The overall purpose of physiotherapy for patients with spinal cord injury is to improve health-related quality of life. This is achieved by improving patients’ ability to participate in activities of daily life. The barriers to participation which are amenable to physiotherapy interventions are impairments that are directly or indirectly related to motor and sensory loss. Impairments prevent individuals from performing activities such as walking, pushing a wheelchair and rolling in bed. During the acute phase, immediately after injury when patients are restricted to bed, the key impairments physiotherapists can prevent or treat are pain, poor respiratory function, loss of joint mobility and weakness (see Chapters 8–11). Once patients commence rehabilitation physiotherapists can also address impairments related to poor skill and fitness (see Chapters 7 and 12).

It is possible to define the role and purpose of physiotherapy for patients with spinal cord injury within the framework of the International Classification of Functioning, Disability and Health (ICF). The ICF was introduced by the World Health Organization in 2001\(^1\) and is a revised version of the International Classification of Impairment, Disability and Handicap.\(^2\) The ICF defines components of health from the perspective of the body, the individual and society (see Figure 2.1). One of its primary purposes is to provide unified and standard language for those working in the area of disability.\(^1,3\)

The ICF can be used to articulate the goals and purpose of physiotherapy for patients with spinal cord injury. For example, the health condition is spinal cord injury. An associated impairment is poor strength. Poor strength directly impacts on the ability to perform activities such as walking and moving. This in turn has implications for participation, such as working, engaging in family life and participating in community activities. Impairments, activity limitations and participation restrictions are all affected by environmental and personal factors, such as support from family and employers, access to appropriate equipment, financial situation and coping mechanisms. In the ICF framework, such environmental and personal influences are termed contextual factors.
Step one: assessing impairments, activity limitations and participation restrictions

The ICF framework can also be used to describe the process involved in formulating a physiotherapy programme. The process involves five steps:

- **Step one**: assessing impairments, activity limitations and participation restrictions
- **Step two**: setting goals with respect to activity limitations and participation restrictions
- **Step three**: identifying key impairments
- **Step four**: identifying and administering treatments
- **Step five**: measuring outcomes

Each of these steps is described in this chapter and provides the framework for formulating physiotherapy programmes. The focus is primarily on patients undergoing rehabilitation. In the period immediately after injury when patients are restricted to bed it is not feasible to assess activity limitations and participation restrictions, and it may not be appropriate to set goals in these domains.

### Step one: assessing impairments, activity limitations and participation restrictions

Assessment is the first step in devising an appropriate physiotherapy programme. The assessment forms the basis of the goal-setting process. It identifies participation restrictions, activity limitations, and impairments.

Initially, various sources need to be used to extract details such as age, cause of injury, time since injury, neurological status, orthopaedic status, other injuries and complications, socio-economic background, medical and surgical management since injury, prior medical history, family support, employment status and living arrangements. These provide key insights into patients’ problems, and help direct the subsequent physical assessment.

### Assessing activity limitations and participation restrictions

There are several well-accepted assessment tools used to measure activity limitations and participation restrictions, including the Functional Independence Measure (FIM®), Spinal Cord Independence Measure, and Quadriplegic Index of Health condition.
Function\textsuperscript{12–14} (see Table 2.1). They all measure independence across a range of domains, reflecting different aspects of activity limitations and participation restrictions. For example, they assess ability to dress, maintain continence, mobilize, transfer and feed. Some have been specifically designed for patients with spinal cord injury, and others are intended for use across all disabilities.

More physiotherapy-specific assessments of activity limitations and participation restrictions quantify different aspects of mobility and motor function. For example, some assess the ability to walk (e.g. the WISCI, 10 m Walk Test, the Motor Assessment Scale, 6-minute Walk Test, Timed Up and Go), ability to use the hands (e.g. the Grasp and Release test, Sollerman test, Carroll test, Jebsen test) and ability to mobilize in a wheelchair\textsuperscript{15,16} (see Table 2.1). There is as yet no consensus on the most appropriate tests, and currently physiotherapists tend to use a battery of different assessments, including non-standardized, subjective assessments of the way patients move.

