carry out fitting in this order:

- Check size and adjustments
- Check posture
- Check pressure
- Check fit while the wheelchair user is moving

#### During wheelchair user training the six most important things to remember to teach are:

- How to handle the wheelchair, including how to use the brakes, move foot plates and arm rests
- How to transfer floor to chair, chair to chair, chair to bed, bed to chair, in/out of the wheelchair and how to propel it safely
- Wheelchair mobility – matched to the user’s needs
- How to prevent pressure sores and what to do if one develops
- How to care for the wheelchair and cushion at home
- What to do if there is a problem

#### To ensure wheelchair user training is successful:

- Find out what the wheelchair user already knows
- Explain, demonstrate and then allow the wheelchair user to practise.
- Use language that everyone can understand
- Have wheelchair users teach other wheelchair users for peer support
- Use good communication skills
- Be encouraging

## Prosthetics

Though the focus of this chapter is on early rehabilitation, as prosthetics are often an end goal of early rehabilitation, it is important to understand them. A prosthetic is an externally applied device used to replace, wholly or partly, an absent or deficient limb segment. There are various types of prostheses, with different components, materials and working methods, but all with the same goal: to support function, body balance, ease of use and optimal cosmesis, in order to restore self-image, quality of life and independence.

Prosthetic components include the socket (interface between the person with an amputation's residual limb and the prosthesis), terminal devices (feet for lower limb and hands/hooks for upper limb), mechanical joints (knee, hip, wrist, elbow and shoulder), pylon (which allows adjustment of the length of the prosthesis) and a suspension system (to keep the prosthetic attached to the body).

The socket is the most important component of the prosthesis, as it determines the user's comfort and ability to control the prosthesis. Upper limb prostheses could be 'body-powered', in which case the terminal device is controlled by movements of the shoulder captured by a harness system, or 'cosmetic', which does not provide any active grasping capability.

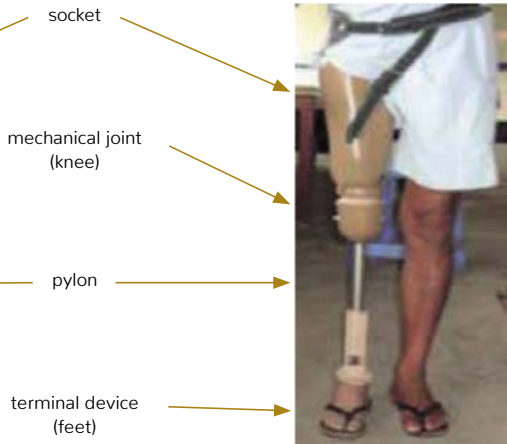
Prosthetic components range from basic to advanced levels of complexity. In conflicts and disasters, the more commonly used components provide essential functions and comfort for the user and are usually made of a limited range of materials. These basic components are relatively low-cost and may include simple knee joints, cushioned-heel feet (SACH foot) and passive hands and hooks.

In conflicts and disasters, it is recognised that prosthetic provision is best met by national providers or long-stay INGOs, such as ICRC or HI. This is vital as prosthetics require regular refitting and adjustment to ensure that the technology used is appropriate and sustainable.

### Transtibial Supracondylar Suspension

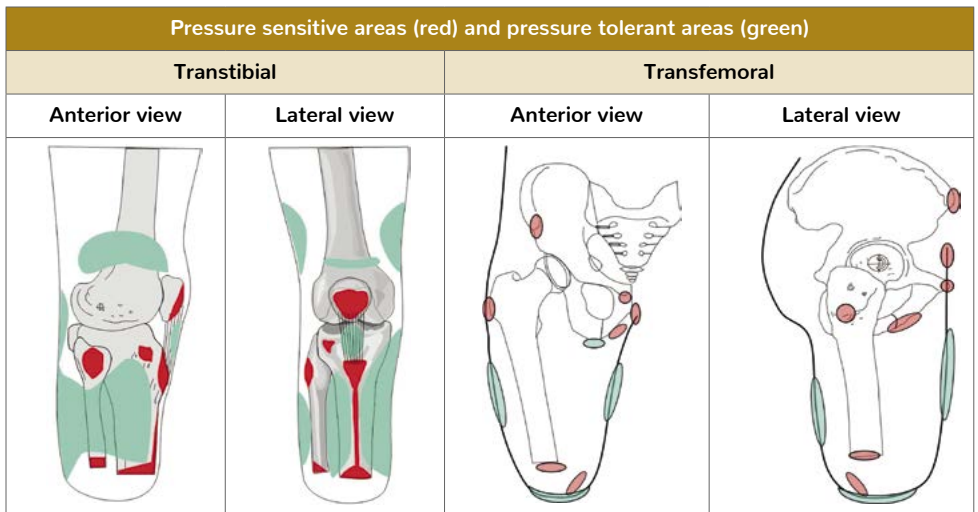


### Transfemoral Belt Suspension System



PTs and OTs work closely with the prosthetist and, if working regularly with people who have sustained an amputation, they should become proficient in the following areas:

- Prosthetic fit and alignment; to be able to evaluate if any gait deviation and/or pain are resulting from a poor fit and alignment
- The functions of the different prosthetic components; to be able to teach the patient how to use the prosthesis properly and to apply the correct gait training strategy
- Correct donning and doffing of the prosthesis
- How to adjust for volume fluctuation and what to do if the socket sits uncomfortably
- Identifying pressure sensitive and tolerant areas of the stump
- Any redness in sensitive areas lasting more than ten minutes should be addressed by the prosthetist



### Discharge Planning

In conflicts and disasters, discharge from acute/inpatient care can happen at any time. Planning for discharge must commence during the pre-operative phase, when the person's likely discharge destination should be known in as much detail as possible. As the patient's functional abilities become better established, it will become possible to assess the assistive devices required for discharge. Careful consideration must be given to how the person's independence in activities of daily living can be facilitated, in order to support a better long-term outcome and reduce caregiver burden. The objectives of the post-rehabilitation phase are:

- To facilitate a safe discharge from inpatient and/or rehabilitation care
- To ensure patients with amputations and their caregivers are educated about long-term management and where/when to seek help
- To ensure patient and caregiver are referred for all necessary support services

Aim	Achieved by:
Identify discharge destination	Discuss with patient where they will be going on discharge: <ul style="list-style-type: none"> <li>— Inpatient/outpatient rehabilitation, own home/ other private dwelling, camp/temporary shelter</li> <li>— Is the discharge destination damaged/safe/ accessible/adequately supportive?</li> </ul>
Identify what assistive devices are required for discharge	<ul style="list-style-type: none"> <li>— Ensure any devices provided can be maintained/ sourced locally</li> <li>— Ensure patient is educated appropriately about safe use of the devices</li> </ul>
Ensure patient has access to disability organisations or peer support networks, where available	<ul style="list-style-type: none"> <li>— Refer patient to, or at least provide information about, locally available networks</li> </ul>
Ensure patient's shelter, protection and water sanitation and hygiene (WASH) needs have been addressed	<ul style="list-style-type: none"> <li>— Refer to specific services if concerns exist and services are available</li> </ul>
Ensure patient's psychosocial needs have been addressed	<ul style="list-style-type: none"> <li>— Refer for ongoing psychosocial support services if required and available</li> </ul>
Ensure patient has access to livelihood support and or vocational retraining	<ul style="list-style-type: none"> <li>— Refer patient to, or at least provide information about, locally available support</li> </ul>

Multiple factors will influence the timing of a patient's discharge from hospital. Therapists should be aware discharge may occur as soon as the surgeon is satisfied with wound healing, and the majority of rehabilitation may occur as an outpatient. In other situations, patients will remain in acute hospital settings until they are ready to transition to inpatient rehabilitation. Clearly, the timing of discharge from inpatient care will have a direct influence on discharge planning and needs.

### Post Rehabilitation Phase

When people who have sustained an amputation are discharged from rehabilitation, they should be fully trained in care of the prosthesis and stump. This should be an integral part of their rehabilitation programme from its commencement and should include caregivers when possible. A leaflet detailing the advice given during rehabilitation and suggesting exercises to be carried out at home can be given to amputees to help them to remember what to do. Patients should also be able to obtain proper follow-up services and return to the centre if they have problems with their prostheses.

The patient leaflet should contain the following information:

- Donning and doffing the prosthesis
- Stump care
- Prosthesis (or wheelchair) care
- Bandaging
- Where to go and what to do if they experience any problems with the prosthesis or wheelchair
- Instructions about any assistive devices provided

## KEY POINTS

- A MDT approach, including the patient and local services as available, is essential to ensure an efficient and effective rehabilitation of the person sustaining amputation
- A traumatic amputation drastically alters an individual's life; not only does it create unalterable physical changes, but can cause serious psychological impact as well
- For the optimal use of a prosthesis, the affected limb should not develop any additional deformity or contracture and should be pain-free
- Early rehabilitation will lead to a greater potential for prosthetic success. The longer the delay, the more likely the development of complications will be, such as joint contractures, general debilitation and a depressed psychological state. However, a flexible approach is also important to adapt to concurrent injuries and/or psychological impact
- OT/PT's should remember that prosthetic rehabilitation is logical and follows a sequence of: donning the prosthesis, ensuring a proper prosthetic fit and alignment, sit-to-stand, gait re-education (stance phase, swing phase and functional tasks)

## KEY REFERENCES

*Wheelchair Service Training Package: Basic Level Reference Manual.* WHO

[https://apps.who.int/iris/bitstream/handle/10665/78236/9789241503471\\_reference\\_manual\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/78236/9789241503471_reference_manual_eng.pdf)

*Clinical guidelines for the pre and post operative physiotherapy management of adults with lower limb amputations.* BACPAR (2016) [https://bacpar.csp.org.uk/system/files/bacpar\\_guidelines\\_nice\\_35\\_lr.pdf](https://bacpar.csp.org.uk/system/files/bacpar_guidelines_nice_35_lr.pdf)

*Management of limb injuries during disasters and conflict.* Geneva: ICRC, 2016.

<https://icrc.aeducation.org/>

---

## CHAPTER 7

### CHAPTER 7: EARLY REHABILITATION OF ACQUIRED BRAIN INJURIES

#### **AIMS:**

By the end of this chapter, you should be able to:

- Demonstrate a basic knowledge of acquired brain injury (ABI)
- Perform a basic assessment for a patient with an ABI
- Develop a problem list for a patient with an ABI
- Develop and deliver a basic rehabilitation plan for a patient with an ABI



## CHAPTER 7: EARLY REHABILITATION OF ACQUIRED BRAIN INJURIES

### INTRODUCTION

An acquired brain injury (ABI) is a leading cause of death and disability in situations of conflict or disaster settings. Brain injuries can range from a temporary, mild injury to a severe, lifelong impairment. In this chapter, we refer to an ABI as any injury to the brain that is not present at birth or inherited. ABIs can be sub-divided into either traumatic or non-traumatic brain injury. A non-traumatic brain injury, for example, can be caused by lack of blood supply to the brain, as in ischaemic stroke, or by an infectious disease, such as meningitis. A traumatic brain injury is caused by external forces, such as a gunshot or blunt force wound.

In conflicts and disasters, rehabilitation professionals are likely to see different types of ABIs, both traumatic and non-traumatic. Conflicts and disasters increase the incidence of ABI, both through persons who are directly injured, and over the longer term where disrupted healthcare systems prevent people from accessing their regular medication. For example, prolonged conflict or road damage due to earthquakes may prevent the distribution of antihypertensive drugs, leading to an increase in the occurrence of stroke.

In conflicts and disasters, you may see traumatic brain injuries caused by gunshot, a blow to the head or a penetrating injury, such as debris piercing the skull or trauma caused by rapid deceleration in a car crash. The shockwaves from blasts, e.g. bombs or exploding debris, can cause damage to the brain and open or closed head injuries. Due to their size and relative frailty, e.g. thinner skin and softer skull bones, children are particularly vulnerable to brain injury as a result of blasts. Non-traumatic causes of brain injury seen in conflict and disaster settings include cerebral malaria, meningitis, stroke related to cardiovascular or sickle cell disease, tumour causing pressure on the brain or near drowning. There are many potential sources of brain injury and you should not consider these examples an exhaustive list of all possible causes.

In settings where healthcare services are severely disrupted or poorly developed pre-crisis, people with the most severe brain injuries are unlikely to survive, while those with less severe injury may be missed when emergencies or mass casualties overwhelm available health services. Therefore, rehabilitation professionals are most likely to treat mild-moderate severity brain injury.

All rehabilitation professionals working in conflicts and disasters should be able to provide aftercare information to patients with mild brain injury or suspected brain injury, including how to recognise signs of deterioration. Rehabilitation of an ABI is frequently complicated by the presence of poly-trauma, such as associated skull (and other) fractures, open wounds and internal injuries. The principles of assessment and treatment shown in this chapter can be applied to all ABI presentations.



Cerebral palsy (CP) is typically caused by damage to the brain before or at birth and is characterised by disordered movement. Rehabilitation has a significant role to play. CP is not classified as an ABI and is therefore not addressed in this chapter. There are online resources available to guide you, e.g. [https://www.physio-pedia.com/Managing\\_Children\\_with\\_Cerebral\\_Palsy](https://www.physio-pedia.com/Managing_Children_with_Cerebral_Palsy)

ABI in the developing brain of a baby or toddler presents with similar rehabilitation needs to CP. In these cases, you are best to use paediatric-specific resources to guide you.

## Presentation of an ABI in conflicts and disasters

In conflicts and disasters, certain factors will impact a rehabilitation professional's approach to assessing and treating a patient with an ABI. Please refer to Chapter 3 of this handbook for general factors that could impact your rehabilitation care, however, please keep the following points in mind that are specific to an ABI:

**Behavioural aspects:** While brain injury can directly result in changes in behaviour and decreased inhibitions (e.g. frontal lobe injury), in conflicts or disasters reactions to traumatic experiences can also present as changes in behaviour or expressiveness. Social interactions and expression of emotions can also vary across cultures and alterations may be missed if you are treating a patient from a different cultural background. Ask a family member whether the person's interactions have changed since the injury, and how.

**Profile of ABI:** Patients with catastrophic brain injury are more likely to die due to the limited availability of neurosurgery and ventilatory care. Unconscious patients are also unable to call for help and so in earthquakes, for example, they may be the last to be pulled from the rubble. You are most likely to see patients with mild and moderate head injuries. These individuals are usually discharged quickly because inpatient beds are in high demand. **Make sure you are familiar with the signs of deterioration in a head injury (these signs of deterioration are explained later in this chapter) and can explain them to the patient and caregiver before their discharge.**

**Neurosurgery:** If you work in an area where neurosurgery with aftercare support is available, note that there are often special considerations and contraindications related to positioning the patient, ventilatory support and other factors. **Only work within your scope of practice and always be guided by the medical team in these situations.**

## Anatomy

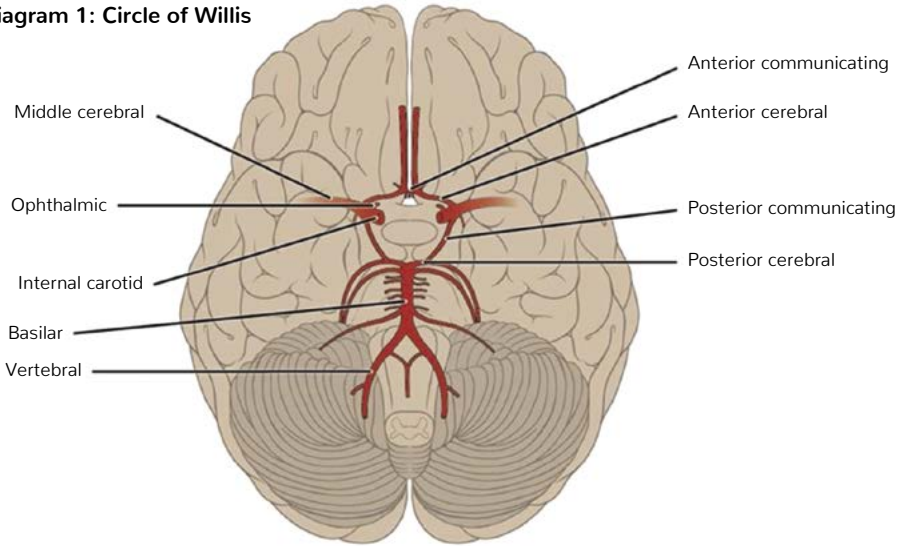
Clinical reasoning in ABI requires an understanding of basic brain anatomy; in the absence of imagery, symptoms can still give an indication of the location and the extent of injury, while any information about the injury can tell you some symptoms to expect and watch for.

The brain is made up of right and left sides (cerebral hemispheres), which communicate by nerve tracts known as the corpus callosum. Each side has four lobes: frontal, temporal, occipital and parietal; at the base of the brain lies the brain stem consisting of the medulla oblongata, pons and midbrain. The cerebellum sits behind this.

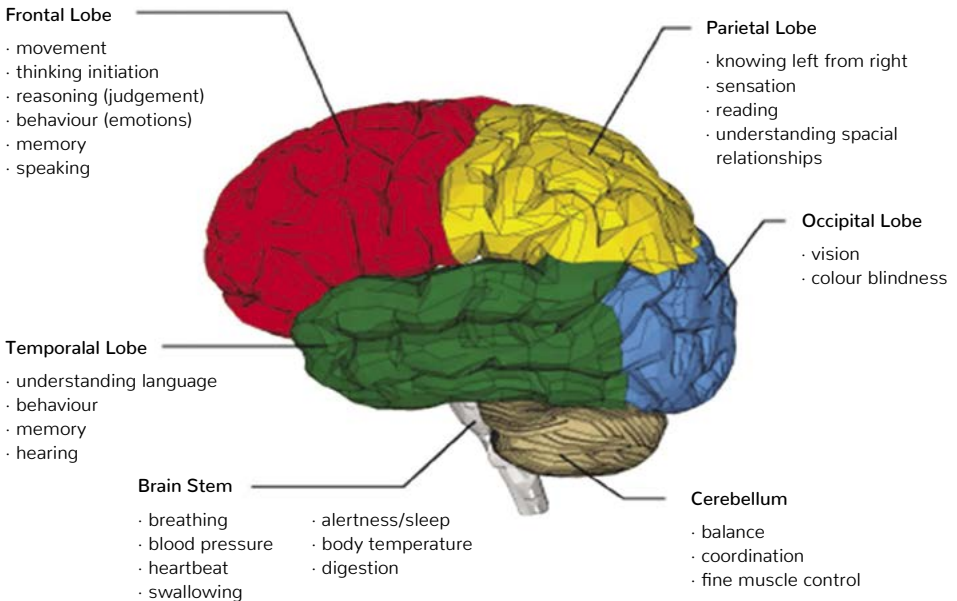
Chambers, called ventricles, within the brain make cerebrospinal fluid (CSF), which circulates between protective outer linings to cushion the brain. The brain has three protective layers (meninges): the external dura mater between the brain and skull; the arachnoid mater in the middle; and the pia mater layer closest to the brain.

