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SCI in OT

EPIDEMIOLOGY

- SCI is relatively rare, afflicting approximately 12,000 people a year in the United States. The number of people with SCI alive today in the United States is estimated to be in the range of 236,000 to 327,000.
- The causes of SCI as tracked by NSCISC since 2005 are as follows. Approximately 39.2% of SCIs are caused by motor vehicle accidents, 28.3% by falls, 14.6% by violence (mostly gunshot wounds), and 8.2% by sports injuries. Other causes, such as nontraumatic SCI, account for the remaining 9.7% (NSCISC, 2012). Nontraumatic SCI is caused by spinal stenosis, tumors, ischemia, infection, and congenital diseases (van den Berg et al., 2010).

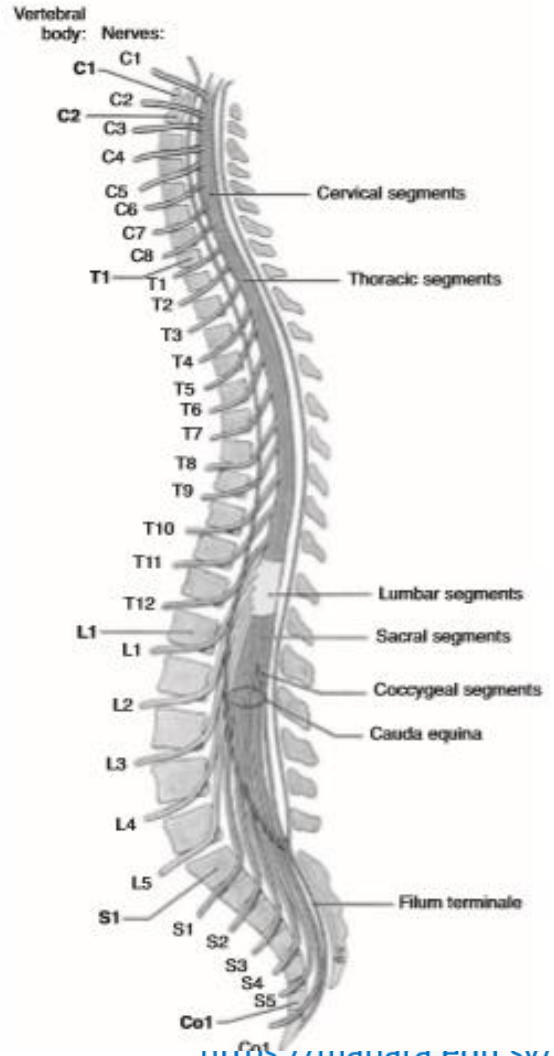
- SCI occurs mostly in adolescents and young adults (ages 15–29 years of age) and in elderly people aged 65 years and older, and the most common causes of traumatic SCI are vehicular accidents and falls, respectively.
- Generally, the level of education of injured individuals is somewhat lower and the unemployment rate is somewhat higher than in the general population. At injury, 51.95% of individuals are single, and the likelihood of getting married postinjury is somewhat lower than the general p opulation.

COURSE AFTER SPINAL CORD INJURY

- SCI causes a disruption in the motor and sensory pathways at the site of the lesion. Because the nerve roots are segmental, a thorough evaluation of motor and sensory function can identify the level of lesion.
- For example, if the spinal cord is completely severed at the level of the 6th cervical nerve root, motor and sensory information below that level no longer can travel to and from the brain. This results in paralysis of muscular activity and absence of sensation below the level of injury.

- Immediately after the injury, a period of spinal shock occurs, characterized by areflexia at and below the level of injury. Spinal shock may last hours, days, or weeks. As soon as spinal shock subsides, reflexes below the level of injury return and become hyperactive. At the level of injury, areflexia may remain as the reflex arc is interrupted.

Neurological Classification of Spinal Cord Injury



- Tetraplegia results in functional impairment in the arms, trunk, legs, and pelvic organs. The term tetraplegia, which has replaced quadriplegia, is defined as impairment in motor and/or sensory function in the cervical segments of the spinal cord.
- Paraplegia refers to motor and sensory impairment at the thoracic, lumbar, or sacral segments of the cord.
- The neurological level is diagnosed by the physician according to the motor and sensory level. The motor level is determined by testing 10 key muscles on each side of the body, and the sensory level is determined by testing sensation of 28 key points on each side of the body

Patient Name _____

Examiner Name _____ Date/Time of Exam _____

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ISCOS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5	☐	☐	Elbow flexors
C6	☐	☐	Wrist extensors
C7	☐	☐	Elbow extensors
C8	☐	☐	Finger flexors (distal phalanx of middle finger)
T1	☐	☐	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

Comments:

L2	☐	☐	Hip flexors
L3	☐	☐	Knee extensors
L4	☐	☐	Ankle dorsiflexors
L5	☐	☐	Long toe extensors
S1	☐	☐	Ankle plantar flexors

(VAC) Voluntary anal contraction (Yes/No) ☐

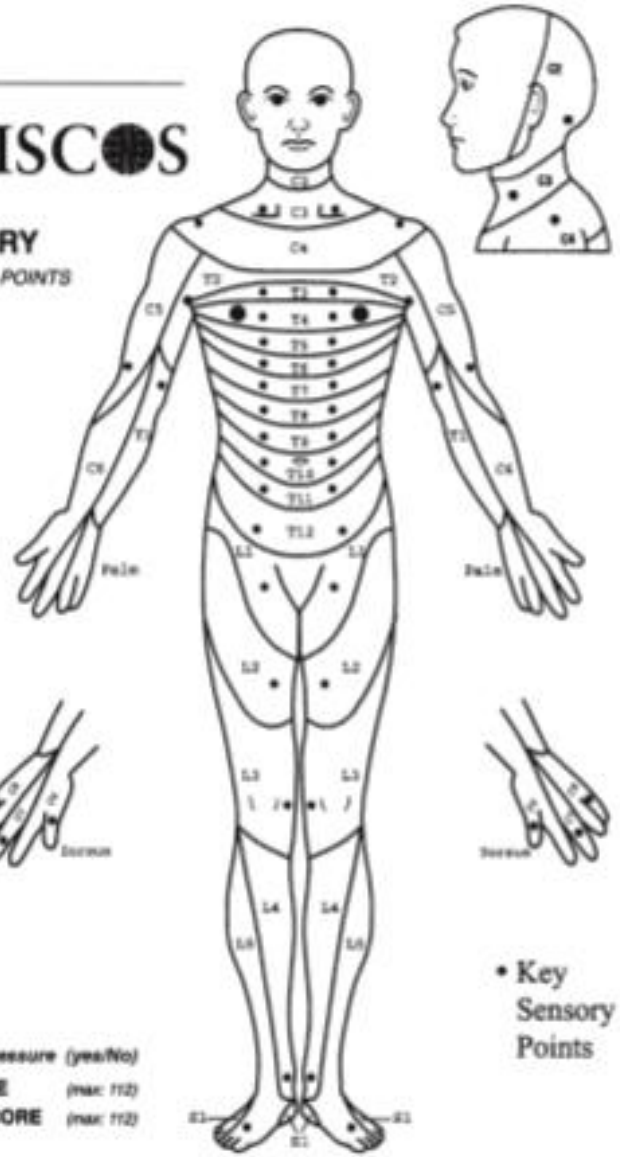
LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				
TOTALS (MAXIMUM)	☐ (56)	☐ (56)	☐ (56)	☐ (56)

0 = absent
1 = altered
2 = normal
NT = not testable



• Key Sensory Points

☐ (DAP) Deep anal pressure (yes/No)

PIN PRICK SCORE ☐ (max: 112)

LIGHT TOUCH SCORE ☐ (max: 112)

NEUROLOGICAL LEVEL
The most caudal segment with normal function

SENSORY R ☐ L ☐
MOTOR R ☐ L ☐

SINGLE NEUROLOGICAL LEVEL ☐

COMPLETE OR INCOMPLETE? ☐
Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE (AIS) ☐

ZONE OF PARTIAL PRESERVATION
Most caudal level with any innervation

SENSORY R ☐ L ☐
MOTOR R ☐ L ☐

- The neurological level of injury (NLI) is the lowest segment of the spinal cord at which key muscles grade 3 or above out of 5 on manual muscle testing (MMT), and sensation is intact for this level's dermatome . Also, the level above must have normal strength and sensation.
- For example, a person is diagnosed as having C6 tetraplegia when radial wrist extensors test 3 out of 5 and sensation is intact for the C6 dermatome. Furthermore, all motor and sensory status above the C6 level is intact. Skeletal level refers to the level of greatest vertebral damage (ASIA, 2011).

- Functional level , a term used by occupational and physical therapists, refers to the lowest segment at which strength of important muscles (key and non-key muscles by ASIA terms) is graded 3 or above out of 5 on MMT and sensation is intact. These muscles significantly change functional outcomes.
- Complete injury consists of the absence of sensory and motor function in the lowest sacral segments (S4–S5) (ASIA, 2011). Consider the patient in the Case Example who has a C6 complete injury (also called AIS A). He does not have either sensation or motor have either sensation or motor function in S4-S5 but does have some muscle and sensory function above that level.
- The term incomplete injury should be used only when there is partial preservation of sensory and/or motor function below the neurological level and must include the sacral segments (ASIA, 2011). The physician tests innervation at the lowest sacral segment, including anal sensation and sphincter contraction

- Central cord syndrome, the most common syndrome, is an incomplete injury, often caused by falls; it results in greater weakness in the upper limbs than in the lower limbs. This injury occurs mostly to older people and is often associated with cervical stenosis (ASIA, 2011).
- Brown-Sequard syndrome is an incomplete injury with damage to half of the cord causing ipsilateral proprioceptive and motor loss and contralateral loss of pain and temperature sensation. This syndrome is rarely seen in its pure form (ASIA, 2011).
- Anterior cord syndrome is a rare syndrome associated with absent blood supply to the cord causing the loss of motor control, pain, and temperature sensation below the injury. Proprioception and light touch are preserved (ASIA, 2011

- Cauda equina syndrome is a lower motor neuron injury to the lumbosacral nerve roots within the spinal canal. It results in arefl exic bladder and bowel and paralysis or weakness of the lower limbs (depending on the level of injury) (ASIA, 2011).
- Conus medullaris syndrome is similar to cauda equina syndrome but in addition to lesions to the lumbar nerve roots, the cord is also damaged, resulting in a mixed physical picture with some preservation of refl ex activity. The bladder, bowel, and lower limbs are affected (ASIA, 2011).

Prognosis

- Neural recovery during rehabilitation is common and can result insignificant improvement in function. In patients with complete injuries, muscles in the zone of partial preservation strengthen, which may result insignificant functional change. This is true especially if a key muscle, such as extensor carpiradialis, strengthens enough to enable the person to extend the wrist and hold objects. Patients with incomplete injury have a better prognosis, and their spontaneous recovery is less predictable in its pattern and outcome than patients with complete injury

- Immediately after the injury, all reflexes cease to function. When spinal shock resolves, patients have an excellent chance to regain motor and sensory function. As time after injury increases, however, the recovery rate declines. Most motor and sensory spontaneous return in both complete and incomplete injuries occurs in the fi rst 3 months post onset. The rate of recovery declines but persists for up to 18 months or longer.

- it is important that the therapist maintain hope while planning a realistic course of treatment. Research data can assist the clinician in predicting recovery and outcomes. The therapist should be sensitive and cautious about sharing this information with patients when they are most vulnerable.
- Long-term survival of people with SCI has improved dramatically over the past 50 years and is only slightly less than the general population (Fawcett et al., 2007). The major causes of death are respiratory complications and infections (NSCISC, 2010).

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ASIA Impairment Scale (AIS)

AIS A = Complete. No sensory or motor function is preserved in the sacral segments S4–S5.

AIS B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4–S5 (light touch, pin prick at S4–S5 or deep anal pressure [DAP]), AND no motor function is preserved more than three levels below the motor level on either side of the body.

AIS C = Motor Incomplete. Motor function is preserved below the neurological level**, and more than half of key muscles below the single neurological level of injury (NLI) have a muscle grade of <3 (Grades 0–2).