<table>
<thead>
<tr>
<th>TABLE 2.1 Assessment tools for measuring activity limitations and participation restrictions</th>
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<tbody>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>Functional Independence Measure (FIM\textsuperscript{®})\textsuperscript{65,66}</td>
</tr>
<tr>
<td>Spinal Cord Independence Measures (SCIM)\textsuperscript{9,10}</td>
</tr>
<tr>
<td>Barthel Index\textsuperscript{68–72}</td>
</tr>
<tr>
<td>Craig Handicap and Reporting Technique (CHART)\textsuperscript{73–78}</td>
</tr>
<tr>
<td>Clinical Outcomes Variable Scale (COVS)\textsuperscript{79,80}</td>
</tr>
<tr>
<td>PULSES\textsuperscript{69,81}</td>
</tr>
<tr>
<td><strong>Brief description</strong></td>
</tr>
<tr>
<td>The FIM assesses activity limitations. It contains 18 items across six domains: self-care, sphincter control, transfers, locomotion, communication and social cognition. Each item is scored on a seven-point ordinal scale ranging from total assistance (one) to complete independence (seven).</td>
</tr>
<tr>
<td>The SCIM was developed specifically for patients with spinal cord injury and contains 16 items covering self-care (four items), respiration and sphincter management (four items), and mobility (eight items). The original SCIM was modified in 2001 and more recently a questionnaire version has been devised.</td>
</tr>
<tr>
<td>The Barthel Index contains 15 self-care, bladder and bowel, and mobility items. Transfers and mobility items (both wheelchair and ambulation) encompass 30%, and toileting and bathing a further 10% of the total score.</td>
</tr>
<tr>
<td>The CHART was specifically designed for patients with spinal cord injury to measure community integration. It consists of 27 items which cover five domains: physical independence (three questions), mobility (nine questions), occupation (seven questions), social integration (six questions) and economic self-sufficiency (two questions). Each item is assessed on a behavioural criteria (i.e. hours out of bed). It is administered via interview or questionnaire.</td>
</tr>
<tr>
<td>The COVS consists of 13 items scored on a seven-point scale and measures mobility in activities such as rolling, lying to sitting, sitting balance, transfers, ambulation, wheelchair mobility and arm function. Lower scores reflect poorer levels of mobility. Although originally developed for a general rehabilitation population, COVS discriminates across lesion level, injury completeness and walking status in patients with spinal cord injury.</td>
</tr>
<tr>
<td>The PULSES assesses activity limitation and participation restriction of those with chronic illness and covers six domains: physical condition (P), upper limb function (U), lower limb function (L), sensation (S), excretory function (E) and support factors (S). The scoring for each item ranges from one (independent) to four (fully dependent).</td>
</tr>
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<table>
<thead>
<tr>
<th>Brief description</th>
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<tbody>
<tr>
<td><strong>Quadriplegic Index of Function (QIF)</strong>&lt;sup&gt;14&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>The Katz Index of ADL</strong>&lt;sup&gt;82&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>SF-36® Health Survey</strong>&lt;sup&gt;83,84&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Sickness Impact Profile (SIP-136)</strong>&lt;sup&gt;89&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Canadian Occupational Performance Measure (COPM)</strong>&lt;sup&gt;91-94&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>The Physical Activity Recall Assessment for People with Spinal Cord Injury (PARA-SCI)</strong>&lt;sup&gt;95,96&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Valutazione Funzionale Mielolesi (VFM)</strong>&lt;sup&gt;97,98&lt;/sup&gt;</td>
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<tr>
<td><strong>The Tufts Assessment of Motor Performance (TAMP)</strong>&lt;sup&gt;99-101&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Needs Assessment Checklist (NAC)</strong>&lt;sup&gt;28&lt;/sup&gt;</td>
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### TABLE 2.1 (continued)

