Rehabilitation of spinal cord injuries

Kemal Nas, Levent Yazmalar, Volkan Şah, Abdulkadir Aydın, Kadriye Öneş

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Abstract

Spinal cord injury (SCI) is the injury of the spinal cord from the foramen magnum to the cauda equina which occurs as a result of compulsion, incision or contusion. The most common causes of SCI in the world are traffic accidents, gunshot injuries, knife injuries, falls and sports injuries. There is a strong relationship between functional status and whether the injury is complete or not complete, as well as the level of the injury. The results of SCI bring not only damage to independence and physical function, but also include many complications from the injury. Neurogenic bladder and bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, fractures, deep vein thrombosis, spasticity, autonomic dysreflexia, pulmonary and cardiovascular problems, and depressive disorders are frequent complications after SCI. SCI leads to serious disability in the patient resulting in the loss of work, which brings psychosocial and economic problems. The treatment and rehabilitation period is long, expensive and requires a multidisciplinary approach. Early rehabilitation is important to prevent disability and complications. An interdisciplinary approach is essential in rehabilitation in SCI, as in the other types of rehabilitation. The team is led by a physiatrist and consists of the patient's family, physiotherapist, occupational therapist, dietician, psychologist, speech therapist, social worker and other consultant specialists as necessary.

Key words: Spinal cord; Injury; Tetraplegia; Paraplegia; Rehabilitation

Core tip: Spinal cord injury (SCI) leads to serious disability and complications. The treatment and rehabilitation process of SCI is long, expensive and requires a multidisciplinary approach. Early rehabilitation is important to prevent disability and complications.
INTRODUCTION

Spinal cord injury (SCI) is the injury of the spinal cord from the foramen magnum to the cauda equina which occurs as a result of compulsion, incision or contusion. As a result of the injury, the functions performed by the spinal cord are interrupted at the distal level of the injury. SCI causes serious disability among patients.[4] Every year, about 40 million people worldwide suffer from SCI. Most of them are young men, typically aged from 20 to 35, although 1% of this population are children.[5] In children, motor vehicle accidents are the most common mechanism of injury. Sports-related injuries are responsible for the largest number of spinal injuries after children begin school and start participating in organized sports. Among all sports, football causes the greatest number of injuries.[6] Sixty to eighty percent of spinal injuries in children occur in the cervical region. The remaining 20%-40% are evenly split between the thoracic and lumbar region. Boys are more likely to experience spinal trauma than girls.[7] The most common causes of SCI in the world are traffic accidents, gunshot injuries, knife injuries, falls and sports injuries. Diving was reported to be the most common sport injury. Injury is usually caused by flexion, compression, hyperextension or flexion-rotation mechanisms. This is called “primary damage” that occurs as a result of these mechanisms. The responses of the body in order to overcome the primary damage, such as hemorrhage, inflammation and the release of various chemicals, are described as secondary damage.[8]

Spinal cord injuries are classified by the American Spinal Injury Association (ASIA) by considering the motor and sensory functions. The last revision of the ASIA Disorder Scale was made in 2011. The term of “deep anal sense” is replaced by “deep anal pressure”. The term skeleton level was not included in the latest “International Standards for Neurological Classification of Spinal Cord Injury (ISNCSC)” contents as it is not always present in spinal cord lesions.[9] The ASIA scale is listed in Table 1.

There is a strong relationship between functional status and whether the injury is complete or not complete, as well as level of the injury. A complete injury means full loss of motor and sensory functions at the distal level of injury.[9] Incomplete injury defines partial preserving of sensory and motor functions below the neurological level and in the lower sacral segments. With this lesion, deep anal sensation and/or anal mucocutaneous superficial sense is expected to be preserved. The status of the lesion could be unclear until the end of the spinal shock period. Although the signs indicating the end of this period are disputed, an increase in reflex activity is known to be a positive indicator.