Blood supply to the brain from internal carotid and vertebral arteries forms a ring at the base of the brain (the circle of Willis) protecting the brain when a supply artery becomes blocked. Terminal branches from this circle supply regions of the brain and blockage in these branches, e.g. stroke, results in tissue damage. Pressure in the skull (intracranial pressure (ICP)) is controlled to ensure adequate blood supply to brain tissue. Trauma to brain tissue raises ICP, which can cause further tissue damage.

**Diagram 1: Circle of Willis**



**Diagram 2: Brain areas and functions**



## Classification of ABI

Multiple systems for classifying brain injury exist. In conflicts and disasters, it is unlikely that you or your patient will have access to many of the types of investigations, such as MRI or CT scans, that usually inform classification systems; however, it is still useful to have the knowledge about classification. Brain injuries can be described by their cause, the area of the brain involved or the progression of the injury. In conflicts and disasters, it is most important to focus on obtaining the answer to three basic questions:

- **Is the ABI traumatic or non-traumatic?** You can find this out through the mechanism of injury, either from the patient themselves, their medical notes, at handover or from a family member or caregiver. *This may have implications for possible associated injuries and the emotional state of the patient and their readiness to engage with early rehabilitation*
- **Is the ABI open or closed?** The patient, their caregiver or their medical notes should contain this information. Be careful not to make assumptions – a patient may have dressings and bandages around their head because of a scalp laceration, but the head injury itself may be closed. *This may have implications for the stability of the patient and the education you should provide about positioning and pressure care*
- **Is the ABI primary or secondary?** Primary refers to the initial injury, which could be traumatic or non-traumatic, while secondary means an ongoing response to the primary injury, such as swelling, raised ICP, seizure or infection. You may be able to gain this information from your subjective assessment, but it is likely you will need to check the medical notes or speak with the medical team. *If the patient's history of the injury is unclear, this may have implications on providing education on the prognosis of recovery and making an accurate treatment plan*

## Severity of an ABI:

Many systems exist to classify the severity of a brain injury. The 'Alert, Verbal, Pain Unresponsive' (AVPU) tool is a simplification of the Glasgow Coma Scale (GCS), which can quickly and accurately be used in conflict or disaster setting. Please refer to Chapter 3 for more information on how to use this tool.

Where haematoma (bleeding) is present in a traumatic brain injury, the injury can also be described by where the bleed is located, either above (extradural) or below (subdural) the dura mater, or lining of the brain. You are only likely to have this information if brain imaging is available. Haematomas cause injury to the brain through the pressure exerted on the surrounding areas, which cuts off oxygen supply. They are common in the frontal and temporal areas where the brain gets pushed against prominent areas of the skull.

Be aware that there are multiple labels for brain injury, including intracerebral haemorrhage, diffuse axonal injury, subarachnoid haemorrhage or ischaemic stroke. Your approach for rehabilitation should always be guided by information from the medical team, a thorough assessment and working within your scope of practice.

**Associated injuries to be aware of:****Skull fractures**

As with other bones of the body, skull fractures can range from simple, with no obvious lumps or bumps, to more complicated, where the shape of the skull may be noticeably deformed. Fractures to the skull may also be open or closed (refer to the fractures chapter). Open fractures carry a high risk of secondary infection. You should be aware that fractures at the base of the skull may be associated with leakage of pale yellow, sticky fluid (CSF) from the ears or nose and can lead to infection, such as meningitis, in the future.

*Signs and symptoms of a skull fracture:* Bleeding, pain, swelling, deformity and bruising of the face. Bruising can include behind the ears or the presence of black eyes; it is best to be review bruising more frequently.

**Deterioration**

Any injury to the head, whether mild, moderate or severe, can worsen as the injured brain swells and creates more pressure and further damage. Remember that, in patients with other injuries, such as spinal cord injury or multiple fractures, a mild brain injury may initially be overlooked and symptoms may only be noticed later in treatment or after discharge. It is important to teach family members what signs of deterioration to look out for, and that they should return to a doctor if they suspect the person is getting worse. If the patient is alone, or has been separated from friends or family, alternative plans for monitoring should be made, such as informing a neighbour or health focal point in emergency accommodation.

The following symptoms indicate potential signs of deterioration:

- Unconscious patient or altered consciousness (the patient can't keep their eyes open)
- Unusual tiredness
- Headaches that worsen or do not resolve
- Increased tiredness (feeling sleepy when normally would be awake)
- Double incontinence
- Dizziness or loss of balance
- Nausea or vomiting
- Irritability or altered mood
- Slurring of words or problems understanding speech
- Difficulties with concentration or memory
- Weakness in one or more limbs
- Visual problems, such as difficulty focusing or sensitivity to light
- Seizures
- Any bleeding or discharge of clear fluids from the nose or ears

## ASSESSMENT

The assessment of a patient with a brain injury in conflicts and disasters should follow the same format as a standard neurological assessment, as identified below. Due to the nature of the injury, it may be difficult to complete a subjective assessment and the patient may be unaccompanied. If this is the case, it is acceptable to only complete the parts of the assessment that it is possible to do. Only assess the components you feel competent to complete and work within your scope of practice.

At the end of the assessment you want to be able to produce a list of priorities and goals, a corresponding treatment plan and to be able to set some goals with your patient or their family/caregiver where possible.

General assessment guidance is provided in Chapter 3 of this handbook, however, give consideration to the specific elements for an ABI stated below.

### Subjective assessment

#### History of Presenting Condition (HPC):

- How long ago was the injury?
- Was there a loss of consciousness?
- Have the symptoms progressed or deteriorated?

#### Past Medical History (PMH):

Find out if the patient has had any surgery/medical conditions which may influence the rehabilitation outcome

#### Social History (SH):

- Who is the main caregiver/family member to involve in rehabilitation?

### Objective assessment

Things to look out for:

- Signs of trauma, including wounds and signs of surgery
- Signs of infection (refer to Chapter 3 for these)
- Any attachments (e.g. a catheter)
- Heart and respiratory rate (if they are abnormally high or low, alert the medical team)
- Position and symmetry of their eyes, face, head, trunk and limbs
- Function (i.e. what are they able to do?)
- Behaviour (see presentation of an ABI)

**Remember to always be aware of signs of deterioration for your patient. Please refer to Table 1 for more information.**

### AVPU

This can be used to quickly assess the severity and check for deterioration of an ABI in conflicts and disasters. A stable patient is likely to be A, but if the AVPU decreases it means the patient is deteriorating; in which case you must inform the medical team. When using the AVPU (or any measure) to assess the patient, the score should be noted as a baseline and then repeated at regular intervals (e.g. daily) to assess any change. Refer to Chapter 3 for information on how to use the AVPU Scale.

## Red flags and complications

These are specific to an ABI only; however, you should always be aware of non-condition specific red flags/complications. Refer to Chapter 3 for more information.

Table 1: Red flags for ABI

Red flag	Meaning	Action to be taken
Deterioration of AVPU or list of signs of deterioration	Sign of worsening or previously missed brain injury	Alert the medical team immediately
Sudden change (increase or decrease in blood pressure)	May indicate serious medical condition, including excess pressure in the brain, or insufficient blood supply	Alert the medical team immediately
Pressure ulcer which is open or not healing	The patient is prone to develop an infection. A pressure ulcer that is not healing can lead to osteomyelitis	You may be able to continue treatment if it does not disturb the wound, but you should alert the nursing team  Review the patient's position and cleaning, and avoid laying the patient on the pressure sore
Patient has persistent or productive cough	Patient may have developed a lung infection and/or may have problems with swallowing. If the cough is more prevalent in association with oral intake (food/drink), they may have problems with swallowing	<b>Alert the medical team.</b> Educate family about safe feeding guidelines: upright posture, slow rate, small mouthfuls. Some patients may benefit from food being mashed/pureed or drinks being made thicker. Keep mouth clean of residue food and bacteria

**Range of motion (ROM):** First check the active ROM and then the passive ROM at each joint. This will tell you the ability of the patient to follow commands and if they have any weakness or contractures.

**Tone:** When moving the joints through their passive ROM, you may feel a catch or resistance, which indicates high tone. Alternatively, the limb may be floppy, which indicates low tone.

**Power:** Test all major muscle groups using the Oxford MRC Scale. Refer to Chapter 3 for more information on its use. Trunk strength can be broadly assessed by the patient's ability to do a sit up.

**Sensation:** Check for ability to feel light touch and pain on all four limbs – ensure the patient has their eyes closed during the assessment.

**Proprioception:** The easiest way to check proprioception is to use joint position sense using the thumb and big toe. Ensure the patient has their eyes closed. Passively move the distal phalanx and ask the patient to identify if the movement is up or down. Proprioception can also be tested by placing the patient’s affected limb passively in a position and asking them to copy it with their unaffected limb if they have a hemiparesis; eyes need to be closed.

**Coordination:** For the upper limb, test finger to nose and look for any signs of tremor or over or under shooting. For the lower limb, test heel slide along the shin from the ankle to the knee. There are additional assessments for coordination that can be done, but these should only be carried out if it is within your scope of practice. More information about other assessments can be found in the *Rehabilitation in Sudden Onset Disasters* manual, referenced at the end of this chapter.

**Vision:** A detailed vision assessment is beyond the scope of this chapter; however, rehabilitation professionals are often the first to notice visual problems after an ABI. Visual problems may include blurred vision, double vision and/or reduced peripheral vision. You may also notice changes in size/reactivity of pupils, or failure of an upward gaze.

**Behaviour and mood:** An ABI, especially with the involvement of the frontal lobe, can result in changes in behaviour and mood. Patients may lose the ability to control their emotions. Emotional outbursts, involving shouting, crying or laughing, may occur and pass quickly. Patients may become very rigid in their thinking, have low motivation or be uninhibited in their behaviour or speech, using rude or suggestive language that would have been out of character before their ABI. If the patient is having difficulty controlling their emotions, they may experience bouts of crying or laughing unrelated to the emotion they are feeling in the moment. The patient’s personality may also appear quieter than before the ABI, and they may have difficulty demonstrating emotion, known as the ‘flat affect’.

**Cognition, memory and perception:** Changes in cognition, memory and perception may present as a decrease in attention, difficulty understanding complex tasks and sentences or difficulty reading emotion in others. Try to conduct your assessment in a quiet, distraction-free space, using clear and simple instructions. Take breaks as needed.

**Communication:** Communication challenges are very common after brain injury. You can screen for communication difficulties by:

- Observing communication during conversation with the patient (e.g. during your other assessments)
- Asking the patient/person accompanying them about changes in communication (use the prompts below or the Cognitive Communication Checklist for ABI) <https://www.assbi.com.au/resources/Documents/Assessment%20Resources/Free/CCABI%20checklist%20FINAL.pdf>

**Swallow:** Coughing when eating or drinking is a sign that the patient may have a problem with swallowing. This could increase the risk of food/drink entering the lungs, which could cause a chest infection.

**Functional assessment:** As part of any physical assessment, it is vital to assess the functional ability of the patient. When assessing functional tasks, you should consider the following:

- Can the patient complete the task?
- Can the patient order tasks correctly?
- Can the patient manage distractions?
- Is the patient impulsive and do they have insight?
- Does the patient present with any neglect to one side of their body?
- If the patient has neglect to one side of their body, can they compensate for this?



## Note

Note: Due to the nature of an ABI, the patient may have poor balance and be at risk of falling; therefore, you need to stay close to the patient during task assessments and may require a second person to help you. Begin your functional assessment with easier, lower-level tasks:

- Bed mobility – can the patient roll to one side and can they sit up on the edge of the bed? What level of assistance is required?
- Transfers – bed to chair, bed or wheelchair to toilet etc. How much assistance or equipment does the patient need?
- Sitting (with feet on the floor) – can the patient maintain sitting position independently or with assistance, and then can they maintain balance while reaching?
- Sit to stand and standing (only test if the patient has good sitting balance) – how much assistance (person or equipment) is needed and how long can the patient stay up? If the patient can stand, can they take a step?
- Walking – (only test if the patient can safely stand and step) – can the patient walk and how much assistance and/or equipment is required? Balance problems and difficulty coordinating movement (apraxia) are more common in cerebellum injuries
- Activities of daily living – can the patient perform routine tasks, such as eating, drinking, washing, dressing, toileting, cooking?
- See treatment section below for additional information

See this video for a rehabilitation assessment of a patient who has experienced a stroke:

<https://www.youtube.com/watch?v=XbI9-uSwtBg&t=1130s>

### Outcome measures

Detailed information about outcome measures (OM) can be found in Chapter 3 of this handbook. OMs should be used at the start of an assessment/treatment and may be repeated regularly to identify any progress the patient is making. Therefore, in conflicts and disasters, it is important to choose an OM that is simple and quick to use. Outcome measures can be quite detailed, assessing multiple tasks, such as the Rivermead Motor Assessment, or they can be simple and require little to no equipment, such as the ten-metre walk test. You can find a wide selection of patient outcome measures online at <https://www.sralab.org/rehabilitation-measures> and <https://www.strokingengine.ca/en/>. Timing how long it takes the patient to transfer from the edge of the bed into the wheelchair can be used as an OM to measure progress.

### Problem list, treatment plan and goal setting:

After completing the assessment of an ABI patient, it is helpful to create a list of the patient's problems. This will then allow you to make a treatment plan based on the areas with which you want to assist the patient. It is important to ask your patient what they want to achieve with rehabilitation. This will allow you to build up a set of goals that you can work towards together.

Remember, you may only have limited time with each patient. So, prioritise the aspects of the assessment that you need to complete, in order to give you the information that you need to start rehabilitation. Education is an important component of your treatment plan, and you should identify the main family member or carer who will be involved in treatment.



## REHABILITATION TREATMENT

Rehabilitation treatment has two main aims for an ABI:

1. To restore as much independence in the patient as possible
2. To educate the patient and their caregiver about realistic expectations and management strategies

The process of rehabilitation should start from basic activities, such as changing postures (when necessary), and then focus on other activities, increasing level of difficulty step by step (sitting, standing, balancing, walking). Important principles of effective neurological rehabilitation include practising specific functional tasks, such as sit to stand, regularly and repeatedly.

### Positioning in bed

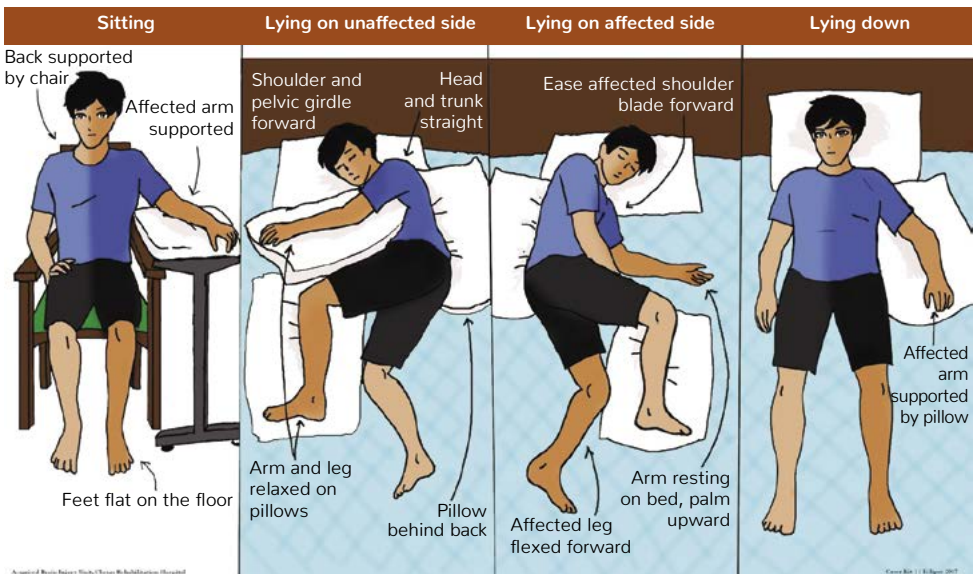
The patient's position should be frequently changed (every 3-4 hours) to avoid complications, such as developing pressure sores, contractures and respiratory problems.

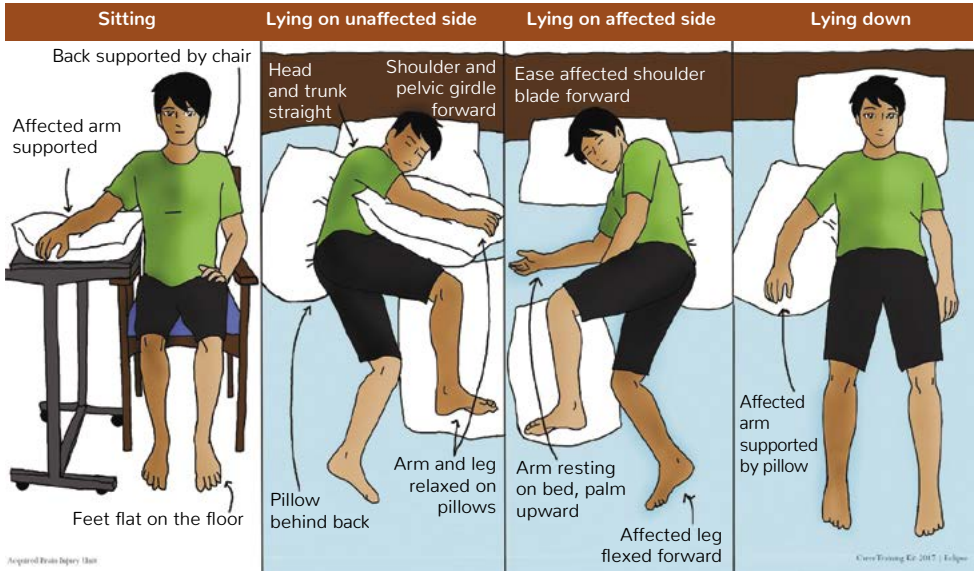
The aim of positioning is to avoid shortening (i.e. developing contractures) of muscles or putting pressure on particular joints or areas of skin. The patient can be moved from supine to right or left side lying in bed. If the patient presents with a hemiplegia (weakness on one side of the body), their position can be changed according to the pictures below. The use of pillows is useful for positioning; however, if you do not have pillows, rolled-up blankets/towels can also be used.