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Gait-related</th>
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</thead>
<tbody>
<tr>
<td><strong>Walking Index for Spinal Cord Injury (WISCI)</strong>&lt;sup&gt;102–104&lt;/sup&gt;</td>
<td>The WISCI was developed specifically for patients with spinal cord injury. It measures ability to walk 10 m and need for physical assistance, orthoses and walking aids on an incremental scale ranging from zero (unable to stand or walk) to 20 (ambulates without orthoses, aids or physical assistance).</td>
</tr>
<tr>
<td><strong>The Spinal Cord Injury Functional Ambulation Inventory (SCI-FAI)</strong>&lt;sup&gt;105&lt;/sup&gt;</td>
<td>The SCI-FAI is an observational gait assessment which uses an ordinal scale to rate nine different aspects of walking. It includes a 2-minute walk test.</td>
</tr>
<tr>
<td><strong>The Walking Mobility Scale</strong>&lt;sup&gt;106–108&lt;/sup&gt;</td>
<td>The Walking Mobility Scale is a five-point scale that classifies ability to walk into the following categories: physiological ambulators, limited household ambulators, independent household ambulators, limited community ambulators and independent community ambulators.</td>
</tr>
<tr>
<td><strong>Timed Up and Go</strong>&lt;sup&gt;109,110&lt;/sup&gt;</td>
<td>The Timed Up and Go test measures the time taken to stand up from a chair, walk 3 m, turn around and walk back to sit down on the chair. No physical assistance is given.</td>
</tr>
<tr>
<td><strong>10 m Walk Test</strong>&lt;sup&gt;65,111,112&lt;/sup&gt;</td>
<td>The 10 m Walk Test measures speed of walking (m/sec&lt;sup&gt;1&lt;/sup&gt;). Patients are instructed to walk 14 m at their preferred speed but time is only recorded for the middle 10 m.</td>
</tr>
<tr>
<td><strong>6-minute Walk Test</strong>&lt;sup&gt;65,113&lt;/sup&gt;</td>
<td>The 6-minute Walk Test is a measure of endurance. Patients are instructed to walk as far as possible in 6 minutes, taking rests whenever required. The distance covered and the number of rests required are recorded.</td>
</tr>
<tr>
<td><strong>Functional Standing Test (FST)</strong>&lt;sup&gt;114&lt;/sup&gt;</td>
<td>The FST measures patients’ ability to reach while standing. It consists of 20 items requiring manipulation and lifting of different objects. Orthoses can be worn and the tasks are done as quickly as possible. Some of the tasks are from the Jebsen Test of Hand Function.&lt;sup&gt;115&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Modified Benzel Classification</strong>&lt;sup&gt;116&lt;/sup&gt;</td>
<td>The Modified Benzel Classification is a seven-point scale that classifies patients according to both neurological and ambulatory status. Neurological classification is based on ASIA and ambulatory classification is crudely based on key gait parameters including ability to walk 25–250 feet (~ 7–75 m).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Upper limb function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capabilities of Upper Extremity Instrument (CUE)</strong>&lt;sup&gt;117&lt;/sup&gt;</td>
<td>The CUE is a measure of upper limb function. It was specifically designed for patients with tetraplegia and is administered via a self-report questionnaire. Patients rate their ability to perform 32 different tasks on a seven-point scale.</td>
</tr>
<tr>
<td><strong>The Tetraplegic Hand Activity Questionnaire (THAQ)</strong>&lt;sup&gt;118&lt;/sup&gt;</td>
<td>The THAQ was designed to measure patients’ perceptions about their hand and upper limb function. Patients are required to rate 153 motor tasks according to their ability to perform the task (four-point scale), need for an aid (four-point scale) and importance of the task (three point scale).</td>
</tr>
<tr>
<td><strong>The Common Object Test (COT)</strong>&lt;sup&gt;119&lt;/sup&gt;</td>
<td>The COT was designed to evaluate the usefulness of neuroprostheses. Patients are required to perform 14 motor tasks. Each task is divided into its sub-tasks and scored on a six-point scale according to the amount of assistance required.</td>
</tr>
<tr>
<td><strong>Grasp and Release Test (GRT)</strong>&lt;sup&gt;120&lt;/sup&gt;</td>
<td>The GRT is a test of hand function. It was initially designed to evaluate the usefulness of neuroprostheses in patients with C5 and C6 tetraplegia.</td>
</tr>
</tbody>
</table>