AIS D = Incomplete. Motor function is preserved below the neurological level**, and *at least half* (half or more) of key muscles below the NLI have a muscle grade of ≥3.

AIS E = Normal. If sensation and motor function as tested with the International Standards for Neurological Classification of Spinal Cord Injury are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

Note: To receive a grade of C or D, a person must have sensory or motor function in the sacral segments S4–S5. In addition, the individual must have either (1) voluntary anal sphincter contraction or (2) sparing of motor function more than three levels below the motor level.

**For an individual to receive a grade of C or D (i.e., motor incomplete status), they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The Standards at this time allows even non-key muscle function more than three levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

Note: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the **motor level** on each side is used, whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the **single neurological level** is used.

ASIA Impairment Scale reprinted with permission from the American Spinal Injury Association. (2011). *International standards for neurological classification of spinal cord injury*. Atlanta, GA: American Spinal Injury Association.

Impairments and Their Therapeutic Implications

Respiration:

Many patients with SCI have compromised breathing especially for individuals with cervical injuries. Respiratory complications, specifically pneumonia, have been identified as the leading cause of death in the first year of life after SCI.

In lesions above C4, damage to the phrenic nerve results in partial or complete paralysis of the diaphragm. These patients require mechanical ventilation.

Lower cervical and thoracic spine injuries can result in paralysis of other breathing muscles, such as the intercostals, abdominals, or latissimus dorsi. Thus, patients with such injuries also have impaired respiration.

Use of proper techniques and infection control standards are important for respiratory care. Under the direction of the physician, the physical and respiratory therapists and the health care team work to achieve adequate bronchial hygiene and to facilitate good breathing at rest and during activities. Good communication with the team allows the occupational therapist to support breathing goals.

Autonomic Dysreflexia

- Autonomic dysreflexia, a sudden dangerous increase in blood pressure, is a possibly life-threatening complication associated with lesions at the T6 level or above. It is brought on by an unopposed sympathetic response to noxious stimuli. Some of the more common causes of autonomic dysreflexia are distended bladder, urinary tract or other infection, bladder or kidney stones, fecal impaction, pressure ulcers, ingrown toenails, invasive procedures such as urinary catheterization or enema, and pain. The main symptoms are hypertension and a pounding headache.

- An increase of 20 mm Hg or more in systolic blood pressure is a sign that must be attended to. A pounding headache is the most common symptom. Other signs and symptoms include heavy sweating, flushed skin, goose bumps, blurry vision, a stuffy nose, anxiety, difficulty breathing, and chest tightness. Take the following steps:

1. Ask the person to stop any ongoing activity, as it may further increase blood pressure
2. Check blood pressure. If high:
3. Have the person sit up with head elevated to avoid excessive blood pressure to the brain.
4. Loosen clothing, abdominal binder, and any other constrictive devices.
5. Check the urinary catheter for kinks or folds and straighten any.
6. Continue to monitor blood pressure and seek medical assistance, which may include bladder irrigation, manual fecal evacuation, and medications.

Orthostatic Hypotension or Postural Hypotension

- Orthostatic hypotension is a sudden drop in blood pressure occurring when a person assumes an upright position. Most common in patients with lesions at the T6 level and above, it is caused by impaired autonomic regulation.
- A decrease occurs in the returning blood supply to the heart, commonly because of blood pooling in the lower extremities. Orthostatic hypotension is aggravated by a prolonged stay in bed. When the patient attempts to sit up, the blood rushes down to the legs. The patient may complain of light-headedness or dizziness and may faint on moving from reclined to upright. The therapist must use caution when sitting the patient up by having the patient move slowly and in stages and letting the blood pressure adjust to the change.
- Elevating the head of the bed, using a tilt table, or using a reclining wheelchair can accomplish this. To control this problem further, patients benefit from wearing abdominal binders and elastic stockings (Alverzo et al., 2009).

Orthostatic or Postural Hypotension

- In contrast to autonomic dysreflexia, in orthostatic hypotension, blood pressure drops to dangerously low levels in response to assuming an upright position. If it is not treated immediately, the person may lose consciousness. Symptoms of orthostatic hypotension include light-headedness, pallor, and visual changes. To resolve the problem:

1. Check blood pressure.
2. If the person is in bed, lower the head of the bed.
3. If the person is in a wheelchair, lift his or her legs and observe for signs of relief. If symptoms persist, recline the wheelchair to place the head at or below the level of the heart.
4. If symptoms persist, put the patient to bed.
5. Continue to monitor blood pressure and seek medical assistance. Do not leave the patient unattended until a nurse or a physician is present

Pressure Ulcers and the Maintenance of Skin Integrity

- Individuals with SCI are in perpetual danger of developing pressure ulcers. Most patients do not have the sensory feedback that periodically cues them to shift position in their bed or wheelchair. The constant pressure caused by maintaining a static position without shifting weight can lead to skin breakdown. All individuals with SCI must adhere to a weight-shifting pressure- relief schedule. Generally, in the wheelchair, people that have strong upper limbs perform pressure relief by leaning forward or side to side. Individuals that cannot perform these skills must rely on a powered wheelchair that tilts back (either a tilt-in-space wheelchair or one that reclines).

- Although most pressure-relief efforts are aimed at the buttocks, many other parts of the body are vulnerable.
- All insensate areas must be inspected daily. For high tetraplegic patients, these areas may also include the spine of the scapula and the back of the head.

- Individuals with SCI incorporate this practice in their daily routines following hospitalization. They must become responsible for carrying out pressure-relief procedures themselves or for asking assistance in doing so. This may sound easy, but data suggest that most people with SCI develop at least one pressure ulcer during their lifetime.
- This underscores the challenge of living life fully while having to stay vigilant, perform routine thorough skin inspections, shift weight routinely, maintain equipment in good repair, and make minute-by-minute choices about activity levels and durations. Recent research suggests that intervals of 2 minutes of pressure relief every hour while seated in the wheelchair is required for tissue oxygen perfusion, rather than 1 minute as previously thought. While in bed, people with SCI must change position every 2 hours.

- Any client interaction must be viewed as an opportunity for a “teachable moment”. Educational materials, such as the Consortium for Spinal Cord Medicine Clinical Practice Guidelines, Consumer Guides—Pressure Ulcers: What You Should Know (2002) and www.PressureUlcerPrevention.com, a user-friendly website for consumers and therapists, are helpful supplements for reinforcing the program. However, education is not enough to prevent ulcers.

- Examples of occupational therapy roles in pressure ulcer prevention include

- training in motor skills, such as checking the skin in bed and in the wheelchair
- establishing routines, such as inspecting and wiping any wetness in vulnerable areas
- assessing environmental and contextual factors, such as helping select high-protein, healthy foods when going to the market
- recommending appropriate equipment such as seating systems, cushions, and padded shower chairs
- assisting in creating a typical day that allows for rest periods and other preventive measures

Bowel and Bladder Function and Management

- Bowel and bladder function is controlled in the S2–S5 spinal segments. Therefore, all persons with complete lesions at and above the S2–S5 levels lose their ability to void and defecate voluntarily. With the presence of intact reflex activity but with a lack of cortical voluntary control, patients void and defecate reflexively. Incomplete injuries and disruption at the S2–S5 levels, as seen in conus medullaris and cauda equina, may present with a mixed sensory and/or motor picture. For example, a person may feel the urge but may lack the ability to void and defecate voluntarily. The goal of a sound bowel and bladder program is to allow the person to develop an elimination routine that supports health, reduces potential complications, and allows the freedom to engage in life roles without disruption.

- Following a thorough medical examination that includes studies of the structure and function of the digestive and urinary tracts, a physician establishes a safe elimination program. Most programs involve behavioural and pharmacological interventions. Surgery is also an option that is typically offered years postinjury to further ease elimination and reduce problems.

- Nurses are the primary trainers of bowel and bladder routines, and occupational therapists have a vital role in supporting the acquisition of these new skills and habits. A typical bowel program for a person with paraplegia includes taking oral medications to allow for optimal feces consistency and establishing a daily routine of transferring to the toilet, managing clothing, inserting a suppository, and, after waiting for some time, inserting a finger to the anus (called digital stimulation), which causes reflexive defecation. The occupational therapist may assist in facilitating skill acquisition in a person with poor vision and/or cognitive deficits.

- A magnifying mirror and a lamp may be placed on the floor to help the person see the process, which helps to further break down the activity to better reinforce each step. Persons with low tetraplegia have added challenges in becoming independent in bowelcare. They may achieve independence or assist in managing their bowel care only after much practice. To compensate for poor trunk control, individuals perform the bowel program on a commode; to compensate for finger paralysis, they require a tool called a dill stick to stimulate the anal reflex to defecate; and to compensate for lack of sensation in the anus and/or parts of the hand, they require a mirror.

Figure 38-4 A simulation of a bowel program for a person with low-level tetraplegia (AIS A). The person is hooking his left arm under the handle for stability. He is using a dill stick to stimulate reflexic evacuation and a mirror to compensate for his lack of sensation in the anal area.

- For safe task performance, occupational therapists may practice commode mobility and dill stick insertion, focusing on effective visual compensation.
- When patients become skilful at bowel evacuation practices, they decrease the risk of complications. Most individuals, after discharge, opt to carry out their bowel program in the morning every other day and can complete the procedure within 45 minutes.

- As with the bowel program, the goal of the bladder program is to achieve a simple routine with minimal risk of complications. Recurring urinary tract infection is a frequent complication and the most frequent cause of rehospitalization after SCI. To avoid complications, patients must empty their bladder routinely.

- An indwelling catheter, which is a catheter that stays in the urethra and is changed only periodically, is commonly inserted soon after the person is admitted to the acute care hospital.
- Although some patients continue to use an indwelling catheter, an effort is made to find other ways to empty the bladder to reduce the chance of urinary tract infections.

- Some common bladder practices include use of either intermittent catheterization (IC) or reflex voiding. IC involves the manual insertion of a catheter into the bladder at fixed intervals of approximately 4–6 hours. Reflex voiding refers to spontaneous urination when the bladder is full. This voiding method requires that males use a condom catheter and a leg bag and that females use a diaper. As with the bowel program, the bladder programs of persons with tetraplegia need more intervention, and the occupational therapist must become thoroughly familiar with individual techniques.

- Interventions may include finding a way to keep down the pants when performing IC in the wheelchair and training with a tool that helps insert the catheter into the urethra. Urinary management is more challenging to females than to males. Women have a shorter urethra and the opening is between the folds of the labia, so it is much harder for women to insert a catheter.

- In addition, women often need to wear diapers because their shorter urethra is more prone to leakage, and there are currently no acceptable female external collection devices that can keep the skin dry.
- To best meet the person's environmental and contextual demands, the occupational therapist must think and practice beyond the hospital or clinic when helping patients rehearse and refi ne bowel and bladder routines. As patients rebuild new routines and habits, the therapist helps identify and embed these new functional skills in real-life scenarios such as emptying a full leg bag at a party, changing clothes when an accident happens in a mall, and performing IC while attending school.

Figure 38-5 Catheterization: Inserting a catheter into the bladder and waiting for urine to flow.

Sexual Function

- The need for emotional and physical intimacy does not diminish after SCI, and questions about intimacy, sexuality, fertility, and reproduction must be answered by a team of sensitive and knowledgeable professionals. SCI affects both sexual intercourse and reproduction, both of which are determined by the level of injury and its completeness. Most male patients with complete injuries are unable to have psychogenic (voluntary) erections and ejaculations. They can, however, have reflex erections that may be controlled by stimulation, such as pulling the pubic hairs or using a vibrator.

- Although most cannot feel orgasms, many describe developing new erogenous zones, such as around the neck and face. Patients with complete injuries at S2–S5 lose bowel, bladder, and genital reflexes and have a complete loss of erection. As with physical performance, male fertility is decreased after SCI. Advances in technology, however, provide ways for male patients to sustain an erection and improve the chances of fathering children.

- Although sexual and reproductive functioning is less affected in women, sex, fertility, and menopause are still issues of concern. Some consequences related to these issues are dysreflexia and bladder incontinence during intercourse and complications of pregnancy and delivery.