### Sitting out of bed

Positioning in sitting should start as soon as the patient is medically stable, as it can improve their level of alertness and it allows the patient to take deeper breaths. (For information on normal levels for heart rate, respiratory rate, blood pressure etc., please refer to Chapter 3 of this handbook).

**Diagram 3: Patient with left hemiplegia**



**Diagram 4: Patient with right hemiplegia**

Sitting out of bed also promotes activity in the muscles needed to keep an upright posture. As early as possible, teach the caregiver and other staff, e.g. nurses, to safely position the patient.

The patient may need support to achieve a good posture and alignment. Sitting training can start with sitting over the edge of the bed. They may need support for their body or head and a second person nearby. If the height of the bed prevents the patient's feet from touching the floor, put a block or support on the ground to ensure the feet are supported, rather than hanging.

Once the patient has sat out over the edge of the bed, they can progress to sitting seated in a chair or wheelchair.

### Training of bed mobility

Treatment should also include teaching the patient how to change position alone or with as little assistance as possible. The caregiver should be included in this training to learn how best to help the patient.

**Diagram 5: Postural management in sitting**

## Mobilisation

Passive movements can help to avoid the development of contractures and help with sensory problems if present. Assisted selective movement, if the person has some muscle activity, can stimulate and guide active movement recovery. If there is high muscle tone and loss of range of movement, prolonged stretches with casts, splints and positioning can be useful (they can be used while patient is resting). If you have access to plaster of Paris (POP) or thermoplastic splinting material, you can make basic splints to prevent contractures. If the patient requires long-term splinting you may need to work with local material and ask help from craftsmen.

Splinting and plaster casting for a patient with central nervous system injury is a difficult and complex skill. It requires a high degree of clinical reasoning to understand the risks and potential adverse effects, which are more complicated than in the case of a patient with a peripheral nerve injury. See <https://www.kcl.ac.uk/cicelysaunders/attachments/splinting-guidelines/neurosplinting-quick-reference-guide.pdf> for further guidance.

## Trunk control

Trunk control is an important early predictor of functional outcome after an ABI. If control in sitting is poor, it's important to focus treatment on trunk training exercises by gradually reducing the support given from behind and at the sides and then progress to dynamic sitting balance activities.

## Standing in the early stages

Standing can be beneficial for:

- preventing shortening of ankle plantar flexor
- hip flexor muscles
- preventing loss of bone density in the lower limbs
- encouraging deep breathing
- increasing alertness
- addressing postural hypotension (low blood pressure causing dizziness) after prolonged bed rest

Heart rate, respiratory rate and other signs, including sweating, colour, facial expression and level of alertness, should be monitored; this will indicate how the patient is tolerating the treatment. When standing the patient for the first time, it is better to have two people help them to stand up from sitting on the bed, so that in case of dizziness or feeling faint, you can immediately lay the patient down and raise their legs.

## Mobility skills (bed to chair transfer, sit to stand, standing, balance, walking, floor transfer)

If the patient can independently maintain sitting position, they can be trained in transferring from bed to chair and back. If it's not possible for the patient to perform this by themselves, the caregiver can be trained to assist.

Where available resources allow, you can give the patient a walking aid (a walking frame if they can use both arms or a single-point or quad cane if they cannot). It is important to teach the patient how to safely use the walking aid. As the patient improves, they may need less support, e.g. moving from using a walking frame to a single cane. In case of ankle plantar flexion due to

high tone or dorsi flexor weakness, an ankle foot orthosis (AFO) may be provided to improve walking by helping the foot to clear the ground.

If the patient has poor balance, work in different positions i.e. sitting, kneeling with one or both knees and standing to improve their stability. If the patient usually spends a lot of time sitting on the floor at home, you should train them to sit on the ground and get back up into standing.



**Picture 6: Resting Splint Positioning**

### Upper limb function

Patients can experience arm weakness, swelling and tight muscles in the upper limbs. This can be due to high tone or low tone in the muscles, contractures, shoulder instability, changes in sensation and pain.

In cases of mild to moderate weakness, encourage use of the affected hand as much as possible. A sling on the unaffected hand or arm can be used (constraint-induced movement therapy) to prevent it from moving. This can promote improvement in a weaker side, with active wrist and finger extension. If the arm/hand is swollen, support

it in a raised position when sitting using a pillow or rolled-up towels. To help prevent contractures and shoulder pain, regularly position the arm as shown in the diagram below, as long as the patient is comfortable. In case of high tone causing a tight hand, a resting splint can be used to avoid contractures. Refer to the peripheral nerve injury chapter for further information on splinting and use of local materials.

**Shoulder instability or pain:** The patient may need an arm support (via pillows/rolled-up blankets) or a sling for shoulder instability. You should teach the patient and the caregiver how to protect the arm by avoiding pulling on it or avoiding letting it hang in a dependent position. More information about pain can be found in Chapter 3 of this handbook.

**Sensory problems:** Sensation can be affected in different ways; touch may be reduced, lost or exaggerated, with certain sensations feeling uncomfortable or intolerable to the patient. If so, you can help retrain the patient's sensation by using different materials, objects and textures to stimulate sensory fibres in areas of absent/ altered sensation. Proprioception may be reduced and the patient may have difficulty understanding where their limbs are in space without observing them. If so, teach the patient basic compensatory strategies, such as observing the limb when moving it, i.e. reaching for something.

**Fatigue:** Fatigue is a significant problem in an ABI, even among patients with only mild brain injury, including concussion. If the patient reports or demonstrates fatigue, include advice regarding sleep hygiene (a dark, quiet bedroom with limited noise and a routine sleep and wake time) and pace activities. During rehabilitation sessions, limit noise and interruptions to prevent the patient from becoming over stimulated.

**Self-care skills, including activities of daily living (ADLs):** Encourage use of the affected limb where possible, or incorporate activities involving limbs. If necessary assist the affected limb during the movement. If the affected limb does not have any active movement, teach bathing

and dressing techniques with one limb (remember that the weak limb/side should be put in the sleeve first and out last). You can also teach the caregiver to do it without injuring the patient by dragging or creating friction over delicate skin, or pulling on the shoulder/limb on the affected side. Find aids that can be provided or built to help the patient increase their independence (such as toileting aids). This video shows a patient dressing themselves after a stroke: [https://www.youtube.com/watch?v=zZkwr\\_mfU5Y](https://www.youtube.com/watch?v=zZkwr_mfU5Y)

Constipation can be a significant problem that causes pain and worsens spasticity. Establishing a bowel and bladder routine as early as possible is important to limit complications and pain. Bladder and bowel retraining is usually led by the nursing team, with the input and cooperation of rehabilitation professionals. If a bladder and bowel routine has not been established, consult the medical team.

**Breathing:** Respiratory problems are a common complication of an ABI. Refer to the respiratory section in Chapter 3 for more information.

**Education:** An important component of treatment for both the patient and their caregiver is teaching them about the condition. Family should be made aware of different aspects of the patient's condition, difficulties they encounter and their residual capabilities.

**Swallowing:** Only give food to the patient when they are alert and able to engage in oral intake. The patient should always be advised to sit in an upright position when eating or drinking and to eat at a slow pace, taking small amounts at a time. Alternating mouthfuls of food and drink can help (though avoid having two different consistencies in the mouth at the same time). Encouraging the patient to cough every few mouthfuls can help protect the airway. Some patients may benefit from food being softened to minimise the need for chewing. Thin fluids can pose a dangerous risk to patients with swallowing difficulties. Providing drinks that are naturally thicker and flow slower can be beneficial in giving the patient more time and more control when swallowing. For example, you can add mashed potato to soup or banana to juice or use flour to thicken some drinks. Maintaining good oral hygiene, so the mouth is free of excess saliva or food debris, which can be aspirated, is critical in minimising the risk of aspiration.

**Mood and behaviour:** It is important for the patient and their family to understand that these changes are a result of brain injury and not the injured person's fault. It's advisable to stay calm when the patient is upset to avoid increasing their agitation. If the patient demonstrates behaviours that are spontaneous or aggressive, plan your treatment accordingly; attend with a colleague, use a private space that is cleared of material that could injure the patient or others and do not overload the patient with tasks or instructions. Reassure the family that it is unlikely that their behaviour or actions triggered an emotional outburst. Gently redirect the patient to another topic, once they have calmed down, and reassure the patient themselves.

**Cognitive skills:** Cognitive changes are often associated with an ABI and it is important to reassure patients and carers that memory or attention problems are due to the brain injury. Advise the family that strategies, such as keeping a diary, regular routines and repetition, may be helpful.

**Communication:** Ideally, if communication difficulties are noted, a speech and language therapist (SALT) should be involved. In conflicts and disasters, it is unlikely that a SALT will be available; therefore, one of the most effective ways to support successful communication is to ensure that other people in the environment (staff and family) are using good communication strategies. Try to establish a clear means of communicating 'yes' or 'no', as this provides a way to obtain consent for your interventions and enables the use of closed questions, e.g. about pain, hunger, toileting etc.

**To support connection:**

- Approach the conversation with the assumption that the patient is competent and able to interact
- Avoid test questions and aim for a genuine, two-way interaction

**To support understanding:**

- Use a natural, conversational tone of voice
- Use one idea per sentence
- Introduce topics and be clear when changing the subject
- Try visual supports or writing key words – talk and point/write at the same time

**To support expression:**

- Allow the patient time to respond
- Use visual supports or write key words
- Use choice questions (e.g. 'is this about your mother, your brother or someone else?')
- Confirm that you understand the patient by repeating what you understood (e.g. 'you're asking about your brother, is that right?')

**Communication aids:**

These may be useful for some patients. Communication boards are not an automatic 'solution' but require a degree of design, support and practice for the patient and those around them. Generic communication boards can be designed for specific conflict and disaster settings. Here is an example used in Mozambique during an emergency response: [https://www.up.ac.za/media/shared/212/ZP\\_Files/humanitarian-aid-emergency-medical-services-portugese.zp172927.pdf](https://www.up.ac.za/media/shared/212/ZP_Files/humanitarian-aid-emergency-medical-services-portugese.zp172927.pdf).

## REHABILITATION TREATMENT OUTCOMES

**Immediate:** Anyone who has experienced a head injury is at risk of deterioration. Before discharging the patient, or sending them home, ensure that they and their caregivers are aware of the signs of deterioration and how they can contact medical services if they experience or notice these signs occurring.

**Short-term:** Around one in every eight patients with a mild brain injury will experience persistent symptoms, such as headaches, problems with their balance, tiredness and changes in the mood or cognition. These should resolve over time, but it is important to advise the patient to take things slowly and not return to all of their previous activities too quickly.

**Medium-term:** By the time you discharge your patient, or finish the early phase of their rehabilitation, you should have achieved certain goals listed below:

- Patients (possibly with the assistance of the caregiver) should be able to manage their highest level of independent movement. This may be bed mobility and positioning, transfers or standing/walking with an aid
- The patient and their caregiver should know their exercise regime to continue at home, with a focus on functional exercises repeated often. They should know that improvement can continue with these exercises
- If the patient uses any splints or aids, such as a wheelchair, they should be able to safely use it and check for signs of damage to the equipment or to their own skin
- The patient and their caregiver should know which activities and positions should be avoided as they may cause harm, e.g. pulling the patient by the weak arm or lying in bed without a position change for more than four hours when they are unable to move independently
- You should have reviewed the appropriate patient information leaflet with them and given the patient and their caregiver a chance to ask any additional questions they may have

**Long-term:** It is unlikely that in a conflict and disaster setting you will be able to continue to see your patient beyond the acute phase, but linking them to any available longer-term services is important. Long-term improvement and outcome depend on many factors; these include the severity of the initial injury, the presence of additional injuries (which can complicate or slow down recovery) and the ability of the patient and their caregivers to understand/adhere to a home exercise programme. Unfortunately, not all patients will make a complete recovery following brain injury; some will be left with lifelong difficulties as a result of their injury. If it seems relevant, you may inform the patient's family that, as the conflict or disaster situation resolves or stabilises, more rehabilitation services may become available and they can seek these out for additional care and rehabilitation.

## CASE STUDY

### Background

The patient is a 32-year-old female who was pulled from the rubble of a collapsed building three hours post-earthquake, ten days ago. She sustained an injury to the head and multiple fractures (left humerus, left tibia/fibula, ribs 7, 8, 9 on the right-hand side) and some facial injuries. Her sister, who was present when the patient was rescued, reports temporary loss of consciousness on the way to the hospital and the patient was confused. She reports no vomiting or seizures. The nurse accompanying the patient to the rehabilitation department reports the medical notes are not available and she does not know the patient well.

### Assessment

**Observation:** Patient is lying in bed, she appears tired, emotional and cries easily, but consents to treatment. She is wearing a left, below-knee cast and her left arm is in a sling.

**Active range of motion:** unable to assess on left side due to fractures, but able to wriggle fingers and toes. Asked the patient to do simple movements, bending her right knee and taking her hand to her mouth. The patient is able to move her right leg, but not through its full range of motion; no movement seen in right arm.

**Passive ROM:** tested in all joints (free from casting) on both sides with no problems noted.

**Tone:** Tested on the right side only, since left side is immobilised by cast and sling. The upper limb felt very floppy during testing, but some resistance to dorsiflexion was noted at the right ankle.

**Power:** Tested using the Oxford MRC Scale, graded as 0/5 for all major muscle groups through right upper limb and 2/5 in the right lower limb

**Sensation:** On testing, reduced sensation to light touch was noted in the right arm and leg, proprioception was normal in all limbs.

**Coordination:** Not tested due to fractures on the left side and extensive weakness on the right.

**Speech and comprehension:** Patient seems to be communicating normally and following basic commands in her own language.

### Functional assessment

The patient is reluctant to roll due to pain, especially around her ribcage. Lying to sitting without a full roll required the assistance of two people – one to support the lower limbs and one to manage the trunk and arm. Once up, the patient does not report any dizziness and can sit unsupported. The patient's legs do not reach the floor, and so were supported on a block. Sitting balance during movement was not tested due to lack of arm function and pain on trunk movement. At this time, the patient requires full assistance with all basic tasks, such as eating and drinking and personal care, and is being supported by family members. Transfers, standing and walking were not assessed due to power of 2/5 in right leg. A non-weight-bearing status on the left leg and arm is initially assumed, due to the lack of medical notes.

### Clinical impression

Right-sided weakness and loss of sensation due to left-sided ABI, indicating likely parietal and frontal lobe involvement. Rib pain is a limiting factor to assessment and a likely limitation for



treatment unless better controlled. Right upper limb is low-toned, lacking activity and at risk of shoulder subluxation and development of shoulder pain. Increased tone in plantar flexors on right-hand side and at risk of muscle shortening. Patient is currently fully dependent for all transfers and daily activities. Noted that the patient was tearful and may need further assessment due to recent psychological trauma and frontal lobe involvement.

**Treatment goals (short-term):** Get patient out of bed for sitting and clarify weight-bearing status on the left leg and precautions for left upper limb.

**Treatment approach:** Build time in upright sitting for now and allow weight bearing in sitting through the right foot while maintaining good ankle positioning. Patient to sit out in a chair regularly but requires a lift transfer to the chair at present. Avoiding complications related to immobility by regular position changes, advice to the patient to wriggle fingers and toes and maintain movement in the left side as pain and fracture sites allow. Confirm weight-bearing status on left leg with medical team. If the patient is non weight bearing, consider splint for right ankle to maintain muscle length during rest. Start regular, repeated right leg exercises to improve activity and power. Once right gluteal and quadriceps are 4/5 on the Oxford MRC Scale, the patient can single leg stand on this leg with assistance. Begin sensory re-education of right side.

**Education:** Advise and teach the patient's sister about the importance of and how to change position regularly. Teach her sister to do safe, daily, passive range of motion exercises for right arm, noting that abduction and forward flexion should remain below horizontal level. Inform her about the risk of developing shoulder pain and how to care for the arm by supporting its weight when upright and avoiding pulling on the arm. Inform her about the possibility of ongoing altered or low mood. Use her sister to identify motivating/interesting stimuli for meaningful activities and to monitor mood. Inform her about the possible development of shoulder pain and how to care for the arm. Ensure her sister is aware of the patient's need for assistance with daily activities.

**Outcome:** As the rib pain decreases, the patient can become more actively involved in bed mobility. Once patient has enough power in her right lower limb to stand and/or fractures have healed or weight-bearing status has changed to full weight bearing (whichever is first), she should then be in a position to work on standing and stepping. At this time, it is not possible to predict the outcome of her right arm function, but once the left arm fracture is healed, she should be more independent in daily activities.

## KEY POINTS

1. In conflicts and disasters, rehabilitation professionals are most likely to encounter mild or moderate brain injuries, rather than severe injuries as severe brain injuries do not survive
2. Rehabilitation professionals must know signs of deterioration of a mild head injury and be able to educate the family/patient on how to spot these and to refer or return back to the medical team
3. Treatment should be based around functional activities/exercises with high repetition and prevention of secondary complications
4. Due to the limited duration of treatment in conflict and disaster settings, education and inclusion of the caregiver should form key parts of your treatment

**Core recommended text**

*Rehabilitation in Sudden Onset Disasters* manual

*Physical Management for Neurological Conditions* Lennon S, Ramdharry G, Verheyden G (Eds.) 2018. 4th Edition, Oxford, Elsevier

*Starting again*, Davies, Patricia M., Springer ed. 1994

---

**REFERENCES**

Web-based resources have been linked throughout the chapter.