Tetraplegia (preferred to “quadriplegia”)

This term refers to impairment or loss of motor and/or sensory function in the cervical segments of the spinal cord due to damage of neural elements within the spinal canal. Tetraplegia results in impairment of function in the arms as well as typically in the trunk, legs and pelvic organs, i.e., including the four extremities. It does not include brachial plexus lesions or injury to peripheral nerves outside the neural canal.

Paraplegia

This term refers to impairment or loss of motor and/or sensory function in the thoracic, lumbar or sacral (but not cervical) segments of the spinal cord, secondary to damage of neural elements within the spinal canal. With paraplegia, arm functioning is spared but the trunk, legs and pelvic organs may be involved depending on the level of injury. The term is used in referring to cauda equina and conus medullaris injuries, but not to lumbosacral plexus lesions or injury to peripheral nerves outside the neural canal.

Tetraparesis and paraparesis

Use of these terms is discouraged as they describe incomplete lesions imprecisely and incorrectly imply that tetraplegia and paraplegia should only be used for neurologically complete injuries. Instead, the ASIA Impairment Scale (AIS) provides a more precise approach to description of severity (i.e., completeness) of the SCI.[10]

In that case, also called quadriplegia, all extremities and trunk are affected by neurological damage. Tetraplegia occurs in cases of injury at C1-C8 segments. Injuries of the brachial plexus and the nerves outside the neural canal are not included in the definition of tetraplegia. The previous definition of tetraplegia is no longer used and incomplete tetraplegia is preferred instead. The term paraplegia indicates the paralysis of lower extremities and part of the trunk resulting from injury of thoracic, lumbar and sacral segments. This concept encompasses lesions of the cauda equina and conus medullaris but it does not include peripheral nerve and lumbosacral plexus lesions outside the neural canal. Paraplegia is sometimes called diplegia. The body and/or extremities may not be affected depending on the level of the lesion. In many cases of paraplegia, sensory loss and urinary and anal sphincter dysfunction would be detected in the distal levels of injury, in addition to loss of motor function.[11]

The most common form of spinal cord injury in the neck is the posterior ligament rupture and dislocation that causes severe neurological pathologies, especially as it is related to damage and ischemia of the gray part in the cord. Ischemia occurs due to direct injury of the circulatory system or neurogenic shock caused by vasospasm. Results of the SCI vary according to the size and localization of the injury.[12]

The results of SCI bring not only damage to independence and physical function, but also cause many...
complications. Neurogenic bladder and bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, fractures, deep vein thrombosis (DVT), spasticity, heterotrophic ossification, contractures, autonomic dysreflexia, pulmonary and cardiovascular problems, and depressive disorders are frequent complications after SCI. These complications are directly related to the patient's life expectancy and quality of life. Bladder infections, pressure ulcers and autonomic dysreflexia especially isolate the patient from society[1,10,11]. Negative changes occur in the patient's perception of health due to complications resulting from SCI. Pressure ulcers, spasticity, contractures, bladder and bowel problems especially cause delay of integration with society and psychosocial distress for patients. SCI patients are hospitalized for a long period of time and experience a variety of limitations in daily living activities due to these complications. Low self-esteem can also occur as a result of the decrease in sexual dysfunction, negatively affecting the patient's body image[12].

During the growth period, diabetes and metabolic diseases are potentially serious diseases in patients who have suffered spinal cord injury in childhood. Spasticity, insulin resistance, dyslipidemia, reduced glucose transfer and obesity are common childhood complications. Passive, active-assisted, active and resistive exercises, cycling and water exercises have to be compatible with the level of SCI and the complications. These exercises will reduce muscle atrophy, decubitus ulcers, inactivity, obesity and bone fractures[13].