(continued)
Assessing impairments

The physical assessment also includes an assessment of impairments. These are similar to standard assessments used by physiotherapists in other populations. They include assessments of strength, sensation, respiratory function, cardiovascular fitness and pain. Details of how to assess impairments in patients with spinal cord injury can be found in subsequent chapters (see Chapters 8–12).

Step two: setting goals

Benefits of goals

Goal setting is an important aspect of a comprehensive physiotherapy and rehabilitation programme. The process needs to be patient-centred. Initially, a few key goals of rehabilitation are articulated by the patient and negotiated with the
multi-disciplinary team.\textsuperscript{17,19,22,23,25,29–33} These goals should be expressed in terms of participation restrictions.\textsuperscript{20,25} For example, a key goal of rehabilitation might be to return to work or school. Physiotherapy-specific goals then need to be identified and linked to each participation restriction goal. The physiotherapy-specific goals should be functional and purposeful activities as defined within the activity limitation and participation restriction domains of ICF and, specifically, within the ICF sub-domains of mobility, self-care and domestic life. These sub-domains include tasks such as pushing a manual wheelchair, rolling in bed, moving from lying to sitting, eating, drinking, looking after one’s health, and pursuing recreation and leisure interests (see Ref. 34 for examples of ways to articulate functional goals appropriate for patients with spinal cord injury). Physiotherapy-specific goals are formulated in conjunction with the patient and other team members who share responsibility for their attainment. Both short- and long-term goals need to be set.\textsuperscript{24,25} These may include goals to be achieved within a week or goals to be achieved over 6 months. In addition, specific goals (or targets) should be set as part of each treatment session\textsuperscript{25} (see Chapter 7).

Goals are important for several reasons.\textsuperscript{24} They ensure that the expectations of patients and staff are similar and realistic, and provide clear indications of what everyone is expected to achieve.\textsuperscript{26} If compiled in an appropriate way, they actively engage patients in their own rehabilitation plan, empowering them and ensuring that their wishes and expectations are met.\textsuperscript{26} Without goals, rehabilitation programmes can lack direction, and patients can feel like the passive recipients of mystical interventions.\textsuperscript{19,22,23,30,35} Goals also help focus the rehabilitation team on the individual needs of patients, and provide team members with common objectives.\textsuperscript{24} Perhaps most importantly, goals provide a source of motivation and enhance adherence.

Goals are also used to monitor the success of therapy and to identify problems. Goals achieved indicate success and goals not achieved indicate failure. Failure may be due to any number of reasons which need exploring. For example, a patient may fail to achieve a goal because of medical complications or because equipment fails to arrive, factors which may be difficult to avoid. Failure to achieve goals may reflect poor therapy attendance. Alternatively, failure may indicate unrealistic goals which need revising. A risk of excessive reliance on goals to measure success is that it encourages the selection of non-challenging goals which have a high likelihood of success.\textsuperscript{27}

### Guidelines to setting goals

Goals should be SMART. That is, they should be: Specific, Measurable, Attainable, Realistic and Timebound.\textsuperscript{36} Physiotherapy-related goals need to be based on predictions of future independence, taking into account contextual factors such as patients’ and families’ perspectives, priorities and personal ambitions.\textsuperscript{19,35,37} Other factors which influence outcome include access to products, technology and support, and personal attributes such as age, personality and anthropometrical characteristics.\textsuperscript{37–43} Clearly, however, the strongest predictor of future independence is neurological status.\textsuperscript{32,44,45} Neurological status determines the strength of muscles which in turn largely determines patients’ ability to move.