- For both men and women, other psychological, social, and physical issues add to the difficulty in resuming satisfying sexual roles. Problems with mobility, dependency, and societal role expectations are some of the issues the person with SCI must face. Individual counselling, often by a psychologist, takes place after a thorough evaluation by a physician. Some areas addressed are sexual satisfaction, sexual function, fertility, and desirability. Patients learn that, despite their injury, they can continue to be desirable and have an active sex life.

- Optimally, experienced clinicians who are a part of an interdisciplinary team specializing in sexual functioning facilitate candid discussion about the topic. In this context, the role of the occupational therapist is to address varied individual needs. The therapist may become involved in helping people groom themselves to improve their appearance and to feel more attractive, help create a cozy environment that allows for intimacy, or find equipment to either compensate for lack of hand function or to help position the person for optimal, safe physical contact.

- In discussing sexual issues, the therapist must be particularly sensitive to the needs of the individual. To learn more about sexuality and reproductive health, Sexuality and Reproductive Health in Adults with Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals is an excellent comprehensive resource.

Temperature Regulation

- Many people with SCI cannot regulate body temperature, which can lead to hypothermia or heat stroke. Because of decreased sensation, patients may become severely sunburned or frostbitten. Education in the importance of neutral temperatures and the prevention of skin exposure to sun and severe temperatures is an important part of the occupational therapy program.

Pain

- Acute and chronic pain (duration of more than half a year) are common after SCI. Studies vary greatly in estimating the prevalence of chronic pain, with the reported range of pain being 26%–96% regardless of completeness and level of injury. Considering the violent nature of most injuries and the courses of illnesses that affect the spinal cord, it is not surprising that most patients have pain at onset and that pain persists for a long time.

- The Bryce-Ragnarsson Pain Taxonomy and the International Association for the Study of Pain task force on SCI pain created taxonomies and algorithms to help diagnose and treat the patient with pain. These algorithms simplify somewhat the complex nature of pain and SCI. These algorithms share some concepts in classifying pain according to location either being above, below, or at the level of injury and sharing two other major pain taxonomies: nociceptive and neuropathic.

- Nociceptive pain is caused by a normal reaction to a noxious stimulus like inflammation, or tissue tear. Examples of nociceptive pains are local soft tissue pains above the level of injury associated with the injury or pain common in the shoulder of the person with tetraplegia because of muscle imbalance and overuse of weak muscles. Neuropathic pain originates in the nervous system and may be caused by different mechanisms such as misdirected neural sprouting after the injury. Neuropathic pain is hard to treat. Individuals with gunshot wounds often have severe shooting and burning neuropathic pains below the level of their injury.

- Because most people with SCI experience pain, often in more than one location and throughout their life, the occupational therapist has many tools that help reduce pain levels and manage and cope with pain, including the following:

● Listen to the person, watch for signs of pain (such as facial expressions), and communicate clearly about the pain. The experience of pain is subjective and must be honored for what it is.

- Modify plans to help relieve the pain prior to activities. For example, instruct the patient to take pain medication half an hour prior to your session.

- Consider the contributing factors to pain such as feeling sad, being tired, or sitting too long and adjust your interventions accordingly.

- Be aware that people with complete injury (AIS A) with no sacral sensory and motor sparing may experience pain below their injury level, and this pain has to be taken seriously because it may signal medical problems such as bowel obstruction or skin breakdown.

- Facilitate positive and meaningful experiences that teach the power of diversion and meaningful occupations in reducing, managing, and coping with pain. For example, the patient may resist going shopping because of pain but after doing so report having enjoyed the outing and feeling less pain.
- Educate and practice routines to prevent long-term complications such as chronic shoulder pain caused by pushing a manual wheelchair. Guidelines for such programs are available from the PVA Clinical Practice Guideline: Preservation of upper limb function following spinal cord injury and from a strengthening program derived from a 2011 study: Strengthening and optimal movements for shoulders (STOMPS).

Fatigue

- Physiological, psychological, and environmental factors all contribute to patients' fatigue. Persistent pain, antispasmodic medications, and prolonged bed rest are physical factors that can make the patient feel tired or sleepy. These factors are often compounded by restless nights interrupted by hospital routines, such as repositioning patients in bed and waking them for checking vital signs and administering medications.

- Occupational therapists must be aware of these constraints and observe and listen to the patient. They must find the optimal waking hours for activities and report night time sleep disturbances, any changes of behaviour that medication may cause, and other factors.

Spasticity and Spasms

- An injury to the spinal cord often results in an increase in transmission within the synaptic stretch reflex. This results in spasticity. Spasticity develops intoclonic or tonic spasms triggered by sensory stimuli such as sudden touch, infection, or other irritation. Management of spasticity is important in maximizing a patient's functional independence. Severe spasticity may hinder function.

- For example, the hypertonicity of the hip and knee adductors can make donning pants difficult. The most common way to decrease spasticity is to use a muscle relaxant, such as baclofen or diazepam. An intrathecal pump, motor point, or nerve blocks may be used in severe cases. Spasticity can lead to contractures and so routine positioning in bed and in the wheelchair and range-of-motion exercise are essential; patient and family must participate in these measures for continuity of care.

Deep Vein Thrombosis

- Deep vein thrombosis is the formation of a blood clot, most often in a lower extremity or the abdomen or pelvic area. A clot may develop further and dislodge from the venous wall, forming an embolus. This condition poses a threat to the patient because the embolus may travel and occlude pulmonary circulation.

- The therapist helps prevent this condition by observing any asymmetry in the lower extremities incolor, size, and/or temperature. When deep vein thrombosis is identified, the patient must have complete bed rest and anticoagulants to prevent embolus. This is a good time to inform the patient and family about the symptoms, prevention, and care of deep vein thrombosis.

Heterotopic Ossification

- Heterotopic ossification, which is pathological bone formation in joints, has been recorded in 15%–53% of SCI patients. It is a condition in which connective tissue calcifies around the joint. Heterotopic ossification usually appears 1–4 months after injury.

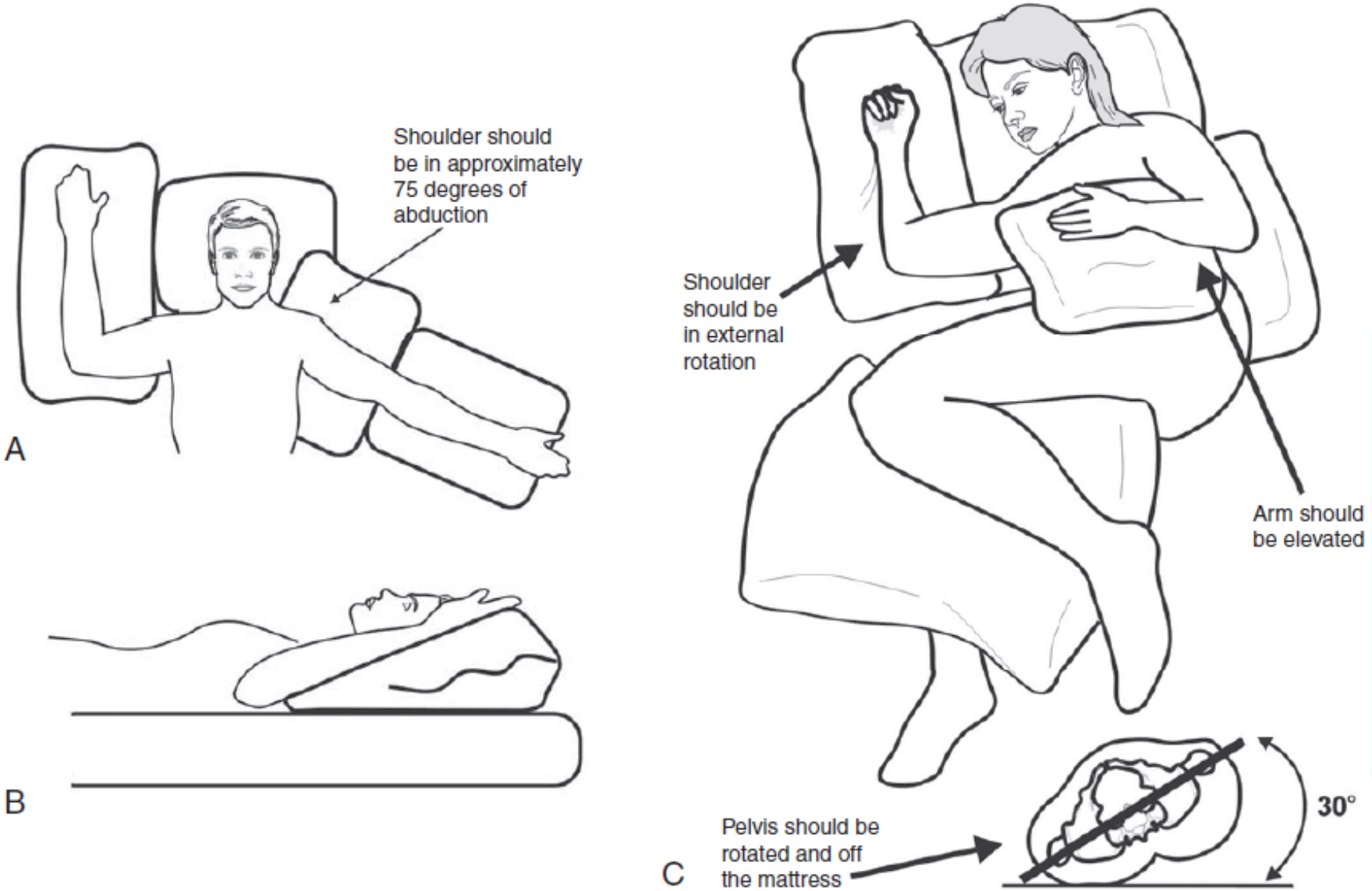


Figure 38-6 Positioning in bed. **A.** Alternate the arm in shoulder abduction and external rotation. **B.** Side view of A, showing placement of foam wedge. **C.** During side-lying, keep the upper back flat on the bed to protect the weighted shoulder. (Printed with permission from Rancho Los Amigos National Rehabilitation Center, Downey, CA.)

- The symptoms are a warm, swollen extremity; fever; and/ or range-of-motion limitations. Most often seen in the hip and shoulder joints, heterotopic ossification can result in joint contractures. Positioning in bed and in the wheelchair and daily range of motion prevent or control heterotopic ossification. Because the first indication of heterotopic ossification most typically is range-of-motion limitation, the occupational therapist must use each rangeof-motion session to monitor joint ranges, especially in patients with spastic muscles.

Psychosocial Adaptation

- SCI, independent of its severity, is an emotionally traumatic event. During the first days after injury and often during acute rehabilitation, paralysis, multiple medical problems, and the need to rely on others for basic functions is overwhelming. Patients may experience a myriad of feelings such as confusion, anxiety, loss, hope, grief, depression, and helplessness. Family and significant others may also experience similar emotions. Despite the paucity of evidence- based data specific to SCI, stage-based models have been prevalent in past decades. Fortunately, they have been replaced with a more open and fluid understanding of an individualized coping process.

- The occupational therapist must facilitate the enlistment of positive coping skills throughout the continuum of care. Here are some examples of how to do this during the acute phase.
  - Foster autonomy in making decisions (“What clothes do you want to wear today?” “How long would you like to rest between sessions?”).
  - Facilitate solving problems (“What do you think is the best way for you to hold your pen?” “What do you think will make you sleep better at night?”)
  - Engage the person in activities that are personally relevant and meaningful.

As occupational therapists, we contribute to psychosocial adaptation after SCI by incorporating the following considerations into evaluation and treatment:

- Set aside all preconceived biases about who the patient is and how he or she should feel or behave. Instead, concentrate on learning to know patients' factors, their unique life contexts, and their individual reactions to their trauma or illness.
- Provide psychological support. At times when the patient is overwhelmed with sadness, it is okay just to be present and available to the person. It is okay to stop an activity, find a quiet environment, possibly outside, and listen, affi rm, and educate.
- Select activities with a just-right challenge. After weeks of being dependent, patients fi nd hope by being able to feed themselves or use their cell phone independently.