The treatment and rehabilitation process for trauma caused by SCI is long, expensive and exhausting, which brings biophysical, psychosocial and economic problems[14]. Treatment of patients with spinal cord injury treatment is an ongoing process for many years and starts shortly after the injury with acute care and early surgical interventions; thereafter, sensory, motor and autonomic dysfunction treatment in the chronic phase and finally, life long treatment in the home environment. Therefore, it is difficult to calculate the cost of treatment in spinal cord injury for many reasons, such as not recording the treatment regularly and not calculating the total cost of the patient as a whole. DeVivo et al[15] reported that overall mean first year costs were $222,087 and that mean annual cost after 1 year were $68815 (2009 US $). Mean initial acute care costs of $76711 and mean rehabilitation costs of $68543 (2009 US $) have been reported. Munce et al[16] reported that both the average per patient and total direct costs of health care utilization for traumatic SCI increased between 2003 and 2005. The average patient cost rose from $102900 in 2003/04 to $123674 in 2005/06.

The treatment and rehabilitation process of SCI is long, expensive and requires a multidisciplinary approach. Therapeutic strategies and results of clinical studies related to the rehabilitation of patients with spinal cord injury are summarized in Table 2.

### Functional goals

Short and long term functional targets are determined by the calculation of the patients’ ASIA scale, taking into consideration medical and social status and the individualized rehabilitation plan. Expected functions of motor complete injury patients at the end of the first year according to the level of the injury are given below[28-33].

### C1-C4 levels

Patients with C3 and higher level injuries need ventilator support. C4 level patients can manage spontaneous respiration. The patients in this level are completely dependent. Mouth bars can be used for some activities such as page turning and writing. Wheelchairs must have high back supports and a safety belt which is able to stabilize the body and is available for a reclining or tilting position. Battery powered wheelchairs must have a head, tongue, breath or jaw control. Elbow flexion and deltoid muscles are moderately powerful in C4 level patients and thus they can use balanced forearm orthosis in personal care. Static wrist orthosis can be used to maintain the normal position of the hand and wrist and reduce the risk of contractures and deformities.

### C5 level

There is enough elbow flexion muscle strength at this level. Range of motion (ROM) and stretching exercises are important in the acute stage to prevent elbow flexion and supination contractures. Static positioning of the hand orthosis preserves the wrist extensors against overstretcing.
Patients can use a battery powered wheelchair with a joystick modification and can push a manual wheelchair with special gloves. Transferability is completely dependent. Most of these patients need assistance for daily living activities although they may eat with a special splint.

**C6 level**

Active wrist extension is possible and hand grip can be achieved with a tenodesis effect. These patients are usually independent in activities like nutrition, care and hygiene and dressing the upper body. A dynamic triceps-driven orthosis is helpful for reading books, eating, teeth and hair care activities in the cases of weak proximal muscles and strong distal muscles. The driven hand/wrist brace can be used for the function of the hand grip. Transfers are achieved by the assistance of transfer board. A manual wheelchair can be used by adding a knob to the circle but a battery powered wheel chair is needed for long distances. While men are independent in bladder care with some modifications such as clean intermittent catheterization,