*Cognitive Communication Checklist for Acquired Brain Injury (CCCABI)* MacDonald, Sheila (2015) CCD Publishing; Guelph, Ontario, Canada, N1H 6J2, [www.ccdpublishing.com](http://www.ccdpublishing.com) available from <https://www.assbi.com.au/resources/Documents/Assessment%20Resources/Free/CCCABI%20checklist%20FINAL.pdf>

Video demonstrating the use of some strategies with a person having difficulty expressing themselves <https://www.youtube.com/watch?v=KWVogM9jmEM>

---

## CHAPTER 8

### CHAPTER 8: EARLY REHABILITATION OF SPINAL CORD INJURIES

#### AIMS:

By the end of this chapter, you should be able to:

- Demonstrate a basic knowledge of a spinal cord injury (SCI)
- Perform a basic assessment for patients presenting with SCI, or possible SCI, including complication monitoring
- Develop a problem list for a patient with an SCI
- Develop and deliver a basic rehabilitation plan for a patient with an SCI



## CHAPTER 8: EARLY REHABILITATION OF SPINAL CORD INJURIES

### INTRODUCTION

Spinal cord injuries (SCIs) are commonly seen following earthquakes, and much of the published literature relates to this presentation. It is important to recognise, however, that these injuries will present in any conflict or disaster setting where people may experience a direct crush injury, crush with traction/rotation (particularly in the pre-hospital recovery phase when extracted from a building or vehicle with limited understanding of spinal precautions), falling from a height or blast injuries which involve a fall or direct trauma to the spine from shrapnel or bullet wounds.

Following conflicts and disasters, hospitals can expect an acute surge in admissions of patients with SCI, and these generally increase for several weeks as people are extracted, identified, or new injuries arise in the aftermath of the event. Complications, such as pressure ulcers and urinary tract infections, are common in conflicts and disasters, due to delayed transfers to specialist centres, high health worker-to-patient ratios, inadequate equipment and consumables and premature discharge related to bed pressures.

During the Nepal earthquake in April 2015, the Spinal Injury Rehabilitation Centre had a total of 38 patients at the time of the first earthquake. Within the first three weeks, an additional 62 patients were admitted, with subsequent daily admissions. Earthquake-related admissions continued for months, with the final known earthquake-related patient being admitted in March 2016. 33% of patients had documented pressure ulcers and urinary tract infection was seen in 29%. Other challenges faced during the surge of patients included inadequate numbers of beds, patients being nursed on the floor and inadequate numbers of staff, equipment and consumables.

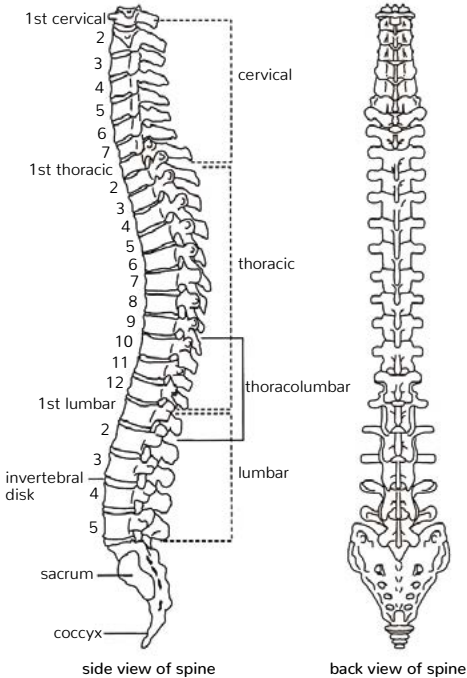
In many low-income countries, the level of pre-existing services for SCI is minimal. There can also be a limited cultural understanding of SCI, poor practices in handling people with suspected SCI after immediate onset of injury and inadequate management of skin, bladder and bowel. The preventable secondary conditions are just as threatening to these patients as their initial injury, leading to compromised health and functioning outcomes or death. Early assessment and rehabilitation may prevent or reduce many of these issues.

Rehabilitation needs for people with SCI will persist far beyond the initial acute stage, therefore, close, supportive collaboration must be established with local services from the outset. Basic information about expected outcome is important to be able to communicate with the patient so they can initiate long-term goals. In conflicts and disasters it should be noted however that the realisation of long-term goals for the person with SCI may be affected if they cannot return to their own home or find appropriate sources of income.

## ANATOMY, PHYSIOLOGY AND PATHOLOGY

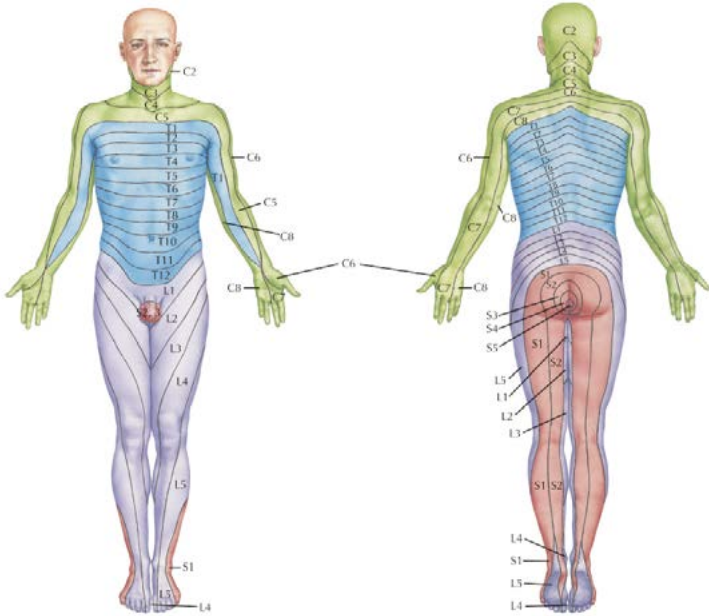
It is important for any rehabilitation professional working with a person with an SCI to have a thorough understanding of the anatomy and physiology of the nervous system, in order to understand the presentation and the impact of the pathology on functioning. The spinal cord

### Diagram 1: Normal spine



consists of 31 segments, associated with 31 pairs of spinal nerves (eight cervical, 12 thoracic, five lumbar, five sacral and one coccygeal). The ascending sensory nerves within the spinal cord receive and transmit sensory information to and from the brain. The descending motor nerves transmit information from the higher brain structures to various parts of the body to initiate motor functions, such as movement, and to regulate autonomic functions, such as respiration and blood pressure. The spinal cord is also critical for transmitting and integrating information within the spinal cord. SCI which results in disruption of the nervous transmission can have considerable physical and emotional consequences to an individual's life. Paralysis/weakness or altered sensations in parts of the body innervated by areas below the injured region almost always occur. In addition, individuals also experience other changes affecting bowel, bladder, pain, sexual function, gastrointestinal function, swallowing ability, blood pressure, temperature regulation and respiration.

For more information, please refer to: <https://www.mascip.co.uk/wp-content/uploads/2015/02/MASCIP-SIA-Guidelines-for-MH-Trainers.pdf>

**Diagram 2: Dermatomes and myotomes map**

## ASSESSMENT AND MONITORING

Assessment is the first step in the management of the person with an SCI. All patients with a diagnosed or suspected traumatic SCI must be considered to be critically ill, due to both the severe changes related to the interruption of neural transmission conveyed by the spinal cord and the high risk of related complications. During the early rehabilitation phase, it is recommended that a multidisciplinary team (MDT) assessment is carried out. This assessment must include an overview of the risk of developing complications.

Three factors may affect the overall clinical condition of patients with an acute SCI:

1. The extent of neurological damage, including the completeness of the injury and zone of partial/lack of innervation
2. Presence of associated trauma
3. Age and/or pre-existing medical history

## Complications

These complications are specifically highlighted for SCI; however, you should always be aware of non-condition-specific red flags/complications. Refer to Chapter 3 for more information.

**Table 1: SCI-specific complications**

Complication	Meaning	Action to be taken
Autonomic dysreflexia (AD)	<p>Those with lesions at T6 and above after resolution of the spinal shock phase are at risk of AD, which refers to an uncontrolled and excessive increase in sympathetic activity, usually caused by:</p> <ul style="list-style-type: none"> <li>— Nociceptive stimuli under level of the lesion</li> <li>— Distended bladder due to blocked catheter, or full bag</li> <li>— Distended bowel</li> <li>— Signs and symptoms include:               <ul style="list-style-type: none"> <li>— Sudden rise in blood pressure (&gt;20mmHg)</li> <li>— Decreased heart rate/bradycardia</li> <li>— Flushing above level of injury</li> <li>— Sweating above level of injury</li> <li>— Tight band around chest depending on sensory deficit</li> <li>— Feeling unwell</li> <li>— Sudden headache</li> <li>— Blurred vision</li> <li>— Stuffy nose</li> <li>— Feeling of impending doom</li> </ul> </li> </ul>	<p><b>ALERT MEDICAL TEAM IMMEDIATELY</b></p> <p>This condition, if not recognised and treated, may result in death</p>
Change in neurology	<p>Particularly relevant in the acute SCI phase and maybe a sign of an unstable spine. It is important to be aware of signs indicating damage at a higher level of the spinal cord. New signs of deterioration in respiratory function can be an indicator that this may have occurred (respiratory functions are affected by injuries at C5 and above)</p>	<p><b>ALERT MEDICAL TEAM IMMEDIATELY</b></p> <p>Risk of further damage to spinal cord and supporting structures</p> <p>Ensure safe handling techniques and maintain a stable spine (see treatment section)</p>

Complication	Meaning	Action to be taken
Neurogenic shock	<p>Sudden disruption of signals that maintain autonomic nervous system control over vasoconstriction leading to hypotension. Occurs in acute SCI at cervical or high thoracic level that blocks sympathetic activity</p> <p>Secondary effects of general autonomic disturbance following SCI can include: Bradycardia (HR less than 60bpm), hypotension (systolic &lt;90mm/hg), sudomotor changes, thermoregulation poikilothermia</p>	<b>ALERT MEDICAL TEAM</b>
Spinal shock	<p>All reflexes lost below level of injury for three days to three months. Loss of gastrointestinal function, resulting in paralytic ileus and neurogenic bladder/bowel</p> <p>Difficulty digesting food with subsequent abdominal distention and vomiting</p>	<b>ALERT MEDICAL TEAM</b>
Patient has persistent or productive cough	<p>Patient may have developed a lung infection and/or may have problems with swallowing (dysphagia). If the cough is more prevalent in association with oral intake (food/drink) they may have problems with swallowing, resulting in fluid and food entering the airway. This could increase the risk of developing pneumonia</p>	<p><b>ALERT MEDICAL TEAM</b></p> <p>Educate family about safe feeding guidelines: upright posture, slow rate, small mouthfuls. Some patients may benefit from food being mashed/pureed or drinks being made thicker. Keep mouth clean of residue food and bacteria</p>
Pressure injury	<p>A pressure injury is localised damage to the skin and underlying soft tissue usually over a bony prominence.</p> <p>May present as intact skin that is red and fails to blanch (may be difficult to detect in dark pigmented skin) or an open ulcer and may be painful if the person has sensation in the affected area</p> <p>Occurs as a result of intense and/or prolonged pressure or pressure in combination with shear</p> <p>Typical areas where people develop pressure ulcers include the heels, buttocks, shoulder blades, thoracic spine, posterior ears and occiput, depending on positioning and how much time is spent in prone</p>	<p>Identify issue with nursing team</p> <p>See treatment section for pressure injury prevention and care</p>



Complication	Meaning	Action to be taken
Deep vein thrombosis (DVT) and/or pulmonary embolus (PE)	<p>Signs and symptoms include:</p> <ul style="list-style-type: none"> <li>— Swelling of the lower limb (usually unilateral)</li> <li>— Reduced peripheral pulses</li> <li>— Erythema/redness of the skin (not seen in dark pigmented skin)</li> <li>— Heat of skin increased</li> <li>— Pyrexia</li> <li>— Autonomic dysreflexia symptoms in patients with a T6 and above lesion</li> <li>— Pain depending on sensory deficit</li> <li>— Increased leg spasms</li> </ul>	<p><b>ALERT MEDICAL TEAM IMMEDIATELY</b></p> <p>Stop passive movements, mobilisation and manual respiratory techniques until after medical review</p>
Heterotopic ossification (HO)	<p>Abnormal calcification that develops in soft tissues outside of the joints.</p> <p>Signs and symptoms include :</p> <ul style="list-style-type: none"> <li>— Erythema/redness of the skin (not seen in dark pigmented skin)</li> <li>— Heat and swelling of affected area</li> <li>— Hard, palpable mass</li> <li>— Reduced joint mobility and subsequent loss of function</li> <li>— Pain depending on sensory deficit</li> <li>— Increased spasticity</li> <li>— Pressure area</li> <li>— Autonomic dysreflexia</li> </ul>	<p><b>ALERT MEDICAL TEAM FOR ASSESSMENT</b></p> <p>Care required with manual therapy</p>
Spasticity/contracture	<p>The cause of contractures can be:</p> <ul style="list-style-type: none"> <li>— Neurally mediated – due to spasticity or involuntary contraction of muscles which are velocity dependent</li> <li>— Non-neural mediated – primarily due to prolonged positions and immobility</li> </ul>	<p>Maintain joint mobility and prevent oedema through exercise, positioning or splinting</p> <p>Link with medical team for medication options related to pain and spasticity management</p>

Complication	Meaning	Action to be taken
Unmanaged bladder and bowel issues	<p>Incontinence, retention and constipation may cause significant complications such as:</p> <ul style="list-style-type: none"> <li>— Infection (see Chapter 3)</li> <li>— Autonomic dysreflexia</li> <li>— Pain</li> <li>— Functional, social and psychological impact</li> </ul>	<p>Co-ordinate with the MDT for assessment and ongoing management</p> <p>See treatment section for details</p>

It is important to follow a systematic approach to assessment and treatment. General assessment guidance is provided in Chapter 3 of this handbook; however, give consideration to the specific elements for a SCI stated below. Assessment should be part of the MDT approach. At the end of the assessment you should be able to produce a list of priorities and goals and a corresponding treatment plan, and be able to set some goals with your patient or their family/caregiver where possible. It is important to begin planning for discharge with a patient with an SCI and their caregiver as early as possible; therefore, this should be thought about while creating a plan after your initial assessment.



The key specific areas of assessment for patients with an SCI, both initially and ongoing, are:

- Identification of complications (see Table 1 above)
- Autonomic function
- Bladder and bowel function
- Motor function
- Sensory function
- Activities of daily living (ADLs)
- Psychological and emotional wellbeing

It is imperative that assessments, as a minimum, include the ISNCSCI 2019 Revision (International Standards for the Neurological Classification of Spinal Cord Injury) – formally known as the ASIA assessment, the ASIA Impairment Scale (AIS) and the SCIM III (Spinal Cord Independence Measure).



### ASIA ASSESSMENT

The International Standards for the Neurological Classification of Spinal Cord Injury (ISNCSCI) This gold standard assessment for documentation of the level and severity of an SCI provides an internationally standardised classification system for SCI, giving a 'neurological level of injury' and also an 'incomplete' versus 'complete' injury classification.: [https://asia-spinalinjury.org/wp-content/uploads/2016/02/International\\_Stdts\\_Diagram\\_Worksheet.pdf](https://asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stdts_Diagram_Worksheet.pdf).

To learn more, please access the free online e-learning resource from the American Spinal Injury Association (ASIA): 'The International Standards Training e-learning Programme (InStEP)'. This modular course is designed to enable clinicians to perform accurate and consistent neurological examinations: <https://asia-spinalinjury.org/learning/>.

### **The Spinal Cord Injury Independence Measurement Scale (SCIM III)**

A clinician-administered disability scale, developed to specifically address the ability of people with an SCI to perform basic activities of daily living independently. The SCIM assesses three areas: self-care, respiration and sphincter management and mobility (including toileting). A self-report version of SCIM (SCIM-SR) is also available: [https://scireproject.com/wp-content/uploads/SCIM\\_Toolkit\\_Printable-1.pdf](https://scireproject.com/wp-content/uploads/SCIM_Toolkit_Printable-1.pdf).

## **REHABILITATION TREATMENT**

Regardless of context, the fundamentals and management principles of SCI rehabilitation are similar. [www.elearnsoci.org](http://www.elearnsoci.org) physiotherapy and occupational therapy modules provide a comprehensive educational resource relating to the management and treatment of the person with an SCI, and are a recommended resource.

### **Initial medical and surgical management**

Vertebral injuries are managed either conservatively or surgically. If managed conservatively, patients are typically immobilised in bed for six to eight weeks. If managed surgically, patients are typically mobilised sooner after injury. The way vertebral injuries are managed has implications on the type and intensity of rehabilitation provided. For immobilised patients, it is important that the patient is facilitated to be as physically and psychologically active as possible. It is critical to prevent stiffness and oedema and maintain muscle strength, so the focus should be on active rehabilitation.

### **Precautions and safe handling of the unstable spine**

Rehabilitation professionals involved in the care of these patients need to follow specific precautions for an unstable SCI when carrying out their assessments and treatments to protect the spine from instability. This will be dependent on the level of injury.

The Multidisciplinary Association of Spinal Cord Injury Professionals (MASCIP) Guideline 'Moving and handling patients with actual or suspected spinal cord injuries' provides therapists with a practical pictorial guide to ensure the safe handling of a patient with SCI, or a suspected SCI: <https://www.mascip.co.uk/wp-content/uploads/2015/02/MASCIP-SIA-Guidelines-for-MH-Trainers.pdf>

The integrated care pathway for patients with an acute SCI involves numerous transfers between surfaces, wards and departments, or even between different hospitals before eventual admission to a specialist care facility. Wherever there is a reasonable suspicion of acute SCI, the aim is to maintain full spinal alignment during any moving and handling activity. Careful handling, positioning and turning, on every single occasion, can prevent or significantly reduce

the patient's pain and discomfort. It will also reduce the potential for skin damage and secondary spinal cord trauma. The pictorial guidelines by MASCIP are provided as a resource for moving and handling trainers to support the promotion of best practice: <https://www.mascip.co.uk/wp-content/uploads/2015/02/MASCIP-SIA-Guidelines-for-MH-Trainers.pdf>

Number of persons required for turning a patient with an unstable SCI, according to ATLS (Advanced Trauma Life Support) and MASCIP guidelines, are:

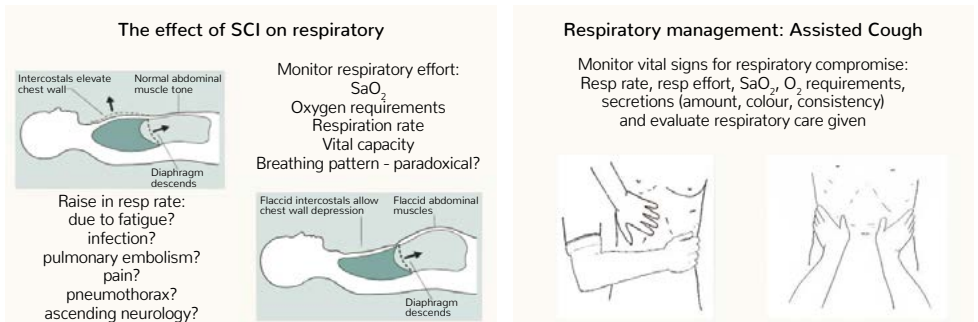
- For an injury of T9 and above: a five-person turn
- For injuries T10 and below: a four-person turn

## Breathing

Respiratory problems are a common complication of SCI. Refer to the respiratory section in Chapter 3 for more general information. Paralysis or partial paralysis has a marked impact on respiratory function, due to respiratory muscle weakness, plus decreased pulmonary and rib compliance.