- When providing information, do not overwhelm the person with too much detail. Find the opportunity for a “teachable moment” for a particular “chunk” of information, and be sensitive of patients’ signs to help you determine how to proceed and when to stop (Potter et al., 2004; Wolfe, Potter, & Sequeira, 2004).
- Accept patients’ emotional states without judging them (Hammell, 1995). Lack of evidence of depression or anger does not necessarily mean that individuals are coping poorly with their injury. They may be using ways of coping that are not the textbook ones. Remember that there is no requirement to mourn to learn to accept and live with the injury (Magasi, Heinemann, & Wilson, 2009). Consult with the team physician and mental health providers if the person expresses suicidal ideations (Magasi, Heinemann, & Wilson, 2009).
- Create opportunities for peer education and support. Peers with SCI are often very effective in reaching patients and helping them feel less isolated and more optimistic. Individuals with similar levels of injury can truly understand the pain that comes with SCI and may help the therapeutic process.

ASSESSMENT: GETTING TO KNOW THE PATIENT

- **Occupational Profile:**

The Canadian Occupational Performance Measure (COPM)

- **Evaluation of Performance Skills:**

The occupational therapist must clarify with the primary physician how much movement and load are allowed without jeopardizing spinal integrity. The physical evaluation includes upper extremity range of motion, strength, muscle tone, and sensation . The therapist also observes the patient's endurance, trunk balance, fatigability, and pain. The Manual Muscle Test is most widely used to measure strength. The appearance of the upper extremities can reveal signs of Complex Regional Pain Syndrome, which is a chronic limb disease marked by severe pain, swelling, and skin changes. Such findings are vital for prevention of further deformity by immediately initiating an aggressive treatment regimen.

- **Hand and Wrist of the Patient with Tetraplegia**

Evaluation of the hands and wrists is both physical and functional. Following the administration of the Manual Muscle Test and range-of-motion and tone assessments, most therapists observe hand use while the person is performing activities such as eating and picking up coins or pieces of a game. Standardized hand function tests, specific or nonspecific for people with tetraplegia, are typically not performed during acute rehabilitation.

Some such tests are the Sollerman Hand Function Test (Sollerman & Ejeskar, 1995) and the Jebsen Test of Hand Function (Jebsen et al., 1969).

- Hand muscle function and pinch and grip strength are measured by dynamometers.
- Finally, by asking the person to list functions they want and need to perform with their hands and then examining their performance in these areas, the therapist can concentrate on those functional components most relevant to the person.

Evaluation of Performance in Areas of Occupation

- **Activities of Daily Living and Instrumental Activities of Daily Living**
  - The Spinal Cord Independence Measure III
  - The Quadriplegia Index of Function
  - A non–SCI-specific measure that is widely used in the United States is the Functional Independence Measure (FIM™)
- **Leisure and Sports**
  - COPM
- **School and Vocation**
  - Observation of factors such as hand function and work habits contribute information for the prevocational team and department of vocational rehabilitation.
- **Home and Community**
  - home accessibility and safety
  - Assessing transportation

SETTING GOALS

- What must be done to prevent further deformities and complications?
- What activity is important for the patient to engage in right now?
- What skills must patients and caregivers have for a safe return home?

Functional Expectations (Expected functional outcome charts)

- Respiratory, bowel, and bladder function.
- Bed mobility, bed/wheelchair transfers, wheelchair propulsion, and positioning/pressure relief.
- Standing and ambulation.
- Eating, grooming, dressing, and bathing.
- Communication (keyboard use, handwriting, and telephone use).
- Transportation (driving, attendant-operated vehicle, and public transportation).
- Homemaking (meal planning and preparation and home management).
- Assistance required.

Example:

Level C1-3

Functionally relevant muscles innervated: Sternocleidomastoid; cervical paraspinal; neck accessories
Movement possible: Neck flexion, extension, rotation
Patterns of weakness: Total paralysis of trunk, upper extremities, lower extremities; dependent on ventilator

FIM™/Assistance Data: Exp = expected FIM™ score; **Med** = NSCISC median; **IR** = NSCISC interquartile range
NSCISC Sample Size: FIM™ = 15; Assist = 12

	Expected Functional Outcomes	Equipment	FIM™/Assistance Data		
			Exp	Med	IR
Respiratory	• Ventilator dependent • Inability to clear secretions	• Two ventilators (bedside, portable) • Suction equipment or other suction management device • Generator or battery backup			
Bowel	Total assist	Padded reclining shower-commode chair (if roll-in shower available)	1	1	1
Bladder	Total assist		1	1	1
Bed mobility	Total assist	Full electric hospital bed with Trendelenburg feature and side rails			
Bed, wheelchair transfers	Total assist	• Transfer board • Power or mechanical lift with sling	1	1	1
Pressure relief, positioning	Total assist; may be independent with equipment	• Power recline and/or tilt wheelchair • Wheelchair pressure-relief cushion • Postural support and head control devices as indicated independent with equipment • Hand splints may be indicated • Specialty bed or pressure-relief mattress may be indicated			
Eating	Total assist		1	1	1
Dressing	Total assist		1	1	1
Grooming	Total assist		1	1	1

INTERVENTION

Acute Recovery: Focus on Support and Prevention:

- Immediately after injury, most patients are admitted to an intensive care unit, where the focus is on preservation of life and stabilizing fluids, electrolytes, cardiopulmonary and other vital functions. The patient is immobilized in traction and waiting to hear whether surgery is required to stabilize the spine. For prevention of pressure ulcers, the patient is put in a rotating bed. In the intensive care unit, medical and surgical procedures take precedence over therapy.
- One or two 15-minute sessions per day are often helpful to the patient, who may be in pain, fatigue easily, and become confused or overwhelmed.

the focus of therapy in the acute recovery phase include the following:

1. Providing some environmental controls to help the patient get some control of their immediate environment such as nurse call button or bed controls.
2. With individuals with tetraplegia, maintaining normal upper limb joint range of motion and preventing edema and deformities.

- To prevent range-of-motion limitations, therapists use positioning techniques and assist with range-of motion exercises. In bed, most persons with tetraplegia tend to lie with their arms adducted close to their body, internally rotated, and with elbows flexed.
- Important movements include scapular rotation, shoulder scaption (the functional motion between abduction and flexion), shoulder external rotation, elbow extension, and forearm pronation (daily). Hands are fitted with resting hand splints. Upper limbs are placed in either some abduction or external rotation.
- It is important to note, however, that although the goal is to preserve range of motion, one must consider the comfort of patients to allow them a good night’s sleep.

- Range of motion to the hand of the patient with tetraplegia is performed in a special way to facilitate tenodesis grasp : passive opening of the fingers when the wrist is flexed and closing of the fingers when the wrist is extended.
- The patient, family, and others are taught how to perform range-of-motion exercises to the arm and to facilitate tenodesis. Again, range-of-motion exercises must be augmented with proper positioning in bed and in the wheelchair.
- During the acute phase and when medically cleared, the occupational therapist may also evaluate the person’s ability to swallow, sit upright, and begin evaluating and training in appropriate ADL.


A


B

Acute Rehabilitation: Focus on Support, Education, Acquiring Performance Skills and Meaningful Activities

- In the United States in the 1970s, the mean length of stay in acute SCI rehabilitation was 144.8 days. By the late 1990s, mean length of stay had decreased to 97 days and is now less than 37 days.
- Because rehabilitation institutions are the major venues for delivering intensive therapy, this trend has been difficult for patients and clinicians alike, who must make tough decisions about what is most important to accomplish during inpatient stay.
- During acute rehabilitation, occupational therapy continues to focus on providing education and support to patients and helping them begin to explore meaningful activities that restore a sense of efficacy and self-esteem. Treatments must always be structured with these overriding goals in mind.

- **Educating Patients and Family**
- Each encounter with patients and families must be viewed as an educational opportunity. The style, quantity, and direction of each session must be carefully considered. While patients are learning to put on a shoe, for example, the therapist may ask if they have checked skin integrity and, by so doing, draw attention to the importance of skin inspection.
- This discussion may also inform the patient about preferable shoe styles and sizes, pedal edema, and deep vein thrombosis. These “teachable moments” arise often and help embed details of newly learned skills and routines

- Group learning is widely used in SCI centres, to inform and invite group dialogue on topics such as home modifications, accessibility rights, attendant management, assertiveness, travel, and driving. Experiential group activities, such as going to a restaurant, are recommended for building emotional and social alliances with peers while learning from each other's successes and failures.
- Participation in self-initiated learning, such as surfing the Internet, empowers the patient. On the Internet, many SCI consumer websites offer tips, personal stories, and chat rooms, which can provide a lively forum for communication, self-expression, and information. Family education must result in competence in range of motion, positioning, pressure relief, assistance in ADL, and use of equipment. Home and weekend passes provide an excellent opportunity to develop and refi ne skills.

- **Self-Efficacy and Self-Management Skills:**
- The therapist and the rest of the health care team must encourage patients in taking an active role in managing their care, in evaluating behaviors, and in self- reflection about failures and successes.
- We encourage active participation, generalization of information, and the transfer of learning to the post-discharge environment. When planning an outing, for example, ask the group to prepare a list of items to be checked to ensure a safe, successful outing.

- Upon return to the hospital, encourage discussion of the outing to reflect on ways future outings can be improved. Practical issues such as restaurant accessibility to wheelchairs and self- catheterization in public bathrooms may arise. This discussion is also a good time to reflect on performance accomplishments during the outing and to share failures and success experiences in a supportive environment.

- **Balancing Self-Maintenance Skills and Meaningful Activities:**
- The therapist has the difficult task of helping the patient see when relearning skills is valuable and when the skill should be accomplished by a caregiver, either for now or permanently. The ultimate goal of rehabilitation is no longer viewed as the attainment of maximal functional independence. Rather, it is the attainment of optimal desired functional independence.
- Functional expectations charts help us understand the range of expectations but do not answer such questions as these: Why should the patient dress for half an hour when his wife can dress him in 5 minutes? Will it still take that long after adequate training? What will the patient do when his wife is away? Such discussions encourage patients and families to explore the range and consequences of their choices.

- **Choosing Equipment:**
- Most persons with SCI require lifetime use of wheelchairs for their mobility. Choosing the optimal wheelchair requires great expertise and has important implications for ease of mobility, accessibility, and participation. The therapist and the patient must consider many factors in weighing the advantages and disadvantages of specific chairs. For example, if a young adult with a functional level of C6 is returning to college following a rehabilitation stay and would like to use an attractive manual wheelchair to look and feel less disabled, questions about the layout of campus, the terrain, and distances between classes must first be answered prior to recommending the optimal wheelchair. The person's endurance, posture, and transportation are factors that must all be weighed in selecting either a manual wheelchair or a power wheelchair.

- Patients and families should be involved also in the purchase of any other major equipment, such as commode, other bathroom equipment, or a bed.
- Only essential equipment should be sent home with the patient, because much of it is costly, and it may further complicate the person’s life. Also, a universal device should be favored over multiple assistive devices.

Assistive Devices for Spinal Cord Injury

- **Mobility Devices:** they include wheelchairs (manual, sport, power, power-assisted), walking frames, crutches, hand bike, canes, and adapted shoes.
- **Beds:** full-electric, semi-electric, and manual beds. The levels of care to consider when choosing mattresses include pressure reduction, pressure relief and fluid. When choosing bed, height is a very important factor considering turning, positioning, transfers, and getting dressed.
- **Transfer Equipment**: It includes transfer boards, lifts, slings and benches.

- **Respiratory Equipment:** They include ventilators and Continuous Positive Airway Pressure (CPAP) machines
- **Self-care Tools:** Self-care tools include shower bench or commode, dressing stick, reaching devices, adapted silverware, etc.
- **Environmental Control Devices:** They are needed to control things in the immediate environment of the patients such as putting light on, answering the telephone, opening and closing doors and windows, etc.
- **Sports Equipment:** They may include equipment used for various types of sports and recreational activities. It also includes physical activity and exercising implements.