| Ref. | Therapeutic strategy | Results |
|------|----------------------|---------|
| Mehrholz et al[20] | Locomotor training for walking after spinal cord injury | There is insufficient evidence from RCTs to conclude that any one locomotor training strategy improves walking function more than another for the patients with SCI. The effects of robotic-assisted locomotor training are not clear, therefore research in the form of large RCTs, particularly for robotic training, is needed. Specific questions about which type of locomotor training might be most effective in improving walking function for the patients with SCI need to be explored |
| Berlowitz et al[24] | Respiratory muscle training for cervical spinal cord injury | Inspite of the relatively small number of studies included in this review, meta-analysis of the pooled data indicates that RMT is effective for increasing respiratory muscle strength and perhaps also lung volumes for people with cervical SCI. Further research is needed on functional outcomes following RMT, such as dyspnea, cough efficacy, respiratory complications, hospital admissions, and quality of life. In addition, longer-term studies are needed to ascertain optimal dosage and determine any over effects of RMT on respiratory function, quality of life, respiratory morbidity and mortality |
| Domingo et al[23] | A systematic review of the effects of pharmacological agents on walking function in people with spinal cord injury | There is limited evidence that pharmacological agents tested so far would facilitate the recovery of walking after SCI. More studies are needed to better understand the effects of drugs combined with gait training on walking outcomes in people with SCI |
| Wessels et al[21] | Body weight-supported gait training for restoration of walking in people with an incomplete spinal cord injury: a systematic review | Subjects with subacute motor incomplete spinal cord injury reached a higher level of independent walking after over ground training, compared with body weight-supported treadmill training. More randomized controlled trials are needed to clarify the effectiveness of body weight-supported gait training on walking, activities of daily living and quality of life for subgroups of persons with an incomplete spinal cord injury |
| Taricco et al[27] | Pharmacological interventions for spasticity following spinal cord injury | There is insufficient evidence to assist clinicians in a rational approach to antispastic treatment for SCI. Further research is urgently needed to improve the scientific basis of patient care |
| Hitzig et al[25] | Randomized trial of functional electrical stimulation therapy for walking in incomplete spinal cord injury: effects on quality of life and community participation | The present study provides insight into the perceived benefits acquired by participating in an RCT comparing exercises to FES therapy and serves as a model for pinpointing domains of well-being that could be targeted for assessment in future SCI trials |
| Astorino et al[26] | Effect of chronic activity-based therapy on bone mineral density and bone turnover in persons with spinal cord injury | Chronic activity-based therapy did not reverse bone loss typically observed soon after injury, yet reductions in BMD were less than the expected magnitude of decline in lower extremity BMD in persons with recent SCI |
| Sadowsky et al[22] | Lower extremity functional electrical stimulation cycling promotes physical and functional recovery in chronic spinal cord injury | FES during cycling in chronic SCI may provide substantial physical integrity benefits, including enhanced neurological and functional performance, increased muscle size and force-generation potential, reduced spasticity, and improved quality of life |
| Gorgey et al[28] | Neuromuscular electrical stimulation attenuates high skeletal muscles atrophy but not trunk muscles after spinal cord injury | NMES can delay the process of progressive skeletal muscle atrophy after chronic SCI. However, the effects are localized to the trained high muscles and do not extend to the proximal trunk muscles |
| Karimi et al[29] | Robotic rehabilitation of spinal cord injury individual | Although various types of orthotic systems have been developed for paraplegic subjects for walking and rehabilitation, there is not enough research in this regard. It is not easy to determine the therapeutic influence of robotic orthosis on the health status of paraplegic subjects |
| Karimi et al[30] | Functional walking ability of paraplegic patients: comparison of functional electrical stimulation vs mechanical orthoses | There is a huge gap for a randomized clinical trial research to determine the effect of robotic system on the health status of the SCI subjects |

SCI: Spinal cord injury; FES: Functional Electrical Stimulation; RCTs: Randomized controlled studies.
women often need help.

C7-C8 levels
The elbow extension in C7 level and finger flexor muscle strength in C8 level is sufficient. Patients are independent in most daily living activities and transfers. They may need some help in lower extremity dressing. A manual wheelchair is accessible and wheelchair transfer is successful. Specially equipped cars can be used.

T11-T12 levels
Patients are independent in daily living activities, bowel-bladder care, using a manual wheelchair and transferring. The target is therapeutic ambulation in upper thoracic injury patients. They can not socially ambulate. Body control is present in lower thoracic injury patients and they may be ambulant at home with lower extremity orthoses and a walker.

L1-L2 levels
They are fully independent in activities of daily living and personal care. They may be ambulatory with long leg walking device for short distances but they need a wheelchair for a long distance.

L3-L4 levels
Patients can lock the knee fully and dorsiflexion of the ankle can be partly made. Patients can ambulate socially with elbow crutches and ankle foot orthoses. They are independent in bowel and bladder care.