A simplistic summary of levels of innervation for key upper and lower limb muscles is provided in Table 2.2 (for more details see Tables A1 and A2 in the Appendix). The summary is simplistic because muscles have been grouped together even though different muscles and parts of the same muscle often receive innervation from different spinal nerve roots. For example, the pectoralis muscles consist of pectoralis minor and the sternocostal and clavicular parts of pectoralis major. These muscles receive innervation from C5 to T1.\textsuperscript{46}
For some patients, particularly those with motor complete lesions without zones of partial preservation, it is relatively simple to look at the extent of paralysis and identify the *optimal* levels of independence which patients can hope to attain.\textsuperscript{32,47–49} For instance, patients with complete T12 paraplegia and paralysis of the lower limbs have the potential to independently dress and transfer. In contrast, patients with complete C4 tetraplegia do not. However, this type of information can only be used as a starting point. Not only will outcomes be affected by contextual and other factors, but also by individual variations in neurological status. Often patients with the same ASIA classification have subtle but important differences in strength. For instance, a patient with C6 tetraplegia and grade 4/5 strength in the wrist extensor muscles will generally attain a higher level of function than a patient with the same level of tetraplegia but grade 3/5 strength in the wrist extensor muscles.\textsuperscript{50} This is not only due to the implications of wrist extensor strength for function, but also due to the fact that wrist extensor strength is usually indicative of strength in other muscles which are primarily innervated at the C6 level, such as the latissimus dorsi and pectoralis muscles. Weakness in either of these shoulder girdle muscles has deleterious implications for function.\textsuperscript{51}

\begin{table}
\centering
\begin{tabular}{|c|c|c|}
\hline
\hline
\textbf{T1–T12} & Intercostals, abdominals and trunk & \\
\hline
\textbf{L2} & Hip & \\
\hline
\textbf{L3} & Knee & Extensors* \\
\hline
\textbf{L4} & Hip & Abductors \\
\hline
\textbf{L5} & Hip & Extensors \\
\hline
\textbf{S1} & Knee & Flexors \\
\hline
\textbf{S2} & Ankle & \\
\hline
\end{tabular}
\caption{The levels at which muscles receive sufficient innervation to enable reasonable movement\textsuperscript{46}}
\end{table}

The ASIA muscles are asterisked (see Appendix for more details).
Setting goals for patients with complete lesions

This section provides a brief overview of typical outcomes attained by patients with ASIA complete lesions and no zones of partial preservation. A summary is provided in Table 2.3.

C1–C3 tetraplegia

Patients with C2 and above tetraplegia have total paralysis of the diaphragm and other respiratory muscles and consequently are ventilator-dependent. Patients with C3 tetraplegia retain a small amount of diaphragm function but not usually enough to breathe spontaneously (see Chapter 1). All have paralysis of upper and lower limbs and trunk muscles but are able to move their heads. They are fully dependent