Tetraplegia has a marked effect on all lung function apart from residual volume, which means that people with a tetraplegia are at risk of respiratory complications throughout their lives, due to respiratory muscle and decreased pulmonary and rib compliance with a restricted pattern of breathing. For more information, please refer to the MASCIP Guideline (link above).

### Diagram 3: The effect of an SCI on respiration and assisted cough



## Swallowing

Patients should not eat before a swallow assessment is made. The patient should always be advised to sit in an upright position when eating or drinking if possible and to eat at a slow pace, taking small amounts at a time. See the acquired brain injuries chapter for more information regarding treatment of patients with dysphagia.

## Bladder and bowel management

Although assessment, care and education in this area is all generally provided by the MDT it is important for the rehabilitation practitioner to be aware of bladder and bowel management within SCI treatment.

People with SCI commonly use a technique called intermittent self-catheterisation, in which they insert a catheter every few hours for a few minutes to drain their bladders. Alternatively,

they use indwelling (in acute care phase) or suprapubic catheters to manage their bladders. Rehabilitation Professionals require a general understanding of bladder management when treating people with an SCI. Assistance may be required with balance, spasticity and/or hand function to enable bladder management. The rehabilitation professional should be aware of the importance of pelvic floor muscle strengthening in individuals with an incomplete SCI.

People with SCI have a bowel management programme, so that they are continent and evacuate their bowels at a planned time. This programme commonly involves the use of enemas or suppositories (i.e. medication inserted into the rectum). People with SCI also need to be mindful of their diet. Rehabilitation Professionals require a general understanding of bowel management when treating people with SCI. Support may be required with activities of daily living to enhance bowel management.

### Positioning

Positioning will be important for managing an unstable spine (see above), but this is an ongoing aspect of treatment and education for the patient and caregiver, both in bed and while sitting to manage respiratory health, avoid contractures and maintain skin health. Please refer to [disasterready.org](http://disasterready.org) for a full resource of SCI patient information leaflets.



**Picture 1: Supine positioning** of a patient with an SCI in a low resource setting

© Davide Preti/HI



**Picture 2: Side lying positioning** of a patient with a SCI in a lower resource setting

© Davide Preti/HI

## Motor Tasks

After an SCI, further learning of motor tasks is required to maximise functional independence, and so is one of the primary goals of rehabilitation. For example, a person with an incomplete tetraplegia may have sufficient strength but insufficient dexterity and a person with paraplegia will need to learn transfer skills. Sub-tasks are critical steps required for successful performance of a task and it is imperative that the rehabilitation professional has a good understanding of the optimal levels of motor function expected (see rehabilitation treatment outcome section), along with common ways of performing tasks following SCI. Any motor training is often most effective when done repetitively, broken down and graded in small steps and practised in a relevant environment with a common functional activity, where possible.

Motor training is commonly used to improve:

- Balance
- Rolling
- Bed mobility
- Transfers
- Wheelchair mobility
- Upper limb and hand function
- Standing
- Walking

People with a SCI are prone to low blood pressure. This is a problem particularly when a patient is first mobilised in a wheelchair after injury, or when a patient first stands on a tilt table. This should be done progressively. Rehabilitation professionals need to take appropriate action when mobilising patients to avoid dizziness and fainting, such as using an abdominal binder and/or compression stockings when available.

Hand function will need to be optimised, as virtually all activities of daily living rely on some degree of hand movement. If no active grip function is preserved, the tenodesis function is crucial to obtain, in order to facilitate active use of the hands despite loss of active functions (see picture below). Tenodesis is possible for those with active wrist extension but no active finger flexion (lesion at C6).



Picture 4: Tenodesis grip; passive grip



Picture 5: Tenodesis grip opening the hand

## Tendonesis grip

The functional hand or tenodesis grip; with the wrist extended, the fingers flex into the palm and the thumb touches the index finger (Picture 3). Opening the hand; when the wrist flexes, all fingers move to open position and the thumb is abducted/extended, allowing release of objects (Picture 4).

## Daily activities and technical aids

Following an SCI, a person's ability to perform a task may be entirely or partly impaired. However, it is important that, even though a person requires a large amount of assistance, being able to perform a few key aspects of the task themselves provides the satisfaction of independence and privacy and avoids total dependence on another person. If it becomes apparent that the person will not be able to gain independence in a particular task, compensatory techniques and equipment should be investigated as soon as possible to provide support and assistance to meet the person's needs.

Compensatory strategies and skills might also be needed to initiate even basic activities early on.

Despite being in an acute crisis, it is important to promote regaining of activities and roles and encouraging the patient to be engaged in the care of their body. The engagement includes being both physically active and able to verbally instruct their own care. It is imperative to involve nursing staff, caregivers and relatives in this process. The webpages [elearnsoci.org](http://elearnsoci.org) and [spinalistips.se/en](http://spinalistips.se/en) are useful links for hands-on information, strategies and adaptations in daily activities.

The main therapy activities used are purposeful activity, and occupational-based activity. It is important within the first weeks to progress towards a real, occupational-based activity in a currently relevant environment, where able, having established whether corrective and/or compensatory strategies should be included in the treatment plan:

Corrective strategies include exercises and activities to increase strength and range of movement (ROM) to meet specific activity-based goals.

Compensatory strategies enable independence in particular activities, and may be required if the person does not have potential for neurological recovery to enable pre-injury performance. This may involve the use of:

- Static splints/orthotics to position or stabilise body parts to enable activities. For example, wrist splints to facilitate specific grip function
- Functional splints to enable task-specific grasp, such as a splint designed to hold a pen or cutlery
- Mobility/functional aids. For example, wheelchair or walking aids
- Task modifications. For example, lower limb dressing in bed (when dressing in bed, first get the patient in a seated position by raising the head of the bed up and use pillows to help them get into a good position. Roll or bunch each trouser leg into a ring and slip the foot into it. While working with each leg, put on a sock and shoe. Slide the trouser legs up a little and repeat the process for the other leg. Safely roll the patient side to side and pull trousers over one buttock at a time)
- Alternative movement patterns. For example, the tenodesis function of the hand to facilitate adapted grasp and grip activities (see pictures below) or locking the elbow during transfer if triceps are weak.

For more information, please refer to: <http://www.spinalcordessentials.ca/PDF/SCE2-Sd1-Dressing.pdf>.



Picture 5: Cylinder grip



Picture 6: Palmar grip



Picture 7: Key grip



Picture 8: Woven grip



Picture 9: Thumb hook grip



Picture 10: Squeeze grip

### Managing pain

Pain can affect performance, participation in activities and quality of life, and is a common complication following SCI in both acute and chronic forms. Specifically for SCI, it is important to identify pain associated with autonomic dysreflexia, as this can be a life-threatening emergency. See Chapter 3 for more details on assessment and general management of pain.



### Preventing contractures

It is crucial to avoid contractures. Attention is needed from day one, as they cause:

- Restrictions in independence and performing daily activities
- Difficulties in maintaining hygiene
- Pain
- Pressure injuries
- Long-term deformities

Contractures are very time-consuming to reverse and detract time and focus from functional rehabilitation. Contracture intervention should be linked to activities and participation restrictions during any goal planning, especially motor tasks. Prevention and treatment of contractures include the following:

- Active movement via physical training and daily activities
- Stretching
- Passive movements
- Positioning in a lengthened position

Maintain joint mobility and prevent oedema through exercise or positioning for optimal range of motion, actively or passively. All mobility/coordination and skills should focus primarily on helping the patient achieve their goals and can play a significant role in reduction of pain and spasticity through active exercise and maintenance of joint mobility.

Remember to involve patient and family/caregiver early. For example:

- Ensure the feet are supported in bed with a pillow to stretch or maintain length of the ankle plantar flexors
- Alternate arm and shoulder position in bed to maintain full shoulder motion.
- Maintain full elbow extension to enable independence with bed-to-wheelchair transfer
- Regularly sleep in prone position to stretch or maintain hip flexors
- Stand on a regular basis to stretch or maintain length of the lower limb muscles
- Regularly sit with one foot on the opposite knee to stretch or maintain length of hip internal rotators and stretch of hamstrings to facilitate lower limb dressing
- Stretches to the hand to stretch the MCP and IP joints to maintain tenodesis function



**PROM EXERCISE,  
SPLINTING**

### Equipment use

In the immediate phase of a response where you anticipate working with patients with SCI, from a rehabilitation perspective there is some basic equipment you may wish to prioritise stockpiling or obtaining. Some equipment for the patient's home (e.g. standing frames) can be made by local carpenters.

- Supports for leading your information-sharing/education role with the patient and caregiver, covering complication management, options for using assistive products, environmental adjustments for activities of daily living, hygiene and incontinence management
- Mobility aids provided to the patient should adhere to widely accepted guidelines, more particularly wheelchair provision that fits with WHO guidelines, as outlined here: <https://www.who.int/disabilities/publications/technology/wheelchairguidelines/en/>. As people with an SCI may require a wheelchair for lifelong use, it should ideally be customised to their exact needs, and will require ongoing repair and replacement. It is therefore best to refer to a local provider who can provide ongoing services wherever possible.
- Link to priority assistive products list (APL) that can help to direct the choice of overall assistive products for disability and SCI alike: <http://apps.who.int/medicinedocs/documents/s22396en/s22396en.pdf>

### Psychological and emotional distress

People with an SCI and their families will experience varying degrees of psychological and emotional distress. Rehabilitation professionals need to be mindful of this when treating patients and refer appropriately to other team members. Rehabilitation professionals spend large portions of time with patients and develop a close rapport that means they have a significant role in supporting them and helping them manage psychological and emotional distress. While they are not specialists in this area, therapists should be mindful of the potential for patients to have days when they feel more affected than others. They should listen actively, validate their patient's feelings and adapt the intensity of their sessions according to what a patient can cope with on any given day. Referring to peers, as well as a psychologist, can also be useful. It is important that the rehabilitation professionals instil hope without making false promises about a patient's potential for recovery.

### Goal setting

The rehabilitation professional should have clear knowledge on expected outcomes according to level of injury (see Table 3 below). The rehabilitation professional should be able to make short- and long-term (patient-centred) goals with the family/caregiver if available, as well as the MDT. Goal setting must be holistic, meaningful and patient-centred. Therapy treatment plan influences will include:

- Level and completeness of injury
- Expected functional outcome for the level of injury
- Cultural factors – in some countries, a patient with an SCI is considered 'sick' and will be fully dependent/reliant on their caregiver
- Pre-injury function/ability

- Motivation
- Functional expectations of the patient
- Discharge planning – use realistic environment for practice, realistic timings for bladder/bowel management and home modifications required, if able to go home
- Resettlement issues/plans – particularly in a conflict and disaster setting

Goal planning programmes are a useful rehabilitation framework for improving the physical, social and psychological functioning of inpatients with an SCI.

Using a checklist (see below) ensures a systematic approach for the patient, caregiver and the MDT

**Physical:** activities of daily living (dependence, independence), skin management, bladder and bowel management, mobility, wheelchair management and other equipment required

**Psychological:** depression, anxiety, family considerations

**Social:** community preparation, discharge coordination, employment/education

**Prognosis discussed:** Short-term goals agreed and planned, long-term goals agreed and aimed for: Expected functional outcomes discussed

## REHABILITATION TREATMENT OUTCOMES

Table 3: Functional outcomes following rehabilitation (table representing expected outcomes as per level of lesion). For more information, please refer to [disasterready.org](http://disasterready.org) for a resource on Functional Outcomes.

Level	Abilities	Functional goals
C1-C3	Limited movement of head and neck	<p><b>Breathing:</b> Depends on a ventilator for breathing</p> <p><b>Communication:</b> Talking is sometimes difficult, very limited or impossible</p> <p><b>Daily tasks:</b> Fully dependent</p> <p><b>Mobility:</b> Fully dependent</p>
C3-C4	Usually has head and neck control. Individuals at C4 level may shrug their shoulders	<p><b>Breathing:</b> May initially require a ventilator for breathing; may adjust to breathing full-time without ventilator assistance</p> <p><b>Communication:</b> Normal</p> <p><b>Daily tasks:</b> With specialised equipment some may have limited independence in feeding and independently be able to operate an adjustable bed</p>

Level	Abilities	Functional goals
C5	Typically has head and neck control, can shrug shoulder and has shoulder control. Can bend elbows and turn palms face up	<p><b>Daily tasks:</b> Independence with eating, drinking, face washing, brushing of teeth, face shaving and hair care after assistance in setting up specialised equipment</p> <p><b>Healthcare:</b> Can manage their own healthcare by doing self-assist coughs and pressure reliefs by leaning forward or side-to-side</p> <p><b>Mobility:</b> May have strength to push a manual wheelchair for short distances over smooth surfaces. If available, a power wheelchair with hand controls may be used for daily activities. There is potential to drive, but will require further assessment and adaptations</p>
C6	Has movement in head, neck, shoulders, arms and wrists. Can shrug shoulders, bend elbows, turn palms up and down and extend wrists	<p><b>Daily tasks:</b> With help of some specialised equipment, can perform daily tasks with greater ease and independence, such as feeding, bathing, grooming, personal hygiene and dressing. May independently perform light housekeeping duties</p> <p><b>Healthcare:</b> Independent in pressure relief, skin checks and turning in bed</p> <p><b>Mobility:</b> Some individuals can independently perform transfers but frequently require a sliding board. Can use a manual wheelchair for daily activities, but may use power wheelchair for greater ease of independence</p>
C7	Has similar movement as an individual with C6, with added ability to straighten elbows	<p><b>Daily tasks:</b> Able to perform household duties. Need fewer adaptive aids in independent living</p> <p><b>Healthcare:</b> Able to do wheelchair push-ups for pressure relief</p> <p><b>Mobility:</b> Daily use of manual wheelchair. Can transfer with greater ease</p>
C8-T1	Has added strength and precision of fingers that result in limited or natural hand function	<p><b>Daily tasks:</b> Can live independently without assistive devices in feeding, bathing, grooming, oral and facial hygiene, dressing, bladder management and bowel management</p> <p><b>Mobility:</b> Uses manual wheelchair. Can transfer independently</p>
T2-T6	Has normal motor function in head, neck, shoulders, arms, hands and fingers. Has increased use of rib and chest muscles, or trunk control	<p><b>Daily tasks:</b> Should be totally independent with all activities</p> <p><b>Mobility:</b> A few individuals are capable of limited walking with extensive bracing. This requires extremely high energy and puts stress on the upper body, offering no functional advantage. Can lead to damage of upper joints</p>

Level	Abilities	Functional goals
T7-T12	Has added motor function from increased abdominal control	<b>Daily tasks:</b> Able to perform unsupported seated activities <b>Healthcare:</b> Has improved cough effectiveness <b>Mobility:</b> Same as above
L1-L5	Has additional return of motor movement in the hips and knees	<b>Mobility:</b> Walking can be a viable function, with the help of specialised leg and ankle braces. Lower levels walk with greater ease with the help of assistive devices
S1-S5	Depending on level of injury, there are various degrees of return of voluntary bladder, bowel and sexual functions	<b>Mobility:</b> Increased ability to walk with fewer or no supportive devices

### Prognosis

The chance of marked recovery in people with a complete SCI (AIS grade A and no Zone of Partial Preservation) is very low. In contrast, those with incomplete SCI have a reasonably good chance for some recovery. Rehabilitation professionals need to be aware that most recovery occurs within the first eight months after injury, and that it is difficult for doctors to provide an accurate prognosis in the first few weeks after injury.

## CASE STUDY

A 27-year-old male sustained a spinal cord injury caused during the 2015 Nepal earthquake. He was admitted to the Spinal Injury Rehabilitation Centre three weeks later, after being referred from another hospital with a diagnosis of T12 – L1 fracture that had been surgically managed. He was discharged five months post-injury.

**On admission:** Bedridden, Foleys catheter, irregular bowel habit and totally dependent with activities of daily living. All vital signs were stable.

**Medical management:** Pain management, wound management (multiple soft-tissue injury).

**Nursing management:** bladder, bowel management, education, intermittent catheterisation, personal care, bowel routine, prevention of complications, pressure injury and urinary tract infection.

**Physiotherapy management:** included passive ROM exercises of bilateral lower limbs, active ROM exercises of bilateral upper limbs, strengthening of upper back and upper limbs, mobility (room and toilet), independent in bed mobility and pressure relief techniques, transfers from bed to wheelchair independently. Wheelchair skills: basic and advanced, balance training ongoing in static and dynamic settings, education on DVT and its prevention, education to caregiver and patient on ROM exercises and bedside positioning.

**Occupational therapy management:** Independent in most activities of daily living, including feeding, upper and lower body dressing (in chair), upper and lower body bathing and grooming, toilet transfer and use of toilet, all level transfer, basic and advanced wheelchair skills. Educated about and accomplished home modification, initiated a return to work and leisure activities (artist) and has regained his previously role in his family and community.

**Psychological:** Realisation counselling on expected functional outcomes, deep relaxation therapy, individual/group session on safe reintegration to community, group education on sexuality and fertility after an SCI, education on disability rights, encouraged to participate actively all rehabilitation activities, including music therapy and yoga.

Wheelchair service department provided a Motivation three-wheeler wheelchair.

**Functional outcome measure:** AIS on admission: T12 AIS- A; AIS discharge: T12 AIS –A SCIM at admission: 10 SCIM at discharge: 69

**Community reintegration:** Has been working as a peer counsellor at SIRC since 2016. Active role model to newly injured people with an SCI. An excellent artist!

