



REHABILITATION FOR PATIENTS WITH PARAPLEGIA

PARAPLEJİK HASTALARDA REHABİLİTASYON

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SUMMARY:

Paraplegia is an impairment in motor and/or sensory function of the lower extremities as a result of spinal cord injury. Spinal cord injury (SCI) is a devastating condition that requires intensive and specialized clinical rehabilitation. The area of the spinal canal which is affected in paraplegia is either the thoracic, lumbar, or sacral regions. Rehabilitation of these injuries has an increasingly important role. The primary goals of rehabilitation are prevention of secondary complications, maximization of physical functioning, and reintegration into the community. Frequent complications after SCI include neurogenic bladder, neurogenic bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, fractures, deep vein thrombosis, spasticity, heterotrophic ossification, contractures, autonomic dysreflexia, pulmonary and cardiovascular problems, and depressive disorders.

The interdisciplinary approach of the rehabilitation team is important for the optimal care of individual with SCI. The treatment team may include a physiatrists, physical therapist, occupational therapist, orthotist, nurse, and mental health provider. A comprehensive rehabilitation program is essential to optimize functional independence. The program should address functional goals related to mobility, transfer, and self care as well as issues related to health maintenance and self advocacy.

Key Words: Paraplegia, spinal cord injury, rehabilitation

Level of Evidence: Review Article, Level V

ÖZET:

Parapleji omurilik yaralanması sonucu gelişen alt ekstremitedeki motor ve / veya duyu fonksiyonlarında bir bozulmadır. Spinal kord yaralanması (SKY), yoğun ve özellikli rehabilitasyon gerektiren yıkıcı bir durumdur. Parapleji de spinal kanalın torakal, lomber veya sakral bölgesi etkilenir. Bu yaralanmalarda rehabilitasyonun rolü giderek artmaktadır. Rehabilitasyonun birincil hedefleri, sekonder komplikasyonların önlenmesi, fiziksel fonksiyonun arttırılması ve bireyin topluma yeniden kazandırılmasıdır. Nörojenik mesane ve bağırsak, idrar yolu enfeksiyonları, basınç ülserleri, ortostatik hipotansiyon, kırıklar, derin ven trombozu, spastisite, Heterotopik ossifikasyon, kontraktürler, otonomik disrefleksi, pulmoner ve kardiyovasküler problemler ve depresif bozukluklar SKY sonrasında sık görülen komplikasyonlardır.

SKY'lı ile bireyin rehabilitasyondan optimal yararlanımı için rehabilitasyon ekibinin uyum içinde yaklaşımı önemlidir. Tedavi ekibi fizik tedavi uzmanı, fizyoterapist, iş- uğraşı terapisti, ortotist, hemşire ve psikologdan oluşabilir. Kapsamlı bir rehabilitasyon programında, fonksiyonel bağımsızlığı en iyi duruma getirmek gereklidir.

Rehabilitasyon programı, sağlık bakımı ve kendini savunma ile ilgili konuların yanı sıra mobilite, transfer ve kendine bakım ile ilgili fonksiyonel hedefleri de ele almalıdır.

Anahtar Kelimeler: Parapleji, spinal kord yaralanması, rehabilitasyon.

Kanıt Düzeyi: Derleme, Düzey V.

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INTRODUCTION:

Paraplegia is a medical condition involving impairment in motor or sensory function of the lower extremities, which is a classification of paralysis, the universal term to describe the loss of movement or sensation following damage to a nerve in the body^{9,12,24,33}.

Spinal cord injury (SCI) occurs through various countries throughout the world with an annual incidence of 15 to 40 cases per million. Paraplegia is predominantly the result of a spinal cord injury. Traumatic causes are between 70 % and 80 % of the total number of spinal cord injuries. Car accidents are the most common causes, followed by sports accidents, suicide attempts, gunshot and stabbing injuries^{20,25}.