| TABLE 2.3 Typical level of independence attained by patients with ASIA complete spinal cord injury |
|-------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                                                 | C1–C3 tetraplegia | C4 tetraplegia | C5 tetraplegia | C6 tetraplegia | C7–C8 tetraplegia | Thoracic paraplegia | Lumbar and sacral paraplegia |
| Unassisted ventilation                          | no                | yes             | yes             | yes             | yes               | yes               | yes               |
| Push manual wheelchair                          | no                | no              | limited          | limited          | yes               | yes               | yes               |
| Hand to mouth activities                        | no                | no              | yes             | yes             | yes               | yes               | yes               |
| Self-feeding                                    | no                | no              | limited          | yes             | yes               | yes               | yes               |
| Hand function                                   | no                | no              | no              | limited (tenodesis) | limited (tenodesis) | yes               | yes               |
| Driving64                                        | no                | no              | no              | yes             | yes               | yes               | yes               |
| Rolling                                         | no                | no              | limited          | yes             | yes               | yes               | yes               |
| Horizontal transfer                             | no                | no              | limited          | yes             | yes               | yes               | yes               |
| Lying to sitting                                | no                | no              | limited          | yes             | yes               | yes               | yes               |
| Floor to wheelchair                              | no                | no              | no              | limited          | limited           | yes               | yes               |
| Standing in parallel bars with orthoses         | no                | no              | no              | no              | limited           | yes               | yes               |
| Walking with orthoses and aids                  | no                | no              | no              | no              | no               | limited           | yes               |
Step two: setting goals

on others for all motor tasks and personal care activities. They mobilize in chin-control power wheelchairs and can use head-, mouth- or voice-activated technology (see Figure 2.2).

**C4 tetraplegia**

Patients with C4 tetraplegia have partial paralysis of the diaphragm and total paralysis of all four limbs and trunk muscles. They retain a small amount of voluntary control around the shoulders and have good strength in the rhomboid muscles but still mobilize in a chin-control power wheelchair. They can breathe independently but in all other respects their activity limitations are similar to those of patients with C1–C3 tetraplegia.

**C5 tetraplegia**

Patients with C5 tetraplegia have partial paralysis of the upper limbs but full paralysis of the trunk and lower limb muscles. They have good strength of the deltoid and
biceps muscles, but poor strength of other shoulder muscles. They have no function in the triceps muscles or any muscles about the wrist or hand. Despite this, they can use a hand-control power wheelchair with the hand passively rested on or secured to the joystick (see Chapter 13). They are unable to perform gross motor tasks such as transferring, rolling or moving from lying to sitting and require assistance for most personal care activities. They can, however, take their hands to their mouth, head and face. They can use the upper limbs to perform simple tasks provided no fine hand control is required and the appliance or utensil is attached to the hand with a splint. Upper limb function is usually possible with splints to stabilize the paralysed wrist. For example, a keyboard can be used with a typing stick attached to the hand and a steering wheel of a car can be turned with adaptations to the wheel (see Chapter 5).^54

C6 tetraplegia

There is a large functional difference between patients with C5 and C6 tetraplegia. This is due to the preservation of the pectoralis, serratus anterior, latissimus dorsi and wrist extensor muscles. The latissimus dorsi muscle, in combination with the pectoralis and serratus anterior muscles, enables weight bearing through the upper limbs. This provides the potential to lift body weight and transfer (see Chapter 3). The latissimus dorsi muscle also provides some trunk stability.\textsuperscript{55} Although not normally considered a trunk muscle, the latissimus dorsi becomes important in the absence of other trunk muscles. Preservation of the pectoralis muscles makes it possible to roll over in bed and provides stability around the shoulder when weight bearing. Serratus anterior is also important for scapula stability.

Patients with C6 tetraplegia have the potential to live independently, provided they are adequately equipped and set up. Some can transfer, roll, move from lying to sitting, dress, bathe and attend to personal hygiene, although all these motor tasks are time-consuming and difficult to master. Patients with C6 tetraplegia mobilize in a manual wheelchair, but most also use a power wheelchair. Voluntary control of the wrist extensor muscles provides crude grasp (tenodesis grip; see Chapter 5). This makes it possible to hold objects between the index finger and thumb, or in the palm of the hand, despite paralysis of the finger and thumb flexor muscles.