- **Home Modifications**: Home modifications are generally measures taken to ensure assistive technology fits into the structure of the home to ensure independence as much as possible. It also help to improve mobility, access and safety while preventing accidents too. Some common modifications are below;

❑Changing existing floor pattern

❑Building additional structures

❑Converting existing rooms to suit purpose

❑Buying a new home

❑Enlargement of doorways and use of automatic doors

❑Installation of a ceiling hoist to assist transfers

❑Stair lifts

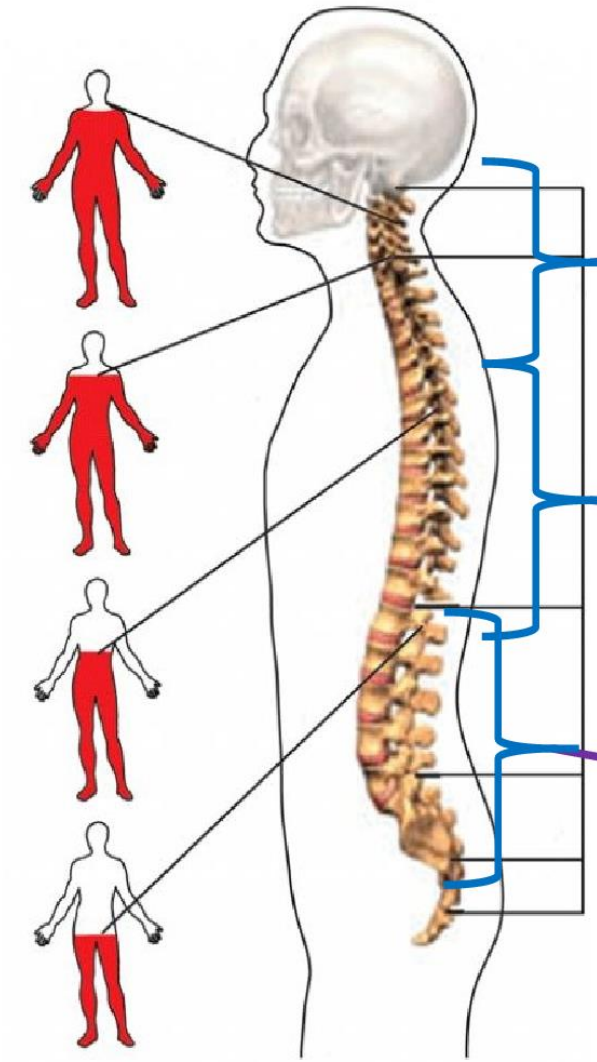
❑Dimensions for door handles, thresholds, hallways, floors, outlets and switches, telephones, furniture, bathroom toilet, sink, etc should be based on appropriate guidelines.

C4 Injury
Tetraplegia results in complete paralysis below the neck

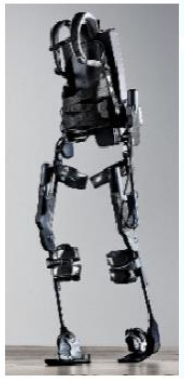
C6 Injury
Results in partial paralysis of hands & arms as well as lower body

T6 Injury
Paraplegia results in paralysis below the chest

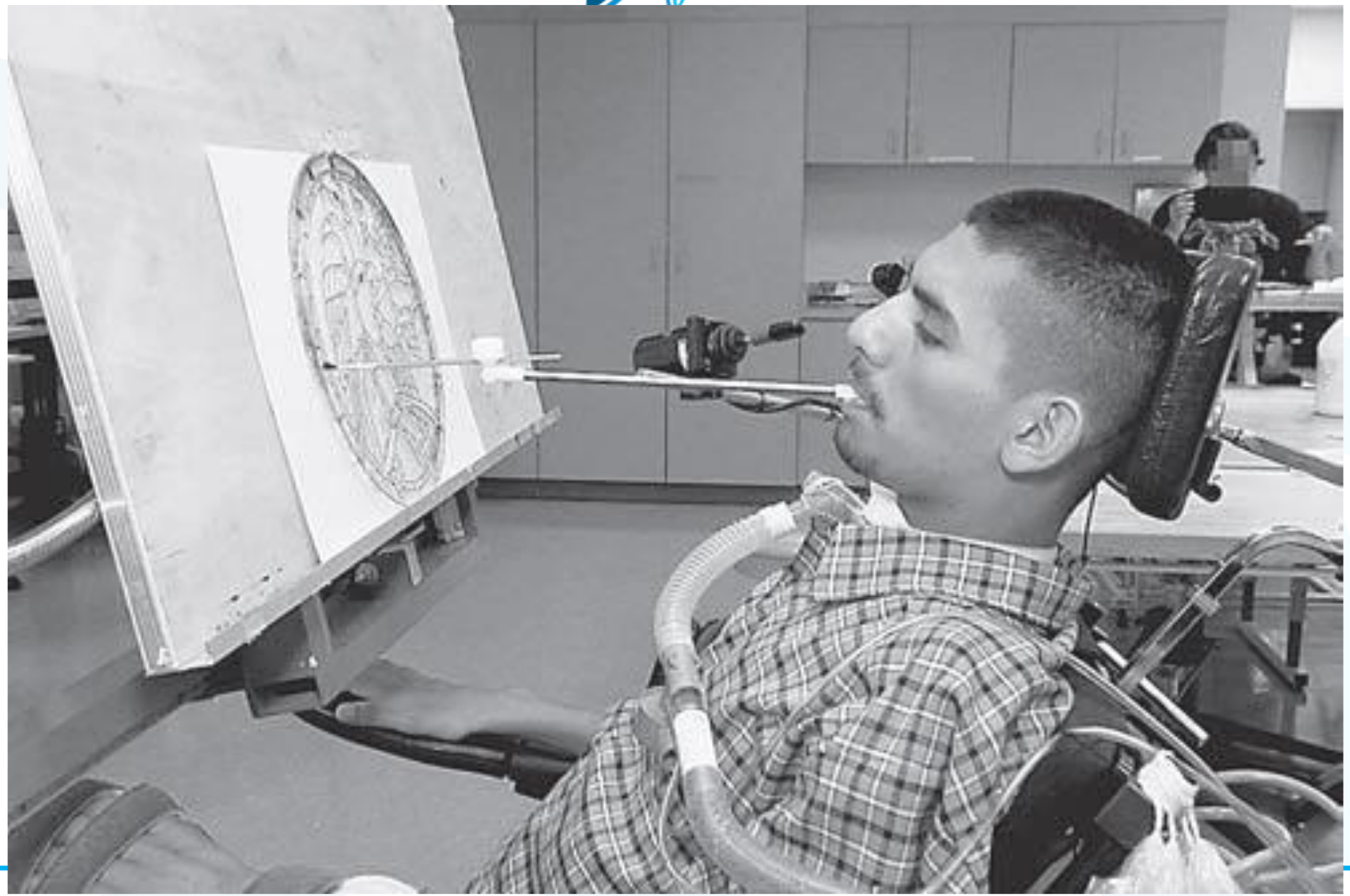
L1 Injury
Paraplegia results in paralysis below the waist



Vertebrae
7 Cervical
12 Thoracic
5 Lumbar
5 Sacral
4 Coccyx



- **The Patient with High Tetraplegia: C1 to C4**
- Patients with complete C1–C3 require an external breathing device because their diaphragm is either paralyzed or only partially innervated (C3). Most persons with C4 tetraplegia require assistance with ventilation during acute care, but as the diaphragm strengthens, they are able to breathe independently. The most common device for assisted breathing is the ventilator, a pneumatic electric machine that forces room air into the lungs. Expiration is passive. This device is attached via plastic tubes directly to a hole in the trachea



- People with complete high tetraplegia are paralyzed from the neck down. These patients require a highly specialized team to stabilize them medically and to prevent further complications, such as respiratory infections and pressure sores. The occupational therapist who works with this population must be comfortable with nursing procedures. These tasks include suctioning (removing secretions from the trachea), manually ventilating the patient with a manual resuscitator (Ambu-bag), and proficiently managing a ventilator.

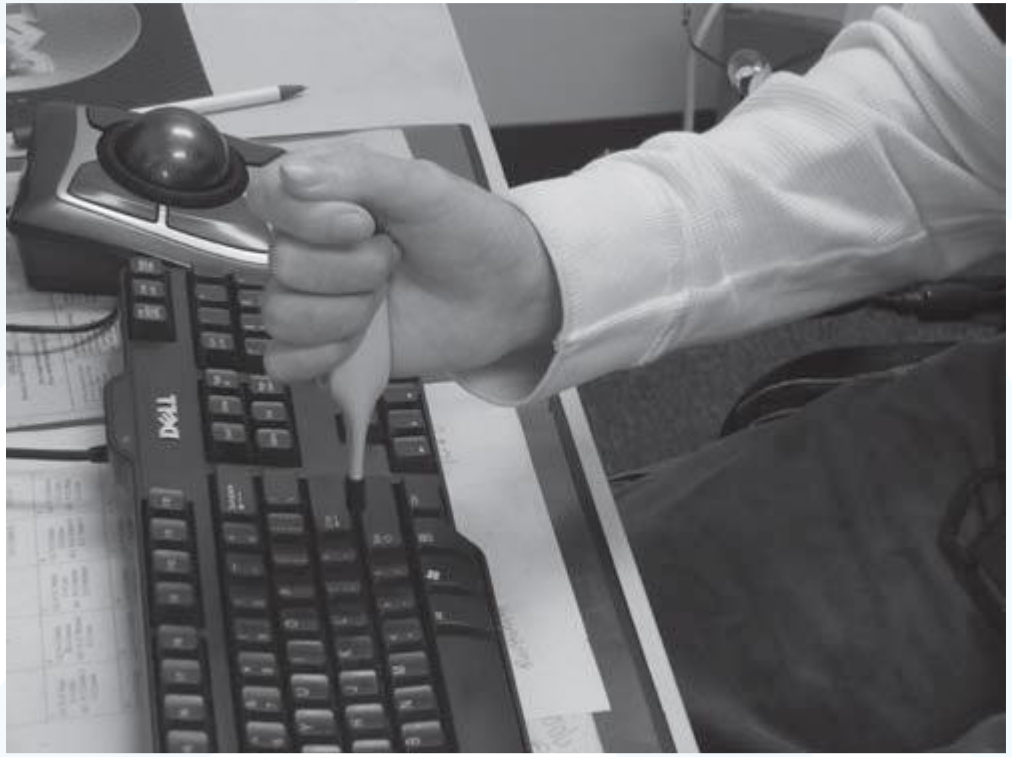
- Some additional roles the therapist may have in treating persons with high cervical injury include teaching them to direct their own care; helping them select specialized and sophisticated equipment (see Chapter 18) for life support, mobility, and ADL; and training them in the use of mouthsticks, which are rigid long rods held in the mouth that allow the patient to perform activities such as turning pages, drawing, typing, painting, and playing board games.

- **The Patient with Lower Cervical Injuries: C5 to C8**
- As in the acute recovery phase, physical intervention includes positioning in bed and in the wheelchair, splinting the upper extremities, daily upper extremity range of motion, and strengthening. Strengthening, an important goal in this phase, can be performed by using weights, pulley systems, tabletop skateboards, suspension slings, mobile arm supports, and modalities such as biofeedback neuromuscular electrical stimulation and robotics.

- Emerging research demonstrates that mass repetitive upper extremity task practice with sensory stimulation can bring about greater brain excitability in the corresponding brain sites and some improvement in function.
- To enhance function and engage in a variety of activities, the therapist works closely with the patient, exploring wrist and hand compensatory techniques and finding devices to compensate for hand paralysis.

Hand compensatory techniques. A. Pressing one hand against the other to lift a bottle.
B. Pressing one hand against the other to write.

C. Dragging the coin to the edge of the table in order to pick it up.
D. Using devices to compensate for lack of ability to point and isolate finger movements.