## KEY POINTS

- Be aware of SCI complication risks and act upon early signs with proper techniques, communication with the MDT, monitoring and assistive products use and maintenance advice
- Involve any caregivers from onset of treatment. Providing information on prognosis, adaptations and ongoing care needs to help support both patient and family for the long-term
- Ensure understanding of diagnosis
- Assessment and goal setting with the patient and caregiver crucial to facilitate ongoing progress after the early rehabilitation phase and to assist transfer of longer-term ongoing care needs



## REFERENCES

*International Perspectives on SCI* WHO/ISCoS, WHO, 2013

*Descriptive study of earthquake-related spinal cord injury in Nepal* Groves C.C. et al. 2017 Spinal Cord

*Emergency Medical Teams: Minimum Technical Standards and Recommendations for Rehabilitation* WHO 2016

*Overview for the whole team, Physiotherapy, Occupational Therapy modules.* Available at: [www.elearnsoci.org](http://www.elearnsoci.org)

[www.physiotherapyexercises.com](http://www.physiotherapyexercises.com)

[www.spinalistips.se/en](http://www.spinalistips.se/en)

*Moving and Handling Patients with Actual or Suspected Spinal Cord Injuries (SCI)* MASCIP Guidelines 2009

*Psychological guidelines in spinal cord injury* ASCoN, 2015. Available at: <https://ascon.info/wp-content/uploads/2018/05/psychosocial-guidelines15.pdf>

*ISCoS Textbook on Comprehensive Management of Spinal Cord Injuries* ISCoS, 2015

---

## APPENDICES

Found on [disasterready.org](http://disasterready.org)

1. MDT SCI Assessment
2. Assessment cheat sheet
3. Positioning, including 30-degree tilt
4. Functional outcomes
5. SCI passport
6. SCI abbreviations





## CHAPTER 9

### CHAPTER 9: EARLY REHABILITATION OF BURNS

#### AIMS:

By the end of this chapter, you should be able to:

- Demonstrate knowledge of a burn
- Perform a basic acute assessment of a burn
- Understand the surgical management of a burn
- Develop and deliver an acute rehabilitation treatment plan of a burn



## CHAPTER 9: EARLY REHABILITATION OF BURNS

### INTRODUCTION

Esselman et al assert that burns injuries can result in significant and complex rehabilitation challenges, given the long-term complications and psychological issues that are associated. This is especially relevant in low-to-middle income countries, where access to timely and adequate medical and therapeutic management may be very limited.

Regardless of the context, burns presentations in conflicts and disasters will reflect those commonly seen in industrial or domestic burns. The management approach for these will be similar.

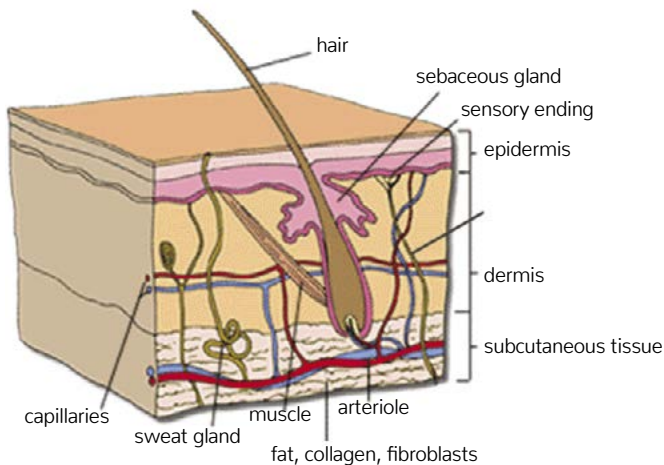
With conflict/blast injuries, one can expect more combined trauma, e.g. a burn overlying a fracture, as well as a high risk of wound contamination. Wounds should be initially debrided and then left open with a protective dressing covering for delayed primary closure to prevent infection. Shrapnel that is easily accessible should be removed; however, if there is a risk of extensive tissue damage in searching for the piece of shrapnel, it will be left in-situ. Blast injuries can cause significant soft-tissue and bony injury with extensive defects, as well as accompanying burn wounds and injury to hollow organs, such as the bowels and lungs. These require careful and ongoing assessment. Chemical burns, such as napalm and phosphorous, will likely cause more severe burns and are thus rehabilitated in the same way as a deep burn.

The treatment principles remain the same for treatment of burns in poly-trauma injury scenarios with considerations for relevant safeguards.

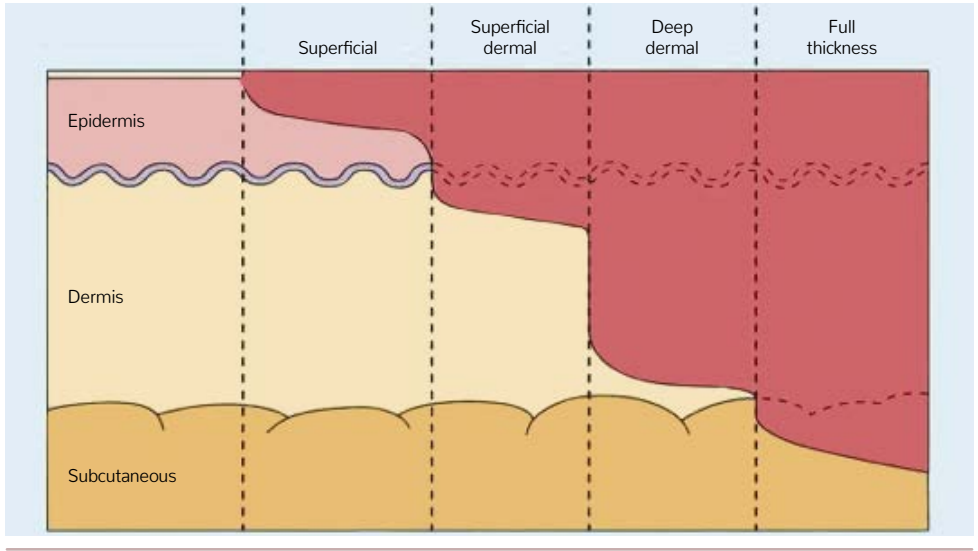
In the very acute care of major burns injuries, medical management will include: fluid resuscitation, airway management, wound debridement and, where relevant, may involve surgical procedures, such as escharotomy and/or fasciotomy.

Rehabilitation for burn injuries starts from day one of the injury, right through the period of scar maturation, and often for years after the injury, especially relevant to the prevention of contractures and in children where growth is not complete.

#### Diagram 1: Anatomy of the skin



**Diagram 2: Depth of burn injury**



**Table 1: Depth of burn characteristics**

Burn depth chart				
Depth of burn	Tissues destroyed	Appearance of burns	Sensitivity to pain	Health time and prognosis
Superficial (1 <sup>st</sup> degree burn)	Outer layer of epidermis (stratum corneum)	<ul style="list-style-type: none"> <li>Red</li> <li>Blistering not common</li> <li>Slight oedema</li> <li>Wound blanches with pressure and refills</li> </ul>	Painful	<ul style="list-style-type: none"> <li>Less than 14 days</li> <li>No scarring expected long-term</li> </ul>
Superficial Partial Thickness Burn (SPT) (2 <sup>nd</sup> degree burn: superficial/intermediate)	<ul style="list-style-type: none"> <li>All of epidermis</li> <li>Upper layers of dermis</li> <li>Some hair follicles and sweat and sebaceous glands destroyed</li> </ul>	<ul style="list-style-type: none"> <li>Red</li> <li>Blisters</li> <li>Moist subcutaneous</li> <li>Oedema</li> <li>Blanched (capillary refill)</li> </ul>	Very painful and hypersensitive	<ul style="list-style-type: none"> <li>7-20 days</li> <li>May scar in rare cases</li> <li>Pigment change</li> </ul>

Burn depth chart				
Depth of burn	Tissues destroyed	Appearance of burns	Sensitivity to pain	Health time and prognosis
<b>Deep Partial Thickness Burn (DPT)</b> (2 <sup>nd</sup> degree burn: deep)	<ul style="list-style-type: none"> <li>■ Epidermal and severe dermis damage</li> <li>■ Most nerve endings, hair follicles and sweat glands destroyed</li> </ul>	<ul style="list-style-type: none"> <li>■ Variable in colour (white with red, e.g. mottled)</li> <li>■ Wet or waxy dry</li> <li>■ Generally blisters</li> <li>■ No or slow capillary refill</li> <li>■ Eschar forms</li> </ul>	Less sensitive to pain due to destroyed nerve endings	<ul style="list-style-type: none"> <li>■ Difficult to determine healing time, at least 21+ days</li> <li>■ Scarring</li> <li>■ Risk of contractures</li> <li>■ May need grafting, especially if has not healed within 15-21 days</li> </ul>
<b>Full Thickness Burn (FTB)</b> (3 <sup>rd</sup> degree burn)	All skin layers damaged or (in very severe cases) down to fat or bone (epidermis/dermis and subcutaneous is damaged or destroyed in very severe cases)	<ul style="list-style-type: none"> <li>■ White, charred, dry, inelastic (tight)</li> <li>■ No blisters</li> <li>■ If circumferential – can have tourniquet effect and escharotomy needed</li> </ul>	No pain from lost cutaneous pain receptors but situation is often painful for the patient and be aware that pain will develop following first surgical debridement	<ul style="list-style-type: none"> <li>■ Very severe scarring</li> <li>■ Risk of contractures</li> <li>■ No skin regeneration</li> <li>■ Will need excision and grafting</li> <li>■ Prolonged hospitalisation</li> </ul>



## Note

Note: Burns injuries can have a mixed pattern presentation in terms of depth, especially thermal and electrical burn (internal injury – entry/ exit wounds may not immediately be visible/obvious).

## ASSESSMENT

### Assessing the area of a burn

The area of a body that has been affected by a burn is measured by **Total Body Surface Area burned (TBSA)**, expressed as a percentage, e.g. a 15% TBSA burn would mean that 15% of the total surface area of the body is burnt/affected.

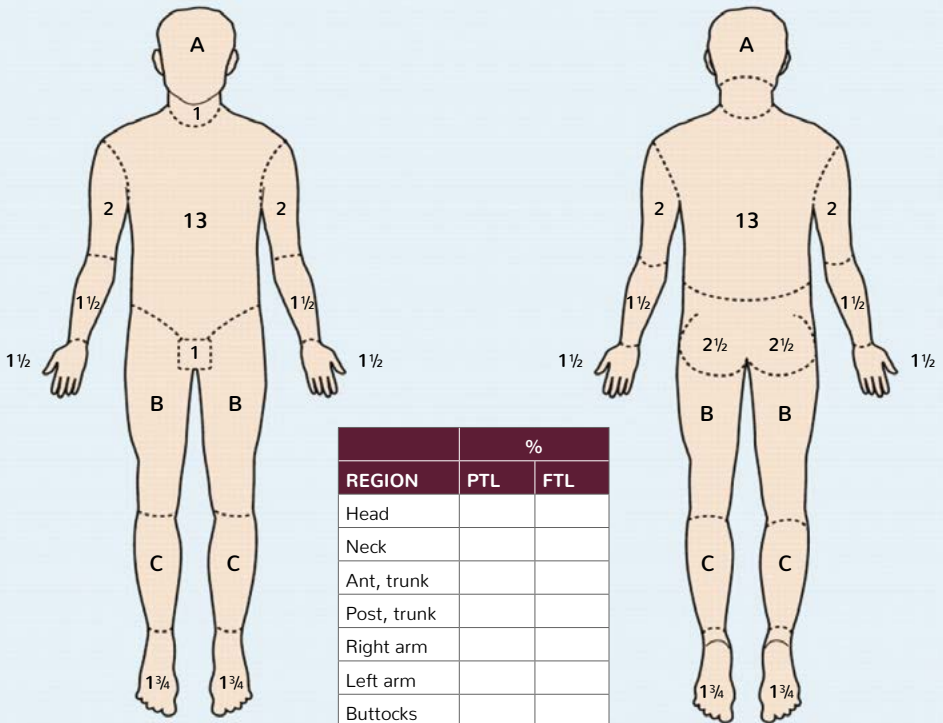
The two most common methods of recording this is by '**Rule of Nines**' and '**Lund and Browder**' (note adults and children have differing percentage mapping) described in Chapter 7 of the manual *Rehabilitation in Sudden Onset Disasters*, page 196.

TBSA percentage is used to calculate fluid requirements and, together with depth of burn, is the biggest predictor of survival and final outcome.

**Major burn:** over 30% TBSA for adults; over 20% TBSA for children.

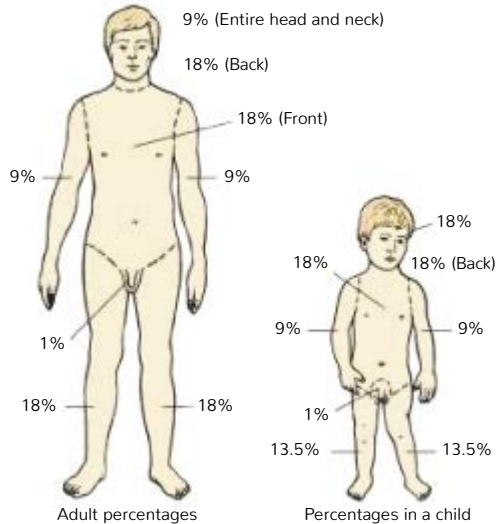
Location and type of burn will also influence the severity and functional impact to the patient, e.g. deep burn of both hands can be very functionally severe for the patient, although a relatively small TBSA%. An electric burn can cover only a small percentage of the TBSA, but can be disastrous for the patient due to the potential internal damage; patient is also at risk of requiring limb amputation to manage the injuries.

**Diagram 3: Lund and Browder Chart**



REGION	%	
	PTL	FTL
Head		
Neck		
Ant, trunk		
Post, trunk		
Right arm		
Left arm		
Buttocks		
Genitalia		
Right leg		
Left leg		
<b>Total burn</b>		

AREA	Age 0	Age 1	Age 5	Age 10	Age 15	Adult
A = 1/2 of head						
B = 1/2 of one thigh						
C = 1/2 of one lower leg						

**Diagram 4: Rule of Nines****Emergency care of burns**

Assess:

**A = Airways**

**B = Breathing** (any signs of inhalation injury may require prophylactic intubation, followed by chest physiotherapy) and circumferential deep or full thickness burns to chest (and abdomen in children) may require escharotomy)

**C = Circulation** (emergency escharotomy may be necessary with circumferential full thickness burns to limbs)

**D = Disability** (no associated trauma, e.g. head injury)

**E = Exposure** (assess area and depth of burn injury)

**F = Fluids** (calculate and administer fluid requirements – medical team responsibility). Fluid resuscitation to prevent hypovolemic shock is required for all burns over 10% in a child and 15% in an adult.

**Complications: (red flags)**

- Hypovolemic shock/inadequate fluid resuscitation (too few or too much)
- Infection
- Compartment syndrome (5P's: pallor, pulselessness, pain, paraesthesia, paralysis)
- Inadequate pain management
  - Severity of burns injury may be increased with any of the following:
    - Extremes of age
    - Co-morbidities
    - Associated injuries, e.g. fractures
    - Inhalation injury
    - Location of burns: face/eyes/ears/hands/perineum/feet
    - Electrical injuries
    - Blast injuries
    - Poor nutritional status (including anaemia)

**Physiotherapy burns assessment pro-forma**

\*With assessment and treatment, always follow a systematic approach

Please follow the 'ABCDE' approach to encompass full medical management (see case studies for examples)

Cause of burn: \_\_\_\_\_

Type of burn/injury: scald/flame/electrical/chemical (alkaline/acid/other)/blast/other:  
\_\_\_\_\_

Inhalation injury: Yes/No (See 'treatment' section for signs and symptoms to watch out for)

Any other injuries/conditions:  
\_\_\_\_\_

Relevant PMH: \_\_\_\_\_

SH: smoker: Yes/No \_\_\_\_\_

Medications/drug hx: \_\_\_\_\_

Occupation: \_\_\_\_\_

Hand dominance: R/L/Both \_\_\_\_\_

KEY:

Superficial   $\Delta$  Circumferential: Yes/No \_\_\_\_\_

Partial thickness  Joints involved: \_\_\_\_\_

Full thickness   $\circ$  Face structures involved: \_\_\_\_\_

Inhalation injury: Yes/No \_\_\_\_\_

Surgical management (pre-rehabilitation assessment):

Split skin graft: Yes/No

Detail: \_\_\_\_\_

Donor site: \_\_\_\_\_

Flap: Yes/No Detail: \_\_\_\_\_

Other surgical intervention: \_\_\_\_\_

Pain (location, description and VAS) \_\_\_\_\_

Mobility: \_\_\_\_\_

Wound/infection\* \_\_\_\_\_

Scar tissue\* \_\_\_\_\_

Oedema\* \_\_\_\_\_

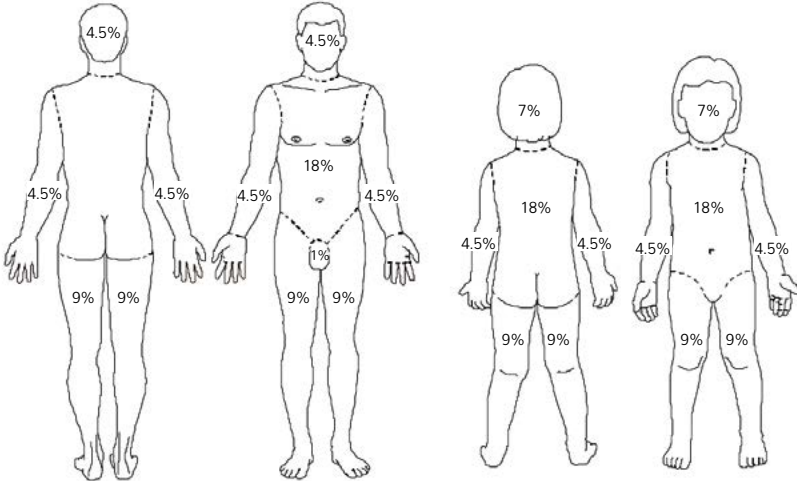
Range of Movement (ROM) - active/passive at affected joint/s

Function: \_\_\_\_\_

**\*BE AWARE\***

Wounds can deepen due to, e.g. infection, lack of nutrition, poor handling and the scenario of granulating tissue and delayed grafting and wound healing can be a recipe for disaster in terms of preventing significant scarring and being able to prevent contractures. Also be aware of any signs of psychological distress.

Ongoing assessment of the burns and ROM are important, as is assessing to check for infection.

**TREATMENT**

Rehabilitation treatment starts immediately (as soon as haemodynamically possible).