CLASSIFICATION:

The extent of the paralysis depends on the level of the spinal cord at which the damage occurs. The area of the spinal canal that is affected in paraplegia is either the thoracic, lumbar, or sacral regions. The condition occurs due to damage to the cellular structure of the spinal cord within the spinal canal. An injury to the upper thoracic (T1 to T8), which is approximately adjacent to the chest, often results in poor trunk control. This can include impairment in breathing. Lower thoracic injuries (T-9 to T-12) retain good trunk control and good abdominal muscle control. The sitting balance of people with lower spinal cord injuries is usually very good. Lumbar and sacral injuries result in decreased control of the hip flexors and legs.

There is a strong relationship between functional status, type of injury (complete or incomplete) and level of injury. Complete injury is an injury where there is a complete loss of motor and sensory functions at the distal level of injury. In incomplete injury, sensory and motor functions below the neurological level and in the lower sacral segments are partially preserved. This allows deep anal sensation and/or anal mucocutaneous superficial sense to be preserved. The status of the lesion is not definite until the end of the spinal shock period. An increase in reflex activity is a positive indicator even though signs indicating the end of this period are disputed.

Classification of spinal cord injuries is made by American Spinal Injury Association (ASIA) according to motor and sensory functions. In 2011 ASIA Disorder Scale was revised. The term "deep anal pressure" took the place of "deep anal sense". In the latest "International Standards for Neurological Classification of Spinal Cord Injury (ISNCSC)", the term skeletal level is not included¹⁰⁻¹¹.

- **A- Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- **B- Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.

- **C- Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- **D- Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- **E- Normal**

MECHANISMS OF INJURY:

Spinal cord blood flow has decreased significantly in the 15 minutes following the spinal cord trauma and will keep decreasing in the first following days. Injuries can be aggravated by blood pressure disorders. In addition, white cells gather at the level of injury in 8 to 24 hours. These inflammatory phenomena are causing edema that aggravates injuries. They also occur during the healing process. Furthermore, there are various interactions between complex biochemical phenomena that can be described. They end up causing the progressive destruction of the nerve tissue⁵.

SIGNS AND SYMPTOMS:

There are many signs and symptoms of damage to the spinal cord related to its physiology^{9,12,33}.

They include

- Motor disorders:
- Sensory disorders
- Pain
- Urethral and anal sphincter disorders
- Genital and sexual disorders
- Respiratory disorders
- Autonomic nervous system disorders
- Other associated disorders

Motor disfunctions:

Paralysis or paresis is a result of damage in voluntary motor control. Distribution of paralysis depends on the injury level. Autonomic motor control is occurs in two forms. Hypertonia is an increase in muscle activity which is due to disruption between the spinal cord and central nervous centers regulating motor control. This is followed by mobilization of limbs and spasticity in which with increased speed stiffening against muscle stretching occurs. Hypotonia, flaccid paralysis, is a loss of tonus triggering the flaccid state of muscles. This state is due to complete or partial injury associated with specific root levels. It can be temporary or permanent state^{9,12}.

Sensory disfunctions:

Spinal cord injuries affect superficial and deep sensibility. Multiple levels of damage may be present in patient. When tactile sensibility is preserved and pain sensation is totally lost, risk of unintentional injury or burn can occur even without

noticing. In case of total loss of sensibility, there is increased risk of developing pressure sores. Knowledge of the exact position of the body in space, pressure and shear force exerted on the skin is determined by deep sensibility. Deep sensibility disorders lead to, trunk balance problems, associated with paralysis of abdominal muscles, and feelings of “vertigo” or fear of heights¹².

Pain:

There are two main categories of pain as injury pain (at the injury level), through radicular pain (nerve root injury) depending on the spinal injury and pain arising on the visceral, vascular and muscular parts that are below the injury level³⁰.

Urethral and anal sphincter dysfunctions:

Urinary bladder disorders are caused by impaired motor control, sensibility and reflexes. If there is a delay in treatment of initial period of total retention, urinary and fecal overflow may occur. Over filling of bladder and rectum which cannot be emptied fully cause involuntary overflow of small amounts of urine and feces. For this reason, it is necessary to use aids for evacuation of bladder and bowel^{12,13,29}.

Genital and sexual disorders:

Genital and sexual function are deeply changed. When the injury is complete and located in the sacral segment of the spinal cord, the reflex erection potential is compromised. However, psychogenic erection potential is preserved. Through using appropriate stimulation techniques and physical stimuli, it is possible to achieve erections in other cases. When segmental levels D11, D12, and L1 are far from the damaged level, ejaculation is to be considered. Otherwise, appropriate techniques are implemented, often requiring an appointment with a paraplegia specialist.