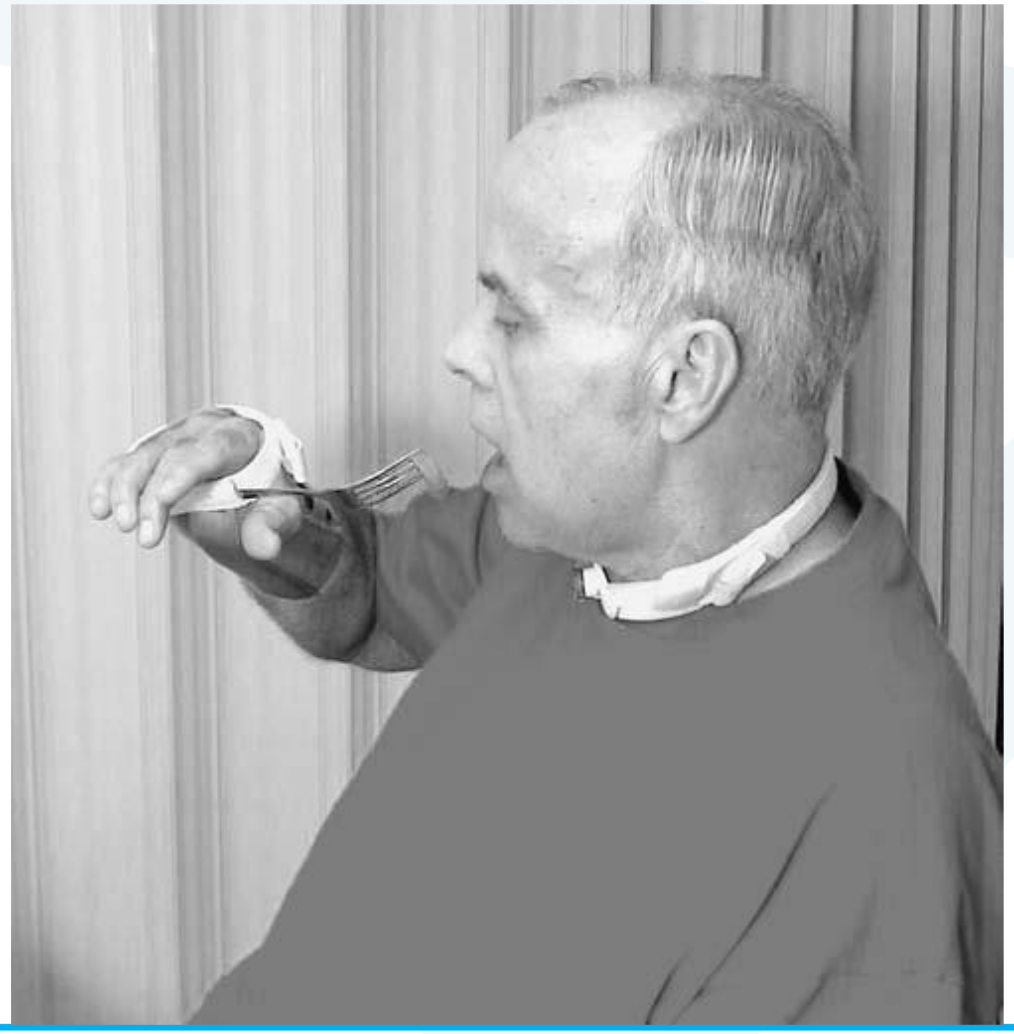


E. Using a track ball instead of a mouse

- **Patients with C5 Tetraplegia** .
- Initially, the deltoids and biceps, key muscles for this level of injury, are weak, so upper limbs require support to function. The mobile arm support, also called a ball-bearing feeder, is a mechanical device attached to the wheelchair. This shoulder and elbow support carries the weight of the arm.
- The mobile arm support can assist the patient in driving the wheelchair, feeding, hygiene and grooming, and carrying out tabletop activities, such as writing and cooking.
- If and when the strength of the deltoids and biceps is 3 + /5 or greater and endurance is good, patients can engage in activities without mobile arm supports.

- Patients with C5 complete tetraplegia need a way to grasp and hold objects, because their wrists and hands are paralyzed. First, the wrist must be stabilized with a splint or orthosis. Next, a device is attached to the hand to enable the person to perform activities. The universal cuff is a simple, inexpensive utensil holder is worn around the palm. Other U- or C-shaped clamps can be attached to objects such as telephone receiver or a shaver. Some splints, devices, and orthoses accommodate the wrist and the hand as a unit. To maximize functional gain with any device, the patient must have adequate time and repeated training sessions.

A person with C5 tetraplegia using a universal cuff



U- or C-shaped clamps can be attached to objects

- Most patients with C5 tetraplegia can master tabletop activities. They lack trunk control and muscles below the shoulder, however, so they are mostly dependent in dressing and bathing.
- With adequate emotional and financial resources, persons with C5 tetraplegia engage in meaningful, productive activities. Case in point: Mr. L. is a financial consultant who lives on his own and has part-time caregivers. He lives a busy life full of business trips and leisure activities with friends. He attributes his success to much planning and good organizational skills.

- **Patients with C6 and C7 Tetraplegia**
- Patients with C6 and C7 tetraplegia may attain significantly higher levels of independence than those with C5 injury. The addition of radial wrist extensors allows patients to close their fingers with a tenodesis grasp. This is a critical functional enhancement because, with it, light objects may be picked up, held, and manipulated. The wrist-driven wrist–hand orthosis (also called the flexor hinge splint or tenodesis splint) is a metal device that transfers power from the extended wrist to the radial fingers, allowing a stronger pinch.

A woman with C6 complete tetraplegia using the wrist driven wrist–hand orthosis to apply makeup. This device enables the person to hold on to objects tightly despite finger paralysis.

- More fully innervated proximal scapular and shoulder muscles, such as the rotator cuff, deltoids, and biceps, allow for an increase in upper limb strength and endurance. Patients can also roll in bed, and their arms can cross the midline more forcefully, with the addition of the clavicular pectoralis muscle.
- The ability to use the triceps, the key muscle for C7 tetraplegia, allows the patient to reach for objects above head level, such as items on a store shelf; transfer with greater ease; and push a manual wheelchair.

- **Patients with C8 Tetraplegia .**
- Hand function is significantly improved with the addition of extrinsic finger muscles and thumb flexors. Hand dexterity and strength are limited by the absence of intrinsic finger and thumb muscles. A person with complete C8 tetraplegia grasps objects with the metacarpophalangeal joints in extension and the proximal interphalangeal and distal interphalangeal joints in flexion. This is called a claw hand or intrinsic minus hand.

claw hand or intrinsic minus hand

- **Surgical Options for the Upper Extremities .**
- Restoring hand function is the top priority of many individuals with tetraplegia. To improve hand function, persons with C5, C6, C7, or C8 injuries may have surgical options. These options do not provide for a normal hand but aim to restore pinch, grasp, and reach. Tendon transfer surgeries are recommended only after full spontaneous motor and sensory recovery has occurred and no earlier than a year after injury because most of these procedures permanently alter the musculoskeletal structures.

- Upper limb reconstructive surgeries, although not frequently performed, are available for increasing motion and function of the upper extremities. These surgeries may shorten or change the direction of pull of tendons of passive (paralyzed) muscles to provide a mechanical advantage to the thumb or fingers. Other common procedures may entail tendon transfers of functioning muscles.
- Typically, a proximal functional muscle with strength of 4 out of 5 or above is attached to a tendon of a distal paralyzed muscle.

- Following the surgery, the patient learns to contract a proximal muscle to move a distal joint. An example of a hand tendon transfer surgery is the brachioradialis to flexor pollicis longus. This surgery restores lateral pinch by attaching the tendon of a strong (4 out of 5 muscle or above) brachioradialis to a paralyzed flexor pollicis longus. To pinch an object, the patient flexes the elbow while the forearm is in pronation. To improve the stability of the thumb, the interphalangeal joint is fused.

- A select number of centres worldwide offer complex procedures for achieving hand function. One such system is the second generation neuroprosthesis, a permanently implanted electrical stimulation device, which allows the person with C5–C6 injury to open and close the hand by moving the opposite shoulder. This electrical device is composed of 12 electrodes implanted into various muscles, electrode leads, transmitter, and a shoulder sensor.
- An external controller box attached to the wheelchair controls the device remotely with no connecting wires. Often, the neuroprosthesis surgery is either combined with or follows other hand surgeries that allow for optimal use of the device.

The Patient with Paraplegia

- Most people with complete or incomplete paraplegia become independent in self-maintenance, self-enhancement, and self-advancement roles, although they require assistance with heavy housekeeping and physically demanding vocational pursuits.
- Paraplegics with injuries at T10 and below may attain skills more easily and rapidly than patients with higher injuries. Good trunk control enables a person with low paraplegia to bend down and from side to side without fear of falling forward. Skills performed while upright (e.g., bowel management, lower body dressing, undressing, and bathing) require the patient with a higher injury to secure the trunk by supporting the body with one arm while performing the activity with the other to prevent falls.

- Patients with paraplegia are discharged quickly from acute rehabilitation settings and may benefit greatly from more interventions and support as they reenter the community.
- These interventions often include reassessing routines such as re-examining self-care skills, facilitating return to school, and exploring work and leisure interests, skills, and opportunities.

The Ambulatory Patient: Incomplete Paraplegia and Tetraplegia

- Typically, when we think of spinal cord injuries, we picture a person using a wheelchair, yet many individuals with incomplete SCI are able to walk. Walking potential is mostly determined by the level and completeness of the injury.
- Other factors may include body weight, age, upper extremity involvement, and pain. Ambulation, a primary goal for most patients, carries with it some unique challenges to the patient and occupational therapist.

Answers to the following questions guide treatment planning:

1. Will upper extremity aids be needed to assist in walking (e.g., a forearm trough walker)? If so, how will the patient carry objects if both hands are occupied?
2. What lower extremity braces are needed? Will the patient require assistance in donning and doffing the braces?
3. Is the goal to walk short distances only? Will the patient need a wheelchair for mobility in the community?
4. What can be done for fall prevention: Better lighting, the removal of area rugs and extension cords?

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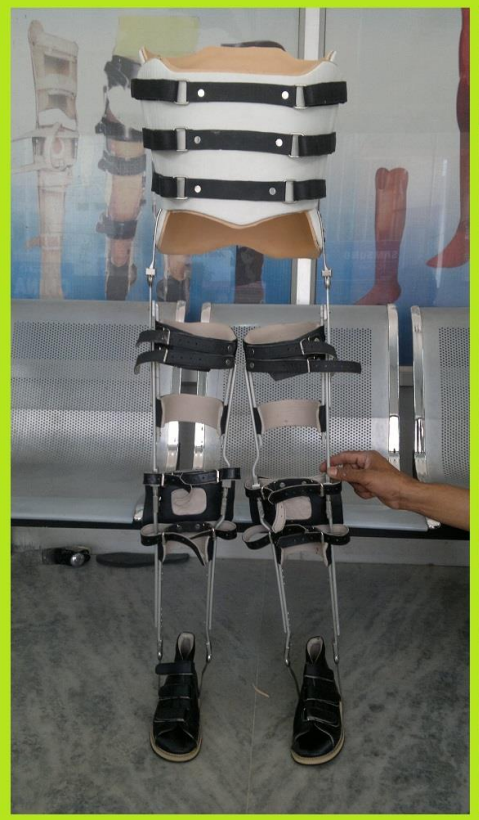


- Not surprisingly, ambulatory patients with tetraplegia pose the greatest challenge with their often weak upper extremities. In the wheelchair, equipment such as lapboards, armrests, and mobile arm supports support weak arms and allow for function. When upper limb proximal muscles are weak, hand function becomes difficult or impossible, because the patient lacks a mechanism for bringing the hand to the mouth or face. Various devices are available that enable the person to both lift and support the arm. A solution for supporting the arm depends on the pattern of upper extremity muscle strength (e.g., a table versus a chair-mounted mobile arm support). Frequently, however, these devices are less than optimal.

Transitions: Restoring Roles at Home and in the Community

- With the short length of acute rehabilitation hospitalization stays, the health care team and occupational therapists are challenged to transition quickly from a protective role to a “launching” role, exposing the person to the real world and promoting autonomy and self-efficacy.
- If therapists conclude that the rehabilitation program is too short for achieving optimal outcomes, they must be prepared to articulate and document the need for longer hospitalization.