Focus of rehab in this very acute stage is:

- Respiratory care
- Oedema management
- Positioning, splinting and pressure relief
- Mobilising/early and progressive exercise
- Maintaining function
- Education

**Respiratory care**

**Inhalation injury:** be aware of signs or symptoms that may indicate an inhalation burns injury, including:

- Burns to face, neck or upper torso
- Singed nasal hair
- Carbonaceous sputum or soot particles or oropharynx
- Change in voice with hoarseness or harsh cough
- Dyspnoea, stridor



- Erythema or swelling of oropharynx on direct visualisation
- History of reduced consciousness

Physiotherapy aims:	Tools to achieve these aims:
<ul style="list-style-type: none"> <li>— Maintenance of the airway (discuss with medical team)</li> <li>— Removal of excess bronchial secretions</li> <li>— Improvement of gaseous exchange</li> <li>— Prevention and/or treatment of atelectasis</li> <li>— Maintenance of thoracic expansion and general mobility</li> <li>— Positioning</li> </ul>	<ul style="list-style-type: none"> <li>— Positioning for facial oedema management – sit patient up</li> <li>— Positioning to maximise secretion clearance and ventilation</li> <li>— Positioning</li> <li>— Manual hyperinflation</li> <li>— Suction</li> <li>— Saline/humidification</li> <li>— Active cycle of breathing</li> <li>— Forced expiratory technique</li> <li>— Vibs/percussion (if none of the above/ other manual or active treatment modalities are an option (more specific to young children))</li> <li>— Oxygen therapy</li> <li>— Mobilisation</li> <li>— Manage pain</li> </ul>

### Oedema management

Oedema is a normal response to the injury and to the fluid resuscitation (N.B. important to avoid over-resuscitation).

Oedema can compromise wound healing.

In the acute stage, manage and limit oedema by:

- Appropriate positioning: e.g. elevation hand/s above the heart level with elbows extended (elbow flexion can cause oedema to collect around the elbow and wrist flexion can cause significant hand oedema to develop)
- Encouraging the muscle pump action through active movement
- Patients with facial oedema must be sat up at least 45 degrees even at night (as safely appropriate)
- Dressings should be firm but allow maximum active movement of all joints

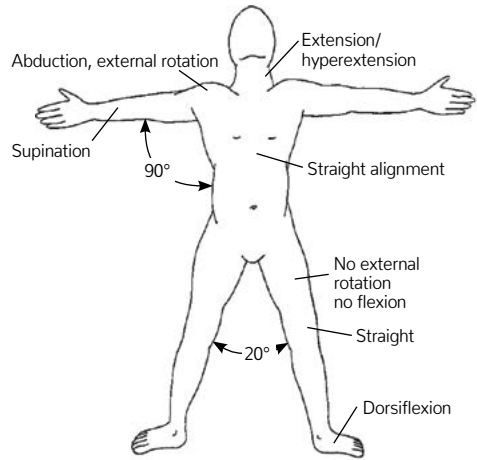
### Positioning and splinting

#### Correct positioning is essential to prevent contracture

- Positioning is used prophylactically when there is no sign of loss of range and can be used to increase ROM if there is a loss of range
- Burn patients will typically adopt positions of comfort, especially in low-resource environments where pain limitation is minimal; generally, this is in a pattern of flexion. Joints will literally get stuck in the position of comfort over time as the developing scar adapts to the shortened position

**Anti-deformity positioning:**

- ✓ Shoulders abducted to 90 degrees, horizontally adducted 20 degrees, encourage ext. rotation
- ✓ Scapula – retraction, depression
- ✓ Arms in neutral rotation, forearms supinated
- ✓ Elbows in extension
- ✓ Wrist 30-40 extension, with MP 45-70 flexion, IP extension, thumb abducted and opposed
- ✓ Neck slightly extended (no pillow)
- ✓ Hips in slight abduction with full extension, block external rotation



Consider pressure areas with positioning. The burn area is very prone to progressing in depth if under continual pressure and the non-burned areas are also prone to breakdown, as many burn patients in low resource settings are malnourished.

**Splinting**

Is generally indicated to

- Position limbs/joints at rest if/as required to reduce contracture risk.
- Protect grafts or flaps during initial phase healing/take post-op as required.

*Note*

Note: splints may need remoulding after a change of dressings and to accommodate, e.g. fluctuations in swelling, particularly relevant for the hand.

**NB:** for splint safeguards please refer to [disasterready.org](http://disasterready.org)

**SPLINTING****Mobilisation and maintaining function**

This is essential to ensure that the patient returns to activity and participation in their life activities. This is achieved through gentle ROM, which should be slow and smooth to avoid pain and inflammation, as well as engagement in functional tasks, especially encouraging some level of independence in self-care and graded mobilisation (walking/moving as able) in the early stage of rehabilitation.

**ROM AND ITU**

## Education

*Thinking ahead* – Educating/giving patient and relevant carer/s information is vital and should include:

- Basic ROM and stretching exercises. The patient can be fearful of movement, especially with the therapist indicating very early active mobilisation of joints and whilst wound is still healing. It is important to explain to the patient (and relevant carers/family) the reason for us doing this, **especially for the prevention of contractures**
- Anticipated time-frames for wound healing and scar maturation to ensure patient engages in the often longer-term rehabilitation regime – this will have direct correlation on continuing management in positioning, active movement, and later more stretching and exercise through function
- Expectations with/for e.g. delayed wound healing, pruritus (severe itching), altered sensation (especially hypersensitivity), contracture formation and management thereof
- Scar management: on complete wound healing, advice about scar massage and moisturisation technique and daily regime with plain emollient cream (find out about locally sourced appropriate options), as well as compression. If pressure garments are not available, advise re safe and appropriate alternate options, e.g. compression bandages, tubular dressings, e.g. tubigrip
- Functional activities (especially self-care tasks, such as feeding) as possible to prevent complications linked to continuous bedrest, enhance ROM and help restore independence
- Splinting regime e.g. timing – removal and fitting of splints in relation to eating, drinking and personal care, and safety in wear regime, including pressure care
- Factors that may exacerbate risks to e.g. infection in surroundings (sanitisation)

## CONSIDER

- ✓ Age and co-morbidities impact on healing and complications
- ✓ Ethnicity and culture will also play a role in the expected outcome
- ✓ Coexisting injuries (fractures, amputations, inhalation injury) will impact recovery
- ✓ Secondary complications of burns, such as heterotopic ossification, severe inhalational injury and graft/flap failure (e.g. shear forces, infection)
- ✓ Location of burn, e.g. small superficial on forearm, get them going quickly and anticipate nil further complications versus same type burn on foot – would want to be more careful for healing with oedema management and anticipate slightly lengthier healing time-frames

**Table 2: Surgical management options in burns care**

Surgery	Details of procedure	Therapy aftercare	Comments/caution
<b>Split skin graft (SSG)</b>	<p>SSG is used to save life and improve/promote wound healing</p> <p>All skin grafts rely on the UNDERLYING blood supply so the burn tissue needs to be excised right down to the healthy bleeding bed</p> <ul style="list-style-type: none"> <li>— Taken from a donor site of intact skin on the patient's body, commonly the thigh or, in paediatric cases, scalp</li> <li>— Taken from a slice of some of the dermis. Often fenestrated or meshed to expand the skin and allow exudate to escape</li> </ul>	<p><b>Grafts over/near joints:</b></p> <ul style="list-style-type: none"> <li>— Immobilise for five days unless the surgeon says is happy with mobilisation. If the part is not immobilised with bulky or tie-over dressings in theatre then make a splint/back slab – discuss with the surgeon</li> <li>— Ensure the splint will not cause damage to the area</li> <li>— The first change of dressing (COD) of the grafted area is at 48 hours to five days</li> <li>— Mobilisation should be progressive 5-7 days post-graft then normally no restrictions to movement post seven days</li> </ul> <p><b>Grafts over non-joint area:</b></p> <ul style="list-style-type: none"> <li>— Usually mobilise from 48 hours unless specific reason not to. For lower limb grafts early mobilisation may be indicated by some surgeons. May otherwise be instructed to wait 3-5 days (average) for first dressing change before giving mobilisation green light to walk the patient</li> </ul> <p>Ensure the lower limb has a supportive dressing, e.g. coban/elastic bandage before mobilisation</p>	<ul style="list-style-type: none"> <li>— Donor site takes up to two weeks to heal and can be very painful. But once healed, the areas can be re-used to take more skin</li> <li>— In poor resource environments, SSG is often delayed and limited, resulting in sub-optimal outcomes, to include more risk of infection and scarring</li> <li>— Hydration of the area can start as soon as healed, scar massage when the area is stable</li> <li>— In extensive burns, any area of non-burned skin may be a donor site</li> </ul>
<b>Full thickness skin graft (FTG)</b>	<ul style="list-style-type: none"> <li>— FTG takes the epidermis and entire dermis, therefore the donor site needs to be directly closed.</li> <li>— Common donor sites are behind the ear and the groin</li> </ul>	<p>As per SSG therapy aftercare, unless the FTG is OVER a joint such as the hand when there is LESS focus on immobilisation through splinting – Discuss with surgeon</p>	<ul style="list-style-type: none"> <li>— FTG are NOT commonly used in acute burns care (apart from eyelids) but for reconstructive purposes</li> </ul>

Surgery	Details of procedure	Therapy aftercare	Comments/caution
Flaps	<p>Flaps are used to fill defects when the bed is not graftable such as exposed tendon, bone etc.</p> <p>Unlike SSG, flaps come with their own blood supply (can include skin, fascia, muscle, bone etc.)</p>	<p>Flaps will vary, therefore discussion with surgeon is VITAL for safe and appropriate post-operative rehabilitative care. The pedicle is the LIFELINE for the new flap and needs to be protected till blood supply is re-established – usually takes three weeks</p> <p>Key principles to safe flap care:</p> <p>DO NOT kink, stretch or compress any part of the blood supply</p> <p>AVOID shearing movement through positioning or handling</p>	<ul style="list-style-type: none"> <li>➤ Causes of flap failure are: tension, kinking, compression, infections and vascular thrombosis</li> <li>➤ Uncommonly used in acute burns care (except sometimes in electrical burns or very deep burns with exposed tendons, joints or bones without their periosteum), but are common in reconstruction of burns and used in acute soft tissue injury</li> <li>➤ Continually monitor: colour, temperature, texture and blanching of the flap to ensure viability</li> </ul>

Areas that have been grafted or flapped need to be elevated post-op. Minimising shearing and not disturbing blood supply is vital, so dressing not too tight.

### ! INFECTION !

Is the most common cause of death of patients with burns injuries who survive the initial injury.

**Infection can significantly delay donor site wound healing and cause failure of grafts and flaps.**


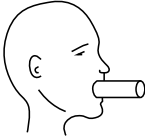
**Wound dressings = KEY part of burn management: clean and correctly applied dressings improve outcomes with several areas of the body requiring special care.**



REHAB THERAPIST  
IN THEATRE

Overleaf is a summary table intended to help guide you in your treatment approach in the positioning, splinting and mobilisation of specific joint areas that may be affected. Splinting and positioning programmes depend on the severity of the injury and may need to be continued for at least six months to be effective.

**Table 3: Splinting and positioning recommendations in the rehabilitation of burns**

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Face	<p>The face can be affected in various different ways, including the inability to open or close mouth fully inability to close eyes fully and the closing of nostrils</p> 	<p>Regular change of facial expression and manual stretching regimen of lips and eyes is required</p> <p>Mouth: achieving a horizontal/vertical/circumoral stretch of the tissue around the mouth</p>  <p>* Certain devices facilitate mainly vertical opening stretch. A horizontal lip opening device can be added, and ensure exercises encompass ALL movements</p>	<p>Oral appliances that need to educate the patient. (NB, be mindful of safeguards with use of splinting with dental care (especially in children with facial growth and teeth position)</p> <p>Examples: locally-sourced options for splint materials: use of a well-padded cylindrical tube or wooden tongue-depressors stacked and safely bound together with plastic wrap</p> <p><b>MAKE SURE NOT TO OBSTRUCT AIRWAY</b></p>


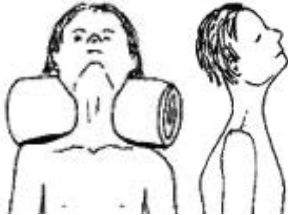

**Face exercises:**



Opening mouth, smiling, top lip over bottom lip, bottom lip over top lip, puckering lips, pull back corners of mouth, mouth side stretches, blowing up your cheeks, eyes open wide, eyes tightly closed, chin poke, neck stretch back with mouth closed.

**Other activities to assist with face exercises:**




Say the vowels of the alphabet slowly and over exaggerate each movement, use a straw, eat an apple with large bites, use your tongue to stretch your lips and cheeks out.

Hold your mouth open as wide as you can when you clean your teeth, use your hands to push upwards on your cheeks to assist with closing your eyes.



Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Front of neck	<p>Neck flexion. The chin is pulled towards the chest reducing neck movement</p> <p>Contours of the neck are lost</p> 	<p>Neck in extension (also when sleeping)</p> <p>No pillow behind head, roll behind neck e.g. rolled towel/big scarf</p> <p>Head tilted back in sitting. Avoid hyper-extension during the night</p> 	<p>If soft cervical collar is not available, a neck collar can be fashioned from flexible suction tubing cut into lengths and stuck together with sticky-tape. The collar is padded with soft gauze and wool and held together with a bandage</p> 

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Posterior neck	Neck extension and other neck movements 	Sitting with head in flexion. Lying with pillows behind the head 	Fabricate similar splint, as above

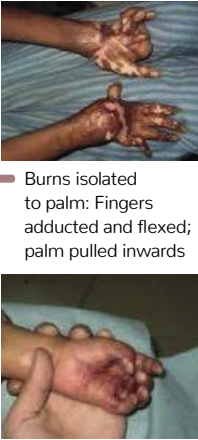
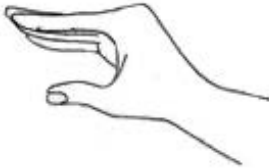



**Neck exercises:**  
Work through passive and active range of movement activities for head and neck, to include ear to shoulder (side flexion), chin to chest (flexion), chin to sky (extension) and rotations.

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Axilla or anterior and posterior axillary fold	Limited abduction, extension and flexion 	Lying and sitting – arms abducted to 90 degrees supported by pillows between chest and arms. Figure-of-eight bandaging or strapping to provide stretch across chest 	Examples: Use of a plastic-moulded pipe or POP (plaster of Paris)  (Be mindful of where your splint ends on the arm to ensure nil adverse pressure with pull of arm down)  If elbow/forearm included, rotate between supination and pronation position)  <b>Paeds:</b> Scarf in a figure-of-eight 

**Axilla/shoulder exercises:**  
Work through all the active and passive range of movement planes of the shoulder.

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Elbow (and forearm)	Limited extension (and limited supination) 	Extension and mostly supination, as relevant. In the case of circumferential burns, also work on flexion and pronation	Fabricate splint with elbow in extension Can use e.g. POP, reinforced carboard (padded!), padded plastic pipe, all of which must be safely bandaged in place 

**Elbow (and forearm) exercises:**  
Active and passive: extension and flexion of the elbow and supination and pronation of the forearm.

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
<p><b>Hand and wrist</b></p>	<p>Characteristic posture of the burnt hand is:</p> <ul style="list-style-type: none"> <li>■ Flexion of wrist</li> <li>■ Extension or hyperextension of MCPJ's (metacarpophalangeal joints)</li> <li>■ Flexion of IPJ's (interphalangeal joints)</li> <li>■ Adduction of the thumb</li> <li>■ Little finger rotation/ deviation</li> </ul>  <ul style="list-style-type: none"> <li>■ Burns isolated to palm: Fingers adducted and flexed; palm pulled inwards</li> </ul>	 <p>Wrist 30-40 degrees extended, MCP's 60-70o flexion, IP joints in extension, thumb mid-palmar radial abduction.</p>   <p>Wrist hyper- extended, minimal MCP flexion, fingers extended and abducted</p>	<p>Splint in POSI (Position of Safe Immobilisation)</p> <p>Examples: use PADDED POP, reinforced cardboard, moulded plastic tube, scotch cast</p> 

**Hand and wrist:**

*These joints will become tight/contract and the hand badly deformed if the patient does not continuously encourage to move the hand and fingers.*

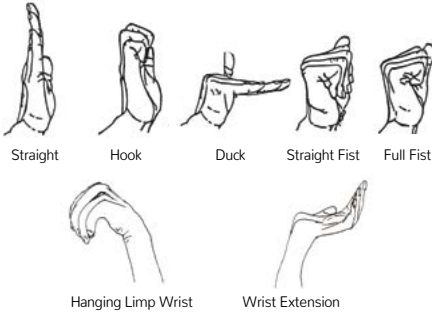
- Initially, pain and oedema limit movement of the hand
- Early vigorous exercise (where no autograft/FLAP)
- Advocate dressing application that DOES NOT HINDER movement too much!
- Recommended to also carry out exercises (where appropriate) during change of dressings

NOTE: suspicion of extensor tendon or extensor hood is involved, limit to gentle active movements only!



**Exercises:**

- Active tendon glides wrist (flexion and extension); passive-assist where necessary
- Active tendon glides fingers: composite AND isolated, especially concentrating on MCPJ isolated flexion (patient may need gentle assistance with movement/s – careful assistance when active ROM is incomplete)
- Thumb flexion and extension composite and isolated IPJ
- Opposition: thumb to individual fingers 'O' tip-to-tip active movements
- Fingers abduction/adduction
- Radial and ulna deviation




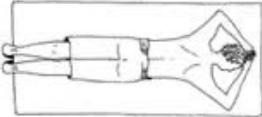
Encourage functional activities (self-care/feeding self/brushing hair/etc.) – consider building up grips with utensils, for example fibreglass volar slab covered with wadding/bandaging and then LIGHTLY bandaged onto patient’s hand/arm

**Wear:** when patient asleep, for example, otherwise encourage patient to use their hand!

NB ensure splint sides not too high and splint not constrictive! Consider fluctuating swelling and associated risks, as well as changes in shape with, e.g. change of dressings.