L5 and lower
They are independent in all activities.

ACUTE AND SUBACUTE
REHABILITATION IN THE SCI
This period begins with admission to hospital and stabilization of the patient’s neurological state and is a 6-12 wk bed period. The aim of rehabilitation in this period is to prevent complications that may occur long term. Passive exercises should be done intensively to resolve contractures, muscle atrophy and pain during the acute period of hospitalization in patients with complete injury. Positioning of the joints is important in order to protect the articular structure and maintain the optimal muscle tonus. Sand bags and pillows can be useful in positioning. If the pillows and sandbags are not able to provide positioning, it can be achieved with plaster splints or more rigid orthotics. Ankle foot orthosis, knee-ankle foot orthosis or static ankle foot orthosis, etc. are mainly used for this purpose.

The most common and important complication is the development of joint contractures and stiffness during this period. At least one joint contracture (43% shoulder, 33% elbow, 41% forearm and wrist, 32% hip, 11% knee, 40% foot and ankle) has been reported in about 66% of patients within 1 year. If the patient is paraplegic or tetraplegic, intensive passive ROM exercises must maintain the lower extremities to be compatible with the level of the injury. ROM exercises prevent contractures and maintain functional capacity. These exercises should be done in a flaccid period at least once a day and at least 2-3 times a day in the presence of spasticity. Damage level, awareness and cooperation with the state determine the places that must be protected by passive EHA. Shoulder ROM exercises are important to prevent pain in all levels of damage. Passive ROM exercises should be done for both upper extremities in C1-C4 level tetraplegia. In injuries of C5 and C6 levels, ROM exercises should be done to prevent the development of contractures, especially contractures of elbow flexion and supination.

Stretching should be done to protect the tenodesis effect in patients without active wrist extension and fingers that are not fully stretched. Muscles are flaccid during the spinal shock period. Exercises can be done more easily with flaccid muscles. Flaccidity is replaced with spasticity after the period of spinal shock. Despite the positive effects of spasticity, it has negative effects on mobility, daily living activities and transferring. The severity and type of the other complications of SCI affects spasticity and the precipitating factors should be eliminated for the treatment of spasticity. Isometric, active or active-assisted truncal exercises should be done in the patient’s bed if partial movements are present, depending on the injury level. Recent studies have shown that early mobilization plays an important role in prevention of pulmonary function decline and in the development of muscle strength. Breathing exercises should be carried out and taught and its importance should be explained to complete or incomplete paraplegic and tetraplegic patients during the acute phase in order to protect lung capacity. During this period, the number of exercises should be kept at the maximum level depending on the patient’s tolerance. If the physiotherapist or allied health staff in the clinic are not present or are not sufficient, the patient’s family should be included in the rehabilitation team from the initial days and the importance and necessity of the rehabilitation must be shared with patients and their relatives.

The most important point is strengthening of the upper extremities to the maximal level in the acute period of rehabilitation in patients with complete paraplegia. Empowering exercises for shoulder rotation are proposed for using crutches, swimming, electric bicycles and walking. At the end of the acute phase, strong upper extremities are needed for the independent transfer from bed. For this purpose, active and resistance exercises to strengthen the muscles of the upper extremity should be initiated at the earliest possible period. Weight and resistance exercises can be applied with dumbbells in bed depending on the patient’s muscle strength. Electrical stimulation may be a useful alternative if extreme fatigue occurs while strengthening the muscles. Shoulder exercises performed with elastic bandages were found to be effective to reduce shoulder pain.

In order to prevent decubitus ulcers, the patient’s position should be changed every 2-3 h. Decubitus ulcers
occur most frequently on the sacrum, ischium, trochanter and superior aspect of the heel. Flexion contractures of the hip may develop due to continuous lying on the side and sitting in the wheelchair. Flexor muscle tension can be reduced with a prone position at regular intervals and ROM exercises in all directions. The ankle ROM exercises are useful to prevent contractures of the foot as well as the proper positioning of the foot while sitting in a wheelchair. Patients should be asked to change position and actively participate. In addition, attention should be paid to keeping the skin clean and preventing the formation of decubitus ulcers[36].