In women, sensations during sexual intercourses are affected by complete analgesia of the perineum. As long as lumbosacral reflex pathways are intact, orgasm remains possible. After sustaining traumatic spinal cord injuries, women become fertile again after 1 to 9 months without periods and can get pregnant and carry their pregnancies to term. Rigorous monitoring is necessary. Delivery can be achieved through natural or vaginal birth. Especially if there is a risk of hyperreflexia, epidural anesthesia may be performed. When the mother's abdominal muscles are paralyzed, forceps are used. The decision of using contraception is considered after a careful overall physical assessment due to the increased risk of phlebitis and infections^{17,23}.

Respiratory disorders:

Impairment of respiratory muscles such as, abdominal and intercostal muscles lead to respiratory disorders.

Circulatory disorders:

Impaired venous drainage of the blood returning to the heart lead to circulatory disorders with cardiovascular deconditioning during physical effort. Flaccid paralysis, leads to a venous stasis aggravated by a vasoplegic syndrome.

Forced immobilization leads to bone demineralization, or osteoporosis, and increased risk of urinary calculi.

REHABILITATION:

Specialized rehabilitation care is prepared by physiatrist and a rehabilitation team. The goal of the treatment is to enable the injured individual to regain the fullest level of independence possible, using all the residual force potential of the muscles located above the level of injury, and learning to control residual functions located at the level of injury and below. In addition, the patient care during the early stages of the disorder must be particularly concerned with preventing complications that may stand in the way of successful rehabilitation^{9,12,15,33}.

Trauma caused by SCI has a long, expensive treatment and rehabilitation process which results in biophysical, psychosocial and economic problems. Treatment of SCI is a long time treatment which starts with acute interventions and early surgical procedures³².

In the beginning of the treatment patient cannot perform daily activities by themselves. With physiotherapy patients range of motion in the joints will improve and muscle atrophy will be avoided. Physiotherapy will help to maintain muscle function at the highest possible level that can be expected.

According to the level of injury expected functions in the treatment¹²:

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 cannot 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.

Functional recovery can be measured by various outcome measures including the Modified Bartel Index (MBI), the Quadriplegia index of function (QIF), the Functional Independence Measure (FIM) and the Spinal cord independence measure (SCOM) to name but a few. The above measures are objective tools that do not take into consideration the patient's opinion and needs. In addition they measure activity and do not include participation measures such as community integration and employment¹.

Positioning:

For to protect the articular structure and maintain the optimal muscle tonus positioning of joints is important. The extent of the paralysis and the preference of the health care provider determine the type of the bed to be used in patient with paraplegia. Patients with spinal cord injuries must be turned frequently and receive special skin care to avoid the development of pressure ulcers^{3,16}.

Proper positioning of the feet and legs will help prevent contractures, foot drop, and ankylosis. Sand bags and pillows are useful in positioning. Positioning can also be achieved with plaster splints or more rigid orthotics. Ankle foot orthosis, knee-ankle foot orthosis or static ankle foot orthosis are mainly used for positioning³³.

In the end of bed rest, corsets are used for fixation and supporting the spine when patient moves to sitting position. Thoracic and upper lumbar region fractures are treated with hyperextension corsets or plaster plastic body jackets. A knight-type corset is preferred to support the fractures at the lower of L2 vertebrae. Knight-Taylor type corsets restrict flexion and extension of the trunk without effecting rotation. Plaster or plastic body jacket corsets should be used to restrict movements in all directions²¹.

Therapeutic exercise:

Therapies generally focus on reducing muscle tone, maintaining or improving range of motion and mobility, increasing strength and coordination, and improving comfort. There are specific programs applied to avoid complications such as frozen joints, contractures or bedsores. Physical therapists will assess joint motion, muscle strength and endurance, posture, pain, heart and lung function and performance of daily living activities to develop an individualized program. Therapies may include stretching, aerobic exercises and strengthening.