C7 tetraplegia

Patients with C7 tetraplegia typically attain higher levels of independence than those with C6 tetraplegia because of the function provided by the triceps, wrist flexor and finger extensor muscles. The triceps muscles are particularly important because they increase the ability to bear weight through a flexed elbow. The triceps muscles also enable patients to carry and hold objects above their heads. Patients with C7 tetraplegia still have paralysis of the finger and thumb flexor muscles so, despite the ability to extend the fingers, they rely on a tenodesis grip for hand function.

C8 tetraplegia

Patients with lesions at C8 have finger and thumb flexor activity, and therefore can actively grasp and release objects. Consequently, hand function is superior to that of patients who rely on a tenodesis grip. Greater strength in the triceps and shoulder muscles enables these patients to more easily attain independence than those with lesions at C6 and C7.
Step three: identifying key impairments

T1 paraplegia

Patients with lesions at T1 have near-normal hand function, although they retain some weakness in the intrinsic and lumbrical muscles affecting fine hand control. They still have extensive paralysis of the trunk muscles and therefore, like those with higher lesions, have difficulty sitting unsupported (see Chapter 3).

Thoracic paraplegia

Patients with thoracic paraplegia have full upper limb movement, varying degrees of paralysis of the trunk and total paralysis of the legs. They are predominantly wheelchair-dependent, although some can walk short distances with extensive bracing and walking aids (see Chapter 6). Patients with high thoracic paraplegia have more extensive paralysis of the trunk muscles than those with lower thoracic paraplegia, primarily affecting their ability to sit unsupported and master complex transfers.

Lumbar and sacral paraplegia

Patients with lumbar and sacral paraplegia have varying extents of paralysis of the lower limbs and do not commonly have complete lesions. Most can walk with or without aids and orthoses although some remain wheelchair-dependent (see Chapter 6).

Setting goals for patients with incomplete lesions

Outcomes for patients with zones of partial preservation, or ASIA C or D incomplete lesions, are less predictable. In these patients, patterns of neurological loss are diverse, the extent of possible neurological recovery is unclear, and consequently accurate and detailed predictions of motor function are difficult. Knowledge about levels of independence attainable by patients with complete spinal cord injury is used as a starting reference then modified depending on individual circumstances and neurological status. Some degree of intuition, developed with experience, is needed to generate goals that are realistic and appropriate.

Step three: identifying key impairments

Once goals of treatment are defined in terms of activity limitations and participation restrictions, it is then necessary to determine which impairments prevent the attainment of each goal. That is, key impairments need to be linked to specific activity restrictions and participation limitations. Identification and treatment of impairments without linking them to activity limitations and participation restrictions risks wasting time, money and resources on impairments which are of little consequence. For example, limited hamstring extensibility is an important impairment for some but not all patients. Unless limited hamstring extensibility is linked to activity and participation goals, physiotherapists might be tempted to direct therapeutic attention at increasing the extensibility of the hamstring muscles in some patients unnecessarily (see Chapter 9).

The process of linking impairments to activity restrictions and participation limitations is the same, regardless of whether one is trying to determine the impairments which prevent a patient with incomplete paraplegia from walking, a patient with C6
tetraplegia from rolling, or a patient with T4 paraplegia from transferring. Each motor task is analysed with respect to sub-tasks. For instance, analysis of transferring between a bed and wheelchair for a patient with C6 tetraplegia is done in relation to the sub-tasks of positioning the legs on the bed, moving forward in the wheelchair and transferring between surfaces (see Table 3.8, p. 71). The underlying reasons for the inability to perform any of these sub-tasks need to be identified and expressed in terms of impairments which are responsive to physiotherapy interventions.

The analysis of motor tasks needs to be done within a realistic framework. For instance, the identification of key impairments preventing a patient with incomplete paralysis from walking needs to be done within the context of how that particular patient can best hope to walk (see Chapter 6). Clearly, someone with paralysis of the quadriceps muscles will not walk in the same way as someone with full strength in the quadriceps muscles. Consequently, gait needs to be analysed with respect to the best gait pattern that can be hoped for, not with respect to the normal kinematics and kinetics of gait for an able-bodied individual. This same principle applies across all mobility tasks and, consequently, physiotherapists require a good understanding of how patients with different patterns of paralysis move (see Chapters 3–6).