Corsets are used for fixation and supporting the spine while moving on to a sitting position after the end of the bed interval. Hyperextension corsets or plaster plastic body jackets are used in treatment of thoracic and upper lumbar region fractures. A knight-type corset would be more appropriate to support the fractures at the lower of L2 vertebrae. Knight-Taylor type corsets restrict flexion and extension of the trunk but have no restriction on rotation. Plaster or plastic body jacket corsets should be used to restrict movements in all directions[37].

Orthostatic hypotension is likely to be found in patients with a long period of lying in bed. Syncope can be seen in these patients while sitting and being lifted up due to low blood pressure. A tilt table may be useful for patients with this condition, starting from 45 degrees for 30 min a day. The degree is increased according to the patient’s complaints or state. Standing upright stimulates the blood pressure reflexly to a sufficient and persistent limit. The patients adapt to sit and stand and are prepared to transfer and balance. When the patient comes to the upright position with a tilt table, the patient should be in a sitting position on the edge of the bed 3-4 times a day and balance exercises should be done to maintain this position. Independent sitting on the edge of the bed is very important for wheelchair use, enabling wheelchair transfer. The purpose of this rehabilitation period should focus on stability and strength education for sitting and transportation. Functional goals must prepare the patient for movements such sitting up in bed or a wheelchair, dressing and transfers. Initially, the goal is for successful bed movements. ROM and stretching exercises are used for functional activities. Exercises for sitting, balance and strengthening of the upper extremities should be done at the beginning. Patients who can tolerate sitting can begin to push up, with static and dynamic balance training to transfer to the wheelchair[38].

Wheelchairs, walkers and crutches are used for out of bed transferring of patients. The wheelchair is the most important tool for SCI patients to be mobile and participate in social life. Ideally, wheelchairs must allow for optimal mobility, protect skin integrity and maintain the normal anatomical posture. A battery assisted wheelchair is appropriate for injuries at the upper segments, whereas a manual wheelchair is preferred at lower levels. Wheelchair dimensions such as the height, pelvic width, seat length, backrest, seat and arm support should be specifically prescribed for each patient[39].

The success of splints or other attempts for functional ambulation depends on whether the injury is complete or incomplete and the injury level. An incomplete SCI patient has the potential to walk, irrespective of level. The beginning of functional ambulation level is considered to be T12. Truncal and pelvic stabilization must be provided to stand and mobilize in the parallel bars. Mobilization in the parallel bars, standing and balance training exercises should be started and the patient could be supported by a posterior shell in the parallel bars during this period. A long and locked knee joint walking device is utilized, ensuring the integrity and stability of the lower extremity joints in patients after the upright standing with a posterior shell. The benefits of standing are a reduction in spasticity and the risk of DVT, bowel and bladder function recovery, prevention of pressure ulcers and osteoporosis, and reduction in depression[40]. Functional neuromuscular stimulation (FNS) is based on innervating nerve fibers of intact muscles. If the muscles are denervated, FNS stimulates the muscle fibers. A study suggests that suitable activation to specific muscles of the trunk and lower extremity can enable patients with SCI to alter their standing postures with minimal upper body effort and subsequently increase the muscle volume[41].

CHRONIC REHABILITATION PERIOD OF SCI

The most important goal is realization of the independent mobilization for both complete and incomplete paraplegic patients during the chronic period. Ambulation can be social, domestic and aimed at exercise. The patient must be able to walk 50 m unaided or with assistive devices for social ambulation. Those who ambulate domestically can walk independently or with partial assistance and need a little help or can be independent at home. Those who ambulate for exercise need advanced help for walking or transferring. Factors such as injury level, age, weight, general health status, motivation and spasticity affect the ambulation potential. Generally, patients with an injury of T10 and above can be ambulated for exercise. Patients with T11-L2 injuries can ambulate in the home (domestic) and the patients of more distal injuries can ambulate socially[42].