They may also include gait training and appropriate use of assistive devices, such as canes, braces, and walkers; balance and coordination activities; transfer training such as how to get from bed to wheelchair or from wheelchair to car; and training in how to fall to minimize possible damage. Massage, ultrasound, electrical stimulation or whirlpool can also be used in therapies. Sessions with a physical therapist generally last just a few months or less. Emphasis usually is on the establishment of a home program with periodic follow-up sessions (Figure-1)^{4,8,24}.



Figure-1. Application of electrical stimulation to a patient with paraplegia

Treatment is carried out progressively with a set of customized routine exercises based on the individual's capacity. A program of therapeutic exercise, including passive and active exercises, is initiated to maintain any remaining muscle function and to restore as much muscle activity in the affected parts as possible^{8,12}.

Passive exercises should be done intensively to resolve contractures, muscle atrophy and pain during the acute period of hospitalization in patients with complete injury. 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.

Active exercise has three types:

a) Stretching/Flexibility Exercises:

These exercises are slow, sustained lengthening of the muscle. Stretching improves flexibility through their full range of motion. Stretching also can reduce muscle spasticity and cramps and may also reduce problems such as tendonitis and bursitis. To be effective, stretching routines must be done regularly, usually once or twice a day. Stretch as far as you can and hold the stretch for 10 seconds and then ease back. Stretching should be performed slowly. Stretching also should

be done before and after other exercises to prevent muscle strain and soreness and to help avoid injuries⁷.

b) Aerobic Exercises:

These exercises are steady exercise using large muscle groups. Aerobic exercise strengthens your heart and lungs and improves your body's ability to use oxygen. It also reduces fatigue, increases energy levels and helps you sleep better, control your weight, and lift your spirits. It is generally recommended to gradually work up to three or four sessions per week, each lasting 15 to 60 minutes.

Include a 5-minute warm-up (including stretching) before the activity and 5 to 10 minutes of a cool down (stretching and slower activity) afterwards. Walking, stationary bicycling, water exercises and chair exercises are excellent choices. Walking is recommended according to your ability, comfort and safety. Even short, slow walks can provide benefit.

Aquatic exercises and swimming provide optimal exercise conditions. Water eliminates the effects of gravity, allowing weakened limbs to attain a greater range of motion. Water also helps support the body so there is less stress on hips, knees, and spine. Exercises in the water can help increase muscle power and endurance and help mobilize joints and muscles. They also help to relax muscles and improve coordination. Temperature and the level of the water are adjustable. Warm water can be especially good for stiff, sore joints. Exercises can be done in shallow water.

Stationary bicycling is a great way to improve fitness without putting stress on hips, knees, and feet. Chair exercises can provide a great workout and easily incorporate strengthening and stretching exercises^{4,8,33}.

c) Strengthening Exercises:

These exercises are repeated muscle contractions until the muscle becomes tired. Strengthening exercises help increase muscle tone and improve the quality of muscles. This enhances mobility and provides energy and a positive sense of well-being. Strong hip and leg muscles are needed to lift the legs to walk, and strong arm muscles are needed to carry out daily functions. Strong abdominal and back muscles help maintain correct posture and can counter pain resulting from poor gait, poor posture or the use of mobility aids. Knowing which muscles need to be strengthened and how to perform the exercise without over-stressing the joints is important¹².

Functional Ambulation:

The success of splints or other attempts for functional ambulation depends on whether the injury is complete or incomplete and the injury level. Irrespective to the level of

injury, incomplete SCI patients have a potential to walk. T12 is accepted for to start point of functional ambulation level.

Mobilization in parallel bars and stabilization of trunk and pelvis is obligatory. 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 (Figure-2).



Figure-2. Standing and balance training exercises with parallel bars

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. Standing is beneficial in reducing spasticity, depression and risk for deep vein thrombosis, pressure ulcers and improves recovery of bowel and bladder function.

In chronic stage ambulation, walkers, crutches and orthoses are used. Orthosis or crutches make walking possible outside the parallel bars for patients with pelvic control. In patients with normal muscle strength of quadriceps femoris, patient can walk with elbow crutches and orthosis without need for wheelchair.