Only impairments which are amenable to physiotherapy interventions are of real interest. For example, there is little point linking the inability of a patient with paraplegia to get from the floor back into the wheelchair with permanent paralysis of the legs because this will not guide treatment. A far more helpful analysis would be to link the inability to vertically transfer with insufficient upper limb strength because this is an impairment which can be addressed with an appropriately targeted strength-training programme (see Chapter 8).

Step four: identifying and administering treatments

Six key impairments are responsive to physiotherapy intervention and commonly impose activity restrictions and participation limitations. These are largely contained within the Neuromusculoskeletal and Movement-Related Functions domains of ICF. They include:

- poor skill (see Chapter 7)
- poor strength (see Chapter 8)
- poor joint mobility (see Chapter 9)
- pain (see Chapter 10)
- poor respiratory function (see Chapter 11)
- poor cardiovascular fitness (see Chapter 12)

Some interventions administered by physiotherapists are directed at preventing, rather than treating, impairments, activity limitation and participation restrictions. In addition, physiotherapists are often responsible for prescribing mobility equipment such as wheelchairs and cushions. These issues will be discussed throughout subsequent chapters.

Step five: measuring outcomes

Measurement of outcomes is an integral part of any physiotherapy programme. It determines whether the type and extent of physiotherapy intervention should continue, stop or change (see Chapter 14). Outcomes are best expressed in terms of
initial goals and, in particular, with respect to activity limitations and participation restrictions. The assessment tools used in the initial examination can be used for this purpose (see p. 36). Alternatively, outcomes can be measured with respect to patient-articulated goals using tools such as the Canadian Outcome Performance Measure (see Table 2.1). Reassessment at the impairment level often provides more sensitive measures of change. Such reassessments are also useful for confirming whether the initial analysis was correct. For example, if an inability to transfer was deemed to be the consequence of poor strength in the shoulder adductor muscles, then improvements in shoulder adductor strength should be accompanied by improvements in the ability to transfer. Measurements which demonstrate an increase in shoulder adductor strength alone are of little relevance if there is no accompanying measurement to demonstrate a change in ability to perform some purposeful motor task.

While there is a temptation to use increasingly sophisticated tools to assess outcomes, there is little to be gained from using expensive technology to detect minuscule changes in impairment or function if the changes are of little clinical relevance. Likewise, there is little to be gained from assessments if they do not influence the clinical decision-making process. For instance, while three-dimensional gait analysis can provide detailed information about angular velocity of the ankle during terminal swing, this information is only useful to clinicians if physiotherapy interventions are sophisticated enough to be able to specifically address terminal velocity of the ankle during swing.

Physiotherapy as part of the multi-disciplinary team

Physiotherapists are members of a multi-disciplinary team, and the overall success of any rehabilitation programme depends on the contribution of all team members. Development of physical independence will be of little avail if patients do not have appropriate accommodation or financial support on discharge home. In the same way, the success of a physiotherapy programme will be undermined if patients return home incontinent or psychologically distressed. The success of rehabilitation is dependent on team members working closely together to ensure continuity and consistency in their individual therapeutic approaches.\textsuperscript{24} For example, occupational therapists, nursing staff and physiotherapists are all involved with the day-to-day physical aspects of patients’ care. New motor tasks learnt in physiotherapy need to be appropriately practised and reinforced outside formal physiotherapy sessions (see Chapter 7). However, motor tasks need to be taught and reinforced in the same way by all health professions. The application of different treatment approaches to inconsistent goals by different team members can be confusing, frustrating and counter-productive for patients. Inconsistencies of this kind are avoided by close teamwork and clear role delineations.

References