Walkers, crutches and orthoses are important to provide chronic stage ambulation. Patients with pelvic control can walk with an orthosis or crutches outside the parallel bars. If the muscle strength of quadriceps femoris is normal, patients can walk with elbow crutches and orthosis without needing a wheelchair. In patients with complete injury of C8-T12, ambulation can be achieved by a parawalker (hip guidance orthosis), both in the house and outside. Walking devices used in spinal cord injury are becoming more and more lightweight and easy to move. However, the devices with advanced technological features are also more expensive. Oxygen consumption, energy expenditure and walking speed can vary significantly depending on the shape, type and weight of material of...
devices used by the patients. One of them is the RGO (Reciprocating Gait orthosis)\(^{[46]}\). For effective use, patient’s excess weight reduction and increased aerobic capacity must be maintained and muscle mass must be increased. RGO has been further developed and is more complicated and more expensive than ARGO\(^{[44]}\). ARGO also leads to an excessive waste of energy like RGO\(^{[46]}\). Hybrid walking devices were created by adding Functional Electrical Stimulation to orthosis. Walking is becoming better within the hybrid devices\(^{[46]}\). Robotic training is a new approach and is developing day by day. A case report showed that upper extremity function has been improved by robotic assistance over four weeks. After training, manual muscle test scores of wrist extensor, finger flexor and finger abductor are significantly increased\(^{[47]}\). Another study demonstrated that the robotic-assisted gait training using the locomot system improved the functional outcome of subacute SCI patients\(^{[48]}\).

The most important expectations in the chronic phase or phase to return home are ensuring the maximum independence related to the level of the patient's injury, integration of the patient to society and teaching the importance of the family's role.

In addition, house modifications are important for patients with SCI in order to have independent activities of daily living. Door width should be 81.5 cm for manual wheelchair access and 86.5 cm for battery assisted wheelchairs. The height of electric switches should be 91.5 cm. Adequate insulation and heat must be provided at home. Door handles must be the “leverage shaped” type and the height of the door sills should not impede the passage of a wheelchair for tetraplegic patients. Carpets should be removed and the surface should be hard in order to maneuver the wheelchair. Bath tubs should be mounted on the wall and must have handles. The height of kitchen apparatuses should be accessible to the patient\(^{[49]}\). There must be a ramp at the entrance to the house\(^{[50]}\).

One of the important features of this period is restoring the patient’s psychological and emotional state again because of the high incidence of depression in patients (the incidence is about 1/3 in the first six months). Depression is not a natural process experienced after SCI but is a complication that needs to be treated. Suicide is the most common cause of death after SCI among patients under the age of 55. Frequency of posttraumatic stress disorder is 17% and usually occurs in the first 5 years. Consultation with a psychiatrist is needed if there is psychotic behavior and depression\(^{[51]}\). Occupational therapy and finding the patient’s role in society are most important factors in restoring the psychological state. Social and psychological problems in the absence of daily activities have been reported. Suicide attempts have been reported due to a lack of daily activity, depression, alcohol dependence and emotional distress. Occupational therapy allows SCI patients to be more social, to use their own functions for creative jobs and to deal with psychological problems like depression\(^{[52]}\).

Occupational therapy is an important part of the rehabilitation process. In developed countries, occupational therapy is carried out by the occupational therapist in the rehabilitation team. Occupational therapists assess the patient's limitations and plan the occupational activities. Occupational therapy is planned and implemented depending on the social and cultural characteristics of individuals, level of education, personality traits, interests, values, attitudes and behaviors before and after the injury. Pictures, music, crafts, ceramic work and a variety of activities (for example, sports) and entertainment are implemented and planned to focus on the purpose in the occupational treatment\(^{[53]}\).

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