- If geographically possible, many patients benefit from outpatient occupational therapy services.
- Most patients continue to gain strength during the first year after their injury, allowing them to become more independent. In outpatient clinics, the occupational therapist continues to facilitate performance skills and performance patterns and explore meaningful occupations in greater depth. Outpatient programs teach clients to use newly acquired voluntary movements and offer them additional ADL training. As clients gain strength and endurance and improve their balance, they reassess and reprioritize their goals.

Adaptation:
Focus on Facilitation toward Full Participation, Improved Quality of Life, and Wellness

- The path from being a dependent patient to becoming a person with a sense of efficacy and self-esteem is long and individual. Occupational therapists are increasingly involved in helping individuals with SCIs to be aware of their special health risks, how to prevent secondary conditions, engage in productive, meaningful activities, and sustain a good quality of life.

Some newly emerging programs:

- **Lifestyle Redesign®** is a program that encourages participants to select health promoting personalized goals and to work toward their achievement and maintenance. The therapist helps the individual identify risks and health-promoting behaviours and build routines to sustain healthy behaviours.
- For example, if a young adult loves to play wheelchair basketball for hours at a time and forgets his pressure reliefs, both the therapist and the person work together to identify the problem, fi nd alternative solutions, test them, and incorporate them into the game and other daily activities.

- **Telehealth**, an all-encompassing term for electronic technologies that promote and maintain health, is becoming more prevalent and opens new avenues for interventions. It offers an ongoing communication with consumers through technologies such as two-way computer monitors, texting, and phone calls, thereby assisting individuals in developing skills, forming new routines and habits, and problem solving together with occupational therapists. This is especially important in rural communities and in areas with harsh winters that make it difficult for clients to get to a hospital. During telehealth sessions, the client may ask the therapist to look at a wheelchair or cushion that suddenly does not feel the same.

- **Wellness programs** are offered by an increasing number of rehabilitation hospitals, independent living centres, nonprofit organizations, and other agencies. They typically offer wellness classes, supervised adapted exercise programs, community recreation programs such as sailing and skiing, adaptive driving programs, computer access programs, and counselling services.

- **Patient self-management programs**, which provide group support and patient education for prevention of secondary conditions and facilitation of healthy living habits, with peers and clinicians acting as facilitators.
- These models of health care are offered to address the challenge of providing care throughout the life span in an environment of minimal resources.

Living Fully and Growing Older

- Long-term survival rates of patients with SCI have improved dramatically in recent decades. Multiple secondary health conditions and rehospitalizations are common with people with SCI. Conditions most linked to decreased life expectancy are pressure ulcers, amputations, infections, and clinical depression. Not surprisingly, rehospitalizations, multiple health problems, and pain have also been linked to reduced reported subjective well-being. Other common body changes include decreased bone density with susceptibility to fractures, and renal and bowel problems.

- Other concerns and risk factors include impaired cardiovascular fitness, because of the inability to walk and limitations in engaging in aerobic exercises, as well as the early development of diabetes. As a result of a more sedentary life, many also become overweight, which makes engaging in self-care and other activities more challenging.
- To address obesity, occupational therapists and other clinicians are involved in creating and testing programs that facilitate adherence to a healthy lifestyle, focusing on routine exercise and nutrition, by offering supportive environments with education classes, exercise regimens, and mechanisms to encourage the maintenance of healthy routines

- Often, to achieve better health, the occupational therapist must ask the person to make difficult choices. Having to make functional adjustments, modify routines and habits, and reduce intensity and occupational engagement is difficult for most people but especially for individuals with SCI who have over many years learned to live with their disability. Therefore, the need to modify daily occupations to meet declining physical capacities or to add exercise to the daily routine must be addressed with great respect and sensitivity.

Spinal cord Injury and Activities of Daily Living

Activities of daily living are defined as activities that are oriented towards taking care of one's own body. Activities are divided into Basic and Instrumental ADL.

BADL

- It includes the following activities bathing, showering, bowel and bladder management, dressing, eating , feeding, functional mobility, personal device care, personal hygiene and grooming, sexual activity, sleep / rest and toilet hygiene.

IADL

- These are the activities which are performed by a person to live independently in community. These activities require advanced problem solving skills.

- Instrumental ADL
- IADL also include 11 activity categories : care of others, care of pets, child rearing, communication device use, community mobility, financial management, health and maintance, home establishment and management, meal preparation and clean-up, safety procedures and emergency response, and shopping.

Evaluation of ADLs and IADLs

- Examples of Standardized ADL assessments for ADL and IADL

ADL:

- Functional Independence measure
- Klein Bell ADL scale

Instrumental ADL :

- Assessment of Motor and process skills (AMPS)
- Kitchen task assessment (KTA)

Measures of ADL and IADL:

- Canadian occupational performance measure COPM
- Kohlman Evaluation of living skills (KELS)

- Home Assessment :
- Home assessment play a vital role in improving the functional independence The client and his family members should be interviewed to identify their expectations regarding the functional independence. Cultural and family values should be taken into account. While doing home assessment , the therapist should consider the safety factors.

Establishing the clients Goals:
Bridge between Evaluation and Intervention

- This is an important step as it serves as a transition from evaluation to intervention.
- Establishing goals require analysis of the evaluation results in conjunction with additional factors that influence outcome, namely clients ability to learn, the client's prognosis, the time allocated for intervention, the clients discharge disposition, and the clients ability to follow through with new routines or techniques.

Identifying appropriate goal behaviours: 1.Value

- It is has been observed that, for some clients, ADLs and IADLs are not the immediate priorities. Patients with severe disability may seek assistance from the caregivers for doing BADL or IADL tasks.
- So while deciding the goals, the therapist has to be careful. So, that they select the goal behaviours, that is ADL and IADL tasks, that reflect the values that client defined during the evaluation.
- Eg. Caregiver assisting the client with C6 Quadriplegia in doing self care tasks as attempt at self care retraining were being met with resistance and frustration by the client. As the activities most valued by the client were computer access and home mobility.

Identifying appropriate goal behaviours: 2.Difficulty

- It is always important to determine the prognosis for functional difficulties of the patient. Communication of the deermined functional difficulties with the client is the next important step.
- The perceived ease with which a client completes an activity and the projected difficulty that will remain after intervention are important considerations in selecting goal behaviors.
- Eg. Client (school going child) with T4 spinal cord injury with a neurogenic bladder requires a self catheterization finds it difficult task for fulfilling his role as self carer and a student as he would prefer not to take help from his family members or school professionals for doing the task of catheterization an he will need to do self catheterization independently and efficiently to fit into his school day. The therapist believes that, the client will be able to do achieve independence in that particular task after a period of practice.

Identifying appropriate goal behaviours: 3.Fatigue and Dyspnoea

- Use of activity analysis is essential to find out the effort and duration required to complete the tasks. Each and every activity which the client does daily should be analysed with respect to fatigue level and energy expenditure
- Eg. For clients with spinal cord injury, fatigue and energy expenditure varies as the level of injury varies from lumbosacral level to higher cervical level 0.

Identifying appropriate goal Levels
1.Independence

- Across all the ages and disabilities, the ultimate goal is to increase the level of independence.
- Independence can be divided into three phases : Initiation of the task , continuation of the task and completion of the task. Therapist may write independence goal that includes initiation such as ''Client may able to initiate and complete bathing independently three to seven times a week by the end of 3 months.

Identifying appropriate goal Levels
2.Safety

- Safety is a quality of a person - task - environment transaction so it is always associated with the independence. Independence performance is assured to be safe. When the therapist has to decide about the independence goals it is always advisable to take into consideration of clients comfort level with the risk, clients ability to analyse the risk factor which are associated with a particular activity an d finding out the plan for managing them so that it can be implemented successfully despite of the impairments.
- Eg. The goal of doing transfer training for a person who demonstrates good judgement and a realistic perception of his skills would be, "client will be independent in sliding board transfers from wheel chair to / from bed within three therapy sessions".

Identifying appropriate goal Levels
3.Adequacy

- Several aspects of activity performance contribute to the adequacy or quality of the behaviour stated in the goal, which can also be reflected as the degree to which the behaviour is expected to be done.

Identifying appropriate goal Levels
4.Pain

- The source of pain and prognosis for it must be considered in establishing the goals and selecting an appropriate intervention approach. Both the evaluation and the goal must have an index of pain so that intervention remains focused on achieving the projected level of independence while simultaneously reducing the presence of pain.
- Eg. Client will prepare a simple meal independently with maximum pain level of 2cm on 10 cm visual analogue scale within 2 weeks.

Identifying appropriate goal Levels
5.Fatigue and Dyspnoea

- when fatigue or dyspnoea can be reduced through task adaptation or conditioning, goals can be established that use these performance parameters as performance outcomes. The initial evaluation should include baseline data for comparison.
- Eg. The client will complete morning care routine with maximum score of 6 on Borg reported Perceived Exertion Scale (Borg 1998) by the end of November.

Identifying appropriate goal Levels
6.Duration

- The duration of daily living activities depends highly on the nature of the activity and the task objects that people choose to use in performing the activity. It takes more time to do dressing when going out for dine in an elegant restaurant than we do when we are going to fast food restaurant. So, it is difficult to establish meaningful norms for ADL activities.

- Establishing appropriate and acceptable time frames for ADL goals must be done collaboratively with clients and their significant others. Social and cultural standards also need to be taken into consideration in establishing outcomes for activity duration.
- Eg. The client will independently complete a simple cash transaction in one minute within three weeks to support participation in shopping.

Identifying appropriate goal Levels
7.Satisfaction

- Satisfaction is a subjective feeling and it varies from person to person. Successful participation of the client in a desired activity reflects their satisfaction level. Clients have their own set of standards for performing ADL activities. So, it is important to add a tool which gives an objective information regarding performance of the client and satisfaction level in that particular task. COPM is a tool which can be used to measure the satisfaction level. Goals can be set once satisfaction level is measured
- Eg. Client will become indecent in locating items needed for doing ADL activities at house with satisfaction rating from 8/10 within 3 weeks t to support participation in ADL.

Different Approaches used:

- 1. Modify / Compensatory
- 2. Establish / Restore

Modify / Compensatory approach :

- Compensatory strategies are used to improve activity performance. If restoration of the previous function Is not possible then this approach can be used.

1. Alter the task Method

- A particular method of performing activity is altered by keeping the objects and the context same.
- Eg. For a person who has difficulty in bathing (unable to get in / out of the tub) can substitute the washing part by doing the activity at sink.

2. Adapt the task objects or prescribe adaptive devices :

- Altering the use of objects which are used for performing a particular task can help to facilitate the performance.eg. Use of enlarge handle spoons or universal cuff for those clients with quadriplegia who have poor hand functions.
- For a person who has difficulty in bathing , use of a bath mitt would be advisable. Clients satisfaction level should be taken into consideration as sometimes use of an adaptive device decreases the satisfaction with the task performance level of the client.

3. Modify the task environment :

- Environmental modification are used to enhance the task performance. The As environmental modifications are fixed in place, the client do not have to remember the necessary adaptations to be carried out for doing the activity.
- Eg. Installing ramp for the wheelchair mobility.
- Installing grab bars and transfer seat so that client can remain seated while performing bathing activity.

Establish / Restoration approach :

- This approach basically focuses on the restoring the lost functions of people with disabilities.
- Eg. Restoring the functions like muscle strength, endurance, range of motion.

ADLs for person with Quadriplegia

- Clients with lower cervical injury level can do ADL acivities same as paraplegic clients except the fact that they have poor fine motor functions.
- Clients with C6 level injury can live independent lives by using various adaptations.
- Whereas upper cervical quadriplegic clients requires specialized equipment's and special care.

Dressing

- It is always advisable to put underwear and trousers when the client is still in the bed, after which he can perform transfers to wheelchair and then he can put on the shirt, socks and shoes.
- Clients with C7 and below level injuries can become totally independent in UB and LB dressing.
- For clients with C6 injuries it is difficult to do LB dressing because of the energy expenditure.
- Clients with C5-C6 lesion can learn some components of UB dressing.
- It is always advised to use a loose clothing with a front opening
- For lower body dressing the trouser used should be one size larger.