**REHAB THERAPIST  
IN THEATRE**

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Groin (hip)	Hip flexion; hip adduction. 	(for anterior groin burn) Lie in prone position with legs extended; no pillow behind knees Limit sitting and side lying. Supine lying with legs extended; no pillow behind knees Ideally, also allow for some hip abduction 	Abduction foam wedge Abduction using rolled-up towels/pillows etc. Moulded thermoplastic  Personal care for toileting means increased risk of infection, so emphasise wound care and hygiene. Prevent prolonged time in hip flexion, e.g. sitting

**Groin (hip) exercises:**




Active and passive ROM activities for flexion extension abduction, adduction and internal and external rotation. If patient is stable enough, then work on sit-to-stand, balance activities, early mobilisation, getting patient to normalise posture (in all positions) and gait pattern (no hip hitching or limited extension).

Anterior surface; avoid hip flexion and adduction. Positioning in prone is useful if no other contraindicat

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Back of knee	Knee flexion 	Legs extended in lying and sitting positions 	Splint with knee in extension. Materials to use as before (POP/PVC, etc.) and safely bandage in place 

**Knee exercises:**

Active and passive full knee range of movement – focusing on extension if burn is posteriorly. Burns at the front of the knee may need a larger focus on active flexion. Exercises to include one leg stand, heel walking (so with knee extended), etc. and controlled squats.

Burn site	Risk of contracture that can develop	Anti-contracture position	Splinting
Ankles and feet	Feet are complex structures and can be pulled in different directions by healing tissues preventing normal mobility. 	Ankles at 90 degrees, use pillows to maintain position. Encourage sitting with feet flat on floor as long as no oedema present. 	Splint ankle in 90 degrees (plantigrade) using padded POP/cardboard. Safely secure in position **   **In cases of deep burn on anterior side of the ankle, period of splinting in plantar flexion is required

**Ankle/feet exercises:**

It is vital the patient maintains adequate dorsiflexion for walking with a heel-toe gait, so include exercises to work on active and passive ROM in dorsiflexion, plantarflexion, eversion and inversion.

Ask the patient to 'tap/move their toes up/down and in/out like windscreen wipers.' Make sure the movement is coming from the ankle and not the hip. This can be done in bed or sitting. When safe to do so, get patient to work on weight bearing.

Get patient to also flex/extend and 'wriggle' toes. NB, dressings should take care of toe spaces.

Friction of shoes may require linings or special footwear. Toe contractures may impact on fit of shoe.

## Pain management

A team approach to pain management is needed. Ensure close collaboration with nurses/doctors to optimise exercises after pain meds have been administered. It is vital that patients are prescribed background pain medication, as well as for interventions (e.g. physio/dressings) and breakthrough pain. The timing of such medication is also crucial to ensure optimal efficacy: try and ensure patient has had their analgesics 30-60 minutes prior to dressing changes and/or exercises (or play in the case of children).



### REHAB THERAPIST IN THEATRE

Encourage play activities to incorporate as part of treatment. Ensure the play areas are safe/protected and, if possible, completely dissociated from where child is having wound debridement/dressings, as this location will be associated with fear/anxiety/pain etc. Consider bringing items with you, such as blow-up light plastic beach balls in different sizes or smaller balls (that can be wiped clean after use), blowing bubbles, crayons/coloured chalk for active play therapy.

## CASE STUDIES

### CASE STUDY 1

Mrs T is a 35-year-old lady who was cooking over a fire in a temporary camp following an earthquake that destroyed her house. The fire was put out with a bucket of cold water and she presented to your facility four hours later. There is no history or additional trauma and you do not suspect C-spine injury, so she does not require neck collar/sandbags and tape.



#### A: Airway and C-spine control

- Is patient maintaining airway? Yes, Mrs T is maintaining her airway. However, there are burns to face and neck, so we are concerned that the airway may be at risk due to swelling and/or inhalation injury. Sit patient up
- Medical management – there is a need for oxygen: link with medical team

#### B: Breathing

- Spontaneously breathing with normal breath sounds throughout
- RR of 16BPM, breathing is a little shallow. Evidence of burns to her chest and upper back – burns appear deep, so patient may require escharotomy – link with medical team
- Signs of superficial burn round nose and mouth (may be indicative of toxic smoke inhalation)

#### C: Circulation

- Patient is not haemorrhaging from anywhere
- Pulse is 110, BP 100/70: likely to be dehydrated, but not in shock

- Hands are cold with poor capillary return in fingers – the burns on the upper arm are deep and circumferential
- Medical team to insert cannulas and start fluid therapy and carry out escharotomy to both arms and chest

#### D: Disability

- Mrs T is conscious and talking when spoken to (V on the AVPU Scale)
- Examination of her pupils are equal and responsive to light, and there appears to be no neurological concerns
- Patient able to sit up independently, so you do not need to log roll her

#### E: Exposure

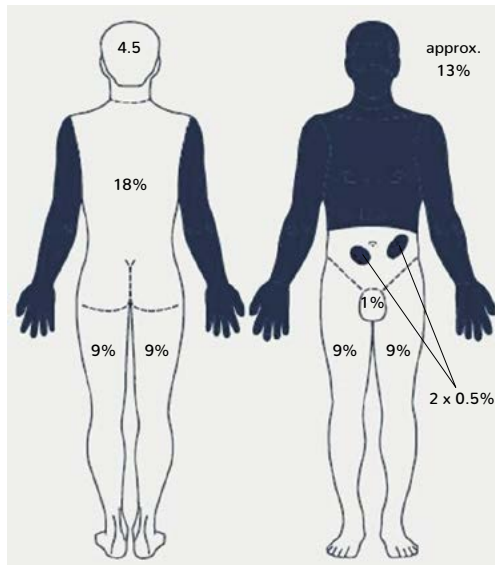
- Patient needs to be kept warm to prevent hypothermia

#### F: Fluid resuscitation

- Crucial in acute burns management: medical team to lead on this (important to monitor urine output, pulse, BP and capillary refill and continue to assess her airway and swelling due to oedema)

### Burns assessment – TBSA and assessment of depth of burns

Plot the burned area on the body chart: shading for TYPE of burns using the symbols or/and rule of nines (\*either shade or use symbols to depict depth of burn).



#### Pain management

- Ensure pain management is covered, to include pre-change of dressings (COD's)/therapy analgesia

**Wound care**

- Discuss the plan for Mrs T's wound care – therapy ties in well to COD's and is a chance to check on wound healing/assess for complications

**From assessment, rehabilitation concerns**

- Oedema
- Respiratory
- Joints affected (REMEMBER– maintain correct position, splint to prevent contracture and mobilise to encourage normal function)

**Rehabilitation treatment**

- Nurse Mrs T sitting up due to inhalation injury risk – add breathing exercises and, if required, chest physiotherapy (as with any other condition). Keeping the patient well-hydrated is important, so that secretions don't dry up
- NB, post-SSG to the chest area vibrations and percussion should be left for five days if possible, and if necessary, done over Gamgee (absorbent cotton between gauze) dressings/pads
- Elevate her arms gently and keep them abducted and extended at rest, as safely appropriate. (see treatment Table). Keep monitoring fingers to check on her circulation
- Splint neck and axilla and, if needed, mouth (see Table)
- Teach ROM and stretching (avoiding overstretch) exercises (see Table for area specific information)
- Assess and advise on mobilisation
- Ensure patient is feeding with her own participation as safely able, and monitor pain levels
- Document everything clearly and COMMUNICATE everything clearly to patient and her family

**Short-term**

Encourage activity from day one.

- Aim is to prevent contracture and maximise return to function – initial movements can be limited if patient has had to undergo any skin grafts, but once surgeon allows it, movement must be encouraged.
- Outcome assessment to include measurement of active and passive ROM and also chin-to-sternal notch measurement and commenting on mouth opening (limited/full), as well as contours of the face, neck and trunk.

**Long-term expected management and outcome**

Assess stage of scar maturation and patient's acceptance of altered body image and function.

## CASE STUDY 2

Mr K is a 23-year-old man who sustained a high-voltage electrical injury trying to get some electricity and has presented two days later with burns to his right hand and both feet.

\* Already you will need to think about acute and ongoing care, as he has suffered a high-voltage injury and the electric current has passed through his body, so he is at risk of cardiac and respiratory abnormalities, as well as myoglobinuria (myoglobin in the urine, usually associated with rhabdomyolysis or muscle destruction) and renal failure. Deep-tissue damage to muscles and the actual area of injury may be more extensive than first observed to include nerve and tendon damage.



### A: Airway and C-spine control

- No history of added trauma and no C-spine injury suspected. He may have stopped breathing at the scene, no-one is sure: he is now awake but confused
- No C-spine management required. Give patient oxygen and monitor closely

### B: Breathing

- Spontaneously breathing with normal breath sounds throughout. RR of 22 BPM
- There are no burns to chest or abdomen and no obvious other life-threatening chest injuries

### C: Circulation

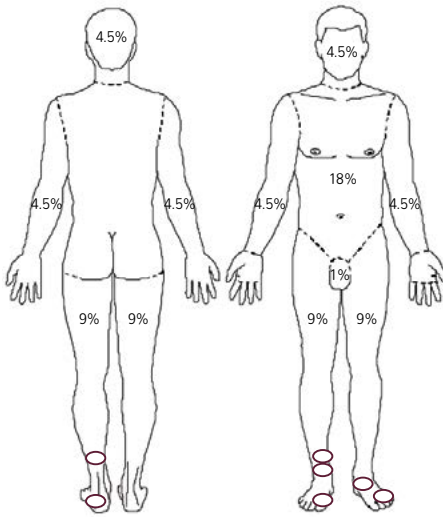
- Patient is not bleeding from any wounds. Pulse is 130 but seems irregular. BP is 100/70
- He has deep burns to the volar aspect of his right forearm and wrist with some swelling but good capillary refill. He needs to be closely monitored, as he may require fasciotomy because he has had a high-voltage injury, which leads to significant muscle damage: Liaise with medical team
- Medical team to insert cannulas and start fluid therapy and set up ECG monitor for heart rate

### D: Disability

- Mr K is conscious and talking when spoken to (V on the AVPU scale) and there appears to be no central neurological concerns. Due to area of injury there will, however, likely be peripheral nerve damage (median nerve in upper limb, peroneal nerve in lower limbs)

### E: Exposure

- Patient is able to sit up independently: burns evident on right arm and both feet – burn on left leg does not extend very far but it is circumferential and the foot is swollen, as is the right wrist (escharotomy may be necessary in both regions plus or minus fasciotomy). No other obvious injuries. Ensure patient is kept warm



Superficial  $\Delta$  Partial Thickness  $\square$  Full Thickness  $\circ$

### Burns assessment – TBSA and assessment of depth of burns

Plot the burned area on the body chart: shading for TYPE of burns using the symbols and/or rule of nines (\*either shade or use symbols to depict depth of burn).

\*Approximately 7% of TBSA, but all burns are full thickness

### F: Fluid resuscitation (and oedema management if required)

From a TBSA point of view, 7% is not a 'resuscitation burn', but we are concerned for deeper tissue damage, therefore medical team needs to lead on this. Liaising with medical team is vital, as after 48 hours of initial injury, if Mr K was in need of escharotomy/fasciotomy, it might be too late: The patient would then have a high risk of requiring amputation.

- It is important to then monitor urine output, pulse, BP and capillary refill and continue to assess HR with ECG and carry on monitoring for further swelling or signs of compartment syndrome in right arm and both legs

### Pain management

- Linking with medical team, ensure pain management is covered to include pre-change of dressings (CODs)/therapy analgesia

### Wound care

- Discuss with medical team what the plan is for Mr K's wound care – likely he will need escharotomy and all wounds will need to be cleaned and dressed. Therapy ties in well to COD's and is a chance to check on wound healing/assess for complications



Fasciotomy incision showing progressive muscle damage at wrist due to an electrical burn

### Rehabilitation treatment

- Currently there is no indication for the need for chest physiotherapy. However, continue to monitor respiration/cough etc.
- Elevate arms gently, notably hand and wrist, and keep abducted and extended (see Table 3). Keep monitoring fingers to check on his circulation
- Elevate feet and keep in position of function (plantigrade splint). NB, it is highly likely he will require bilateral amputation; however, it is vital to maintain correct position, even if there is a later decision to amputate
- Splint right forearm/wrist (see relevant section of Table 3). Get patient to keep moving fingers and use local foam to encourage palmar contours and to create web-spaces (especially between fingers two and three). Aim to keep the interphalangeal joints extended and the metacarpal joints in neutral
- Continue to monitor cardiac signs for dysrhythmias and signs of swelling
- Teach appropriate active and passive ROM and stretching exercises (see Table 3 for area specific information)
- Assess and advise on mobilisation
- Ensure patient is feeding and has sufficient analgesia
- Document everything clearly and COMMUNICATE everything clearly to patient and his family

### Short-term result

- The burns are very deep and will require debridement and graft and/or amputation. Nerve and tendon exploration by plastic surgeon: Will need to be considered to check for damage to these tissues
- Patient is deemed a complicated patient and needs to be managed in an advanced facility

### Long-term expected management and outcome

Assess stage of scar maturation and patient's acceptance of altered body image and function  
NB, patients that present early from NON-war wound injuries should NOT need prophylactic antibiotics.

### Expected outcomes and need for continuing management

The ideal outcome is that wound and soft tissue healing is complete with maximal ROM achieved. Additionally, ensuring previous function, cardiovascular endurance, independent ambulation and independent activities of daily living is key to optimal recovery. Longer-term, the focus should also encompass scar management and psychological motivation.

1. Continuing prevention and treatment of contractures and joint deformities
2. Continuous management scarring (hypertrophic)
3. Possible need for surgery/further surgery for delayed healing wounds and/or contractures
4. Pain management
5. Management of scar hypersensitivity and pruritis (itching)



6. Neuropathy
7. Therapeutic pharmacologic and non-pharmacologic
8. Reconditioning to activities and participation of functional activity
9. Psychological considerations – burns are known to have psychosocial impact on patients, whether in the acute or longer rehabilitation phase:
  - Depression and/or PTSD (post-traumatic stress disorder)
  - Impact on relationships
  - Support for community Integration
10. Body image dissatisfaction (culture may increasingly influence this)
  - Especially consider the greater cosmetic and psychological impact for the face
11. Children – growth considerations
12. Maintaining good nutritional and fluid intake, seeking sun protection (for scarring), padding to reduce shearing on scarring and wearing of protective gloves for hands

## KEY POINTS

### Key points of the chapter

- In this initial phase of emergency management, it is likely that the therapist will not be involved; however, early chest physiotherapy may be needed if inhalation injury exists. In facilities with a high volume of patients, the therapist can be useful in alerting the team to potential life-threatening issues, such as restricted circulation or ventilation due to a deep circumferential burn, and also in assisting with secretion clearance and correct positioning
- Correct positioning is important at this early stage – keep in mind the anti-deformity positioning for contracture prevention; this is the priority, especially for oedema control. It is also important that the nursing/medical team should be well briefed in knowing good positioning
- Pain management
- Infection prevention – be aware of and look for signs of infection or sepsis
- Protection of flaps and grafts – failure of these will negatively impact the patient and their management
- Splinting – be aware of splint safeguards and appropriate patient/carer education
- Education – ensure the patient/carer understands importance of early active mobilisation and assisted mobilisation from the therapist(s) and has information about the long-term rehabilitation of burns injuries

## REFERENCES AND CORE RECOMMENDED READING

*Burn survivor rehabilitation; principles and guidelines for the allied health professional* Australian and New Zealand Burn Association (2007) ANZBA

*Standards of physiotherapy and occupational therapy practice in the management of burn injured adults and children* Burn therapy standards working group (2005) British Burn Association

*Burn Rehabilitation – State of the Science.* American Journal of Physical Medicine and Rehabilitation Esselman P.C., Tombs B.D., Magyar-Russel G., Fauerbach J.A.: (review and analysis) April 2006; 383-413

European Burns Association. 2017. Netherlands. Available at <https://www.euroburn.org/wp-content/uploads/EBA-Guidelines-Version-4-2017.pdf>

*Practice guidelines for the management of pain.* *Journal of Burn Care and Research* Faucher, L. and Furukawa, K. (2006) 27(5); 659-68

*Essential Burns Care Manual* International Network for Training, Education and Research in Burns (Interburns). 2016 [www.interburns.org](http://www.interburns.org)

*War Surgery, Volume 2* International Committee of the Red Cross (ICRC) Geneva, Switzerland 2013. Available at <https://www.icrc.org/en/doc/assets/files/publications/icrc-002-4105.pdf>

*Standards and Strategy for Burn Care: A Review of Burn Care in the British Isles* National Burn Care Review Committee 2001 British Burn Association

*Rehabilitation in Sudden Onset Disasters* Humanity and Inclusion (previously Handicap International), London, UK. Available at [https://www.bond.org.uk/sites/default/files/resource-documents/rehabilitation\\_in\\_sudden\\_onset\\_disasters\\_complete\\_manual.pdf](https://www.bond.org.uk/sites/default/files/resource-documents/rehabilitation_in_sudden_onset_disasters_complete_manual.pdf)

*Splinting strategies and controversies.* *Journal of Burns Care and Rehabilitation* Richard, R. and Ward, S. 2005; 26:392- 396

*The role of massage in scar management: a literature review* Shin, T. and Bordeaux, J. *Dermatologic Surgery* 2012; 38(3):414-23

*Standards of Physiotherapy and Occupational Therapy Practice in the Management of Burn Injured Adults and Children.* 2017. Revised by the Burn Therapy Standards Working Group 2017. Endorsed by the BBA Burn Therapists' Interest Group, the British. Burn Association and the Four Burn Operational Delivery Networks

Every effort has been made to confirm the accuracy of the presented information. The authors and publisher are not responsible for errors of omission or for any consequences from the application of the information in this book, and make no warranty, expressed or implied, with respect to the currency, completeness, or accuracy of the contents of this publication. Application of this information in a particular situation remains the professional responsibility of the practitioner.

The development of this Field Handbook has been made possible by a grant of the AO Foundation, Davos, Switzerland.

This Field Handbook builds on the foundations laid by the ICRC and AO Foundation Limb Injuries Guide and the Handicap International Rehabilitation in Sudden Onset Disasters manual. The contents are directly linked to modules taught on [disasterready.org](http://disasterready.org) where there are additional accompanying resources designed to be used in conflict and disasters settings. Each chapter has been developed by a team of highly specialised rehabilitation professionals, using current evidence or based on best practice consensus, whilst highlighting clinical issues which rehabilitation professionals may encounter in conflicts and disasters.

Humanity & Inclusion UK    T: +44 (0)330 555 0156    [rehab.uk@hi.org](mailto:rehab.uk@hi.org)