Lower body Dressing :

1. Position of the pant should be at the foot of the bed, and front side up.
2. Place one hand below the knee and flex the knee. Put the pant over the foot and then extend the leg.
3. Pull the pant up using the palms
4. Insert dressing stick in front belt loop and pull the pant further up by doing trunk extension.
5. Lean on one side , take weight on the elbow and pull the pant up over the gluteal region.

6. for clients who have poor trunk balance, this can be done in supine exposition and by doing rolling , then by keeping the arm behind the back the client grabs the belt loop by thumb and slides the pant up over the gluteal region
7. Next step is to straighten the legs with the help of palms.
8. Then in supine position the client has to fasten the pant by thumb, pull the zip u with the modifieds zipper.
9. Fro removing the pant, the client has to unfasten and unzip the pant in supine position first.
10. Pant is slided downwards over the hips by holding the beltloops by thumb and by scooting the body forward and maintaining shoulders into extension.
11. Dressing stick can be used to push off the pant over the legs.

Upper Body Dressing

1. Keep the shirt across the thighs with back side up.
2. Place both arms under the shirt and push the sleeves up. By using wrist extensors and shoulder adductors and external rotators along with elbow flexion, pass the shirt over the head.
3. once it reaches over the head, keep the shoulders and wrist relaxed .
4. Shoulder shrugs and leaning forward along with elbow flexion and wrist extension will help to move shirt down over the body.
5. Adaptive devices like button hook or wrist driven flexor hinge splint can be used for doing buttoning.

Eating

- Different options available for performing eating activity are :

1. Use of mobile arm support or externally powered split is recommended for clients with C5 quadriplegia.
2. Wrist flexion hinge splint
3. Use of wrist splint along with the universal cuff
4. Use of non-skid mat and a plate with a plate guard.
5. Combination of swivel fork and spoon. (for clients with c4-c5 level injury)

6. Bilateral or unilateral cup holder.
7. Built up utensils for those who have tenodesis grasp.
8. Use of quad quip knife for cutting the food. (for those who have adequate arm strength)
9. Electric self feeder for upper cervical level injuries.
10. Long plastic straw with a straw clip to stabilize it in the cup.

Fig 12.9: Wrist flexion Hinge Splint

Fig 12.10: Plate with a plate guard

Fig 12.11: Swivel spoon and fork

Fig 12.12: Universal cuff

Hygine and Grooming:

1. Use of shower and bath tub seat along with the transfer boards.
2. Use of long handle scrubber and reacher.
3. Use of bathing mitts for clients who have poor hand muscle strength.
4. Universal cuff for doing combing, brushing.
5. Wall mounted hair dryer.
6. Clip type holder for electronic razor
7. Use of suppository inserts for managing bowel care independently.
8. Use of skin inspection mirror with a along stem and looped handle.
9. Elastic leg bag straps to empty catheter leg bags.

Fig 12.13: shower and bath tub seat

Fig 12.14: Wall mounted hair dryer.

Communication and Environmental adaptations

1. Electronic page turner for turning pages.
2. Typing stick for doing typing activity. Use of universal cuff for doing painting.
3. Speaker phone with mouth stick to push or press the button
4. Use of specialized mouse for computer use.
5. Electronic communicating devices controlled by mouth ,pneumatic controls and head controls for clients with upper cervical level injuries.
6. Use of environmental controls to run tv, radio, telephones.

Fig 12.17: Electronic page turner

Fig 12.18: Typing stick

Mobility and transfers

- For clients with higher cervical injuries, hoists are used for doing the transfers sip and puff wheelchair, powered wheelchair is advisable.
- Mobility can be further enhanced by using electric wheelchairs operated by hand, chin or pneumatic controls.

Home management activities:

- Clients with c6 cervical level injuries can perform light home making tasks by using adaptations and environmental modifications.

ADL for person with Paraplegia

Dressing :

- LB dressing becomes easier if the button is at the front.
- Wide bottom slacks, stretch fabric are recommended.

Lower Body dressing :

1. Use of siderails to pull up to sitting position.
2. Reach forward to feet by sitting on the bed.
3. Flip the pant down to feet.
4. Work pant leg over feet and pull up to hips and pull up the garment.
5. Use of land handel reacher can make the activity easier.
6. Reverse the procedure for removing or undressing.

Upper Body Dressing :

- 1. By keeping the palms on maresss on either side, maintain the balance of your body, back support is needed for those who have poor balance.
- 2. Open the garment on the lap with the collar forwanr chest. put the arms into the sleeves and pull up over elbows.
- 3. Removing the shirt :
- 4. Lean forward, duck the head and pull the shirt over the head.
- 5. Remove the sleeve first from supporting arm and then from working arm.

Shoes:

1. Flex the knee with other hand while the person is sitting on the bed.
2. Use one hand to support the knee which is in flexed position, at the same time use other hand to slip shoe into foot.
3. For removing the shoes, use one hand to remove the shoe while supporting the flexed leg with the other hand.




Fig 12.19-Fig12.24: Removing Shoes

Eating :

1.Use of wheelchairs with desk arms

2.Use of swing away footrests so that the person can sit close to the table.

Fig 12.25: Wheelchair with desk arm

Fig 12.26: Swing away footrest

Grooming :

1. Use of hand held shower.
2. Use long handle bath brushes
3. Use shower chairs or bath tub seats
4. Install the grab bars in the bathroom which will increase the safety.
5. Use of non skid mat
6. Replace doors of the bathroom by shower curtains.

Fig 12.27: Hand Held Shower

Fig 12.28: Long Handle Brush

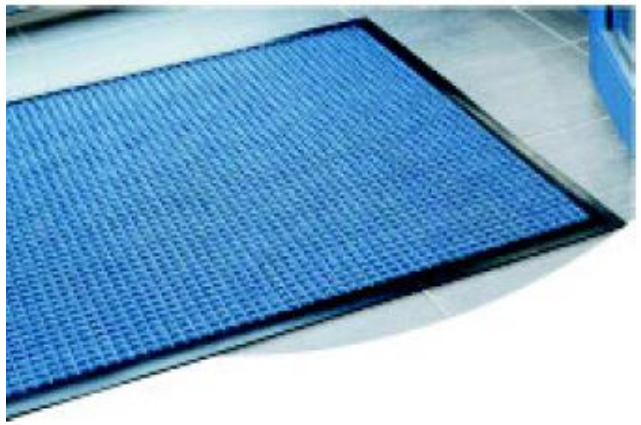

Fig 12.29: Non skid Mats

Fig 12.30: Grab bars

Communication:

1. Use a cord less phone or a mobile.
2. Use of short handle reacher to grasp the receiver.

Environmental Adaptations :

1. Approach the door from the side at which door knob is present.
2. Open the door as far as possible.
3. Start closing the door when half waly through
4. Use the elbow to keep the door open.

Home management activities :

1. Remove the cabinet doors and keep the frequently needed items in the front.

2. Use of offset hinges to replace standard door hinges. Which increase the door width by 2 inches.

3. Use of wheelchair cushion to increase the users height.Use of lapboard which can serve as a work surface for doing different ADL tasks.

4. Use of drop leaf board or a side out board to provide a work surface.

5. Use of front loading washers and dryers.

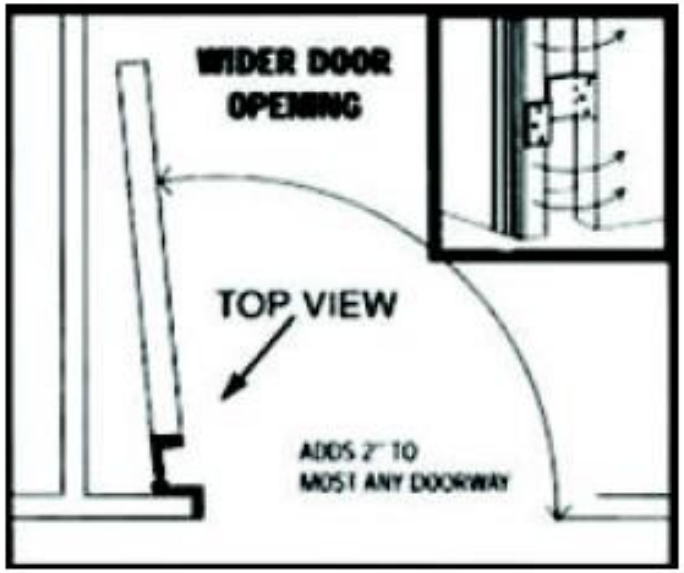

Fig 12.31: offset hinges

Fig 12.32: drop leaf board

Fig 12.33: front loading washers

Fig 12.34: wheelchair cushion

Hand Rehabilitation in SCI:

- Loss of hand function is one of the most devastating consequences of spinal cord injury for a motor complete or incomplete SCI at the neurological level from C2 to T1. More than one third of the individuals sustain a cervical spinal cord injury resulting in quadriplegia. Individuals with quadriplegia remain wheelchair bound and reliant on others for physical care. For a quadriplegic individual limited hand and upper limb function is more disabling and devastating than their inability to walk. Hence even a slightest improvement in hand functions has a major change in their quality of life.

Eg.

- Even a slight amount of finger movements enables a quadriplegic individual to manipulate a key board, press buttons, open bottle lid, scratch on face, wipe hands and turn the book pages.

Figure12.35

Figure12.36

Figure12.37

- Slight thumb movements have helped individuals to grasp on objects, pull on clothes while dressing etc. wrist extension enables a quadriplegic individual to wear on t-shirt, apply brakes to wheelchair, etc..

- Applying wheelchair brakes, Upper Body Dressing)The ability to perform these simple tasks by themselves reduces on the dependency levels on the care givers and it improves their self esteem and improve s their potential for employment
- The role of occupational therapy in upper extremity rehabilitation is to return the individual to meaningful participation in his or her daily activities.

Assessment tools:

- Modified Action Research Arm Test (ARAT): standardized measure of unilateral hand and upper limb function for assessing grasp, grip, pinch and gross movement
- Graded and Redefined Assessment of Strength, Sensibility and Prehension (GRASSP) used to assess upper limb strength
- AIS sensory assessment for assessing the Pin-prick and light-touch sensation of each dermatome
- AsTex® Sensory Test assesses the texture discrimination capabilities of the thumb and fingertips.
- AuSpinal Hand Assessment is a unilateral measure of hand function using a key, nut/bolt, coin, credit card, sweet, telephone receiver and soft drink can
- Capabilities of Upper Extremity (CUE) is an interview-based questionnaire about perceptions of upper limb function specifically designed for participants with quadriplegia

Management:

- Strength training
- Passive or assisted active movements (e.g. provided by therapists, family, carers or devices)
- Arm ergometry
- Stretching provided by therapists, family, carers or devices
- Training for activities of daily living like upper body dressing, cooking or self care activities like eating, brushing etc.

- Task specific training to enhance the hand functions eg: including reaching, grasping, manipulating, pulling, rotating and releasing objects, handwriting training, use of keyboards, etc.
- Functional Electrical Stimulation can be used as an adjunct to improve the hand functions
- Use of computer based games that involve hand and upper limb movement, for example games associated with Nintendo Wii®, PlayStation® or similar equipment. To improve on the grasp, release, pinch, squeeze, twist, push and pull function of the hand. Also progressing to more difficult games as hand functions improve.

- Practicing functional activities: moving checkers, grasping and releasing therapy ball, manipulating objects, turning keys, pouring water, holding cup, holding fork and opening jars.
- Spasticity in the hand and fingers affects the hand function training and it further affects the optimal recovery of hand functions.
- computer training (e.g. training in the use of word processors, internet or computer games)
- splinting (e.g. functional splints, resting splints, active-assist splints or hand orthosis')
- pressure garments or bandaging for oedema management or for the promotion of a passive tenodesis grip (e.g. JOBST gloves or pressure bandaging)

Figure 12.40 Eating

Figure 12.41 Bathing

Figure 12.42

Figure 12.43

Figure 12.42 and 12.43 holding cup

Figure 12.44 holding fork