Parawalker (hip guidance orthosis) is necessary for ambulation in patients with complete C8-T12 injury. Easy mobility in SCI is achieved by decreasing the weight of the walking devices. The cost increases in proportion to the increased technological

features. The shape, type and weight of the material which is used in the device effect the oxygen consumption, energy expenditure and walking speed^{12,33}.

Robotic training is a newly applied technique which is becoming popular day by day. After training, manual muscle test scores of wrist extensor, finger flexor and finger abductor are significantly increased. Another study demonstrated that the robotic-assisted gait training using the locomat system improved the functional outcome of subacute SCI patients (Figure-3)¹⁹.



Figure-3. Use of the Locomat system for training of walking in patient with paraplegia

Bladder and urethral sphincter retraining exercises:

Bladder and urethral sphincter retraining exercises are used to restore a normal continence/micturition cycle that is compatible with social life and achieve complete bladder emptying with each act of urination.

By intensive bladder training bladder control can be achieved. Due to unawareness of need to urinate, patients with neurogenic bladder require training to initiate urination. Patients with reflex bladder emptying require training techniques that make reflex emptying more effective. Suprapubic pressure helps

urine flow when there is no reflex. In case of need intermittent catheterization can be applied by a nurse or patients themselves.

Training must be aimed to avoid over distention and dribbling when the patient has flaccid bladder with paralysis at second, third or fourth sacral segment. Catheters, penile clamps or other collecting devices are required when bladder control is not achieved to a certain degree².

Complications of bladder such as urinary tract infections and calculi formation are seen in patients with paralysis. The formation of bladder stones results from incomplete emptying of the bladder, with pooling of urine and inadequate elimination of wastes. Formation of stones can be minimized by drinking 2500- 3000 ml of fluid daily².

As in bladder training, the program for bowel training is designed according to the individual needs of the patient and ability to work with those who are developing the program. Abdominal distention and fecal impaction are seen in flaccid bowel. The patient may have fecal incontinence as well as frequent accumulations of flatus and fecal material in the lower intestine. Bowel control methods uses in patients to achieve regular defecation. It is important to make the training according to patient's status in regard to nerve damage and potential for rehabilitation. Fluid and food intake should also be regulated in the training. By using appropriate stimulation techniques normal defecation reflex can be achieved. Manual bowel evacuation techniques are used when reflex is impaired. Intestinal transit is eased by balanced diet which is rich in fibers and large amounts of liquids and regular 15 minutes abdominal massages^{13,29}.

Prevention of pressure sores:

Pressure sores are commonly seen in patients with paraplegia. For this reason it is important to teach the patient prevention and monitoring techniques. The risk for pressure sores can be reduced by using specialized wheelchairs, seating systems and mattresses. Skin care should be taken meticulously. In case of unexpected leaks it is important to define the underlying etiology for to take appropriate preventive measures and take care with changing clothes and garnitures. Insensible body parts should be kept far from heat sources especially for to protect legs and feet burns. In case of redness in skin, the golden rule is to eliminate all pressure on this area until redness disappears or fades significantly. If pressure sores occur, patients can experience prolonged periods of time where they cannot sit.

Prevention of pressure sores in paraplegic patients can be achieved by lifting buttocks regularly in sitting position, changing positions regularly in lying position, avoiding sitting on hard surfaces by using a cushion, foam or gel, routine inspection of the skin with a mirror or by palpating gently

the areas at risk and keeping skin dry and clean (especially perineal area)^{27,31}.

Orthostatic hypotension:

Patients with a long period of lying in bed are likely to have orthostatic hypotension. While patients are sitting and being lifted up, syncope can be seen due to low blood pressure. For patients with this condition a tilt table may be useful (starting from 45 degrees for 30 min a day). Patient's complaints or state determines the degree. Blood pressure reflex is stimulated to a sufficient and persistent limit with standing upright. 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. In the wheelchair use and enabling wheelchair transfer, it is important to be able to sit independently on the edge of the bed. Stability and strength education for sitting and transportation is the aim of the rehabilitation. Functional goals must prepare the patient for movements such sitting up in bed or a wheelchair, dressing and transfers. 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 wheelchair¹⁴.

Respiratory problems:

Deep breathing exercises are useful in hypostatic pneumonia and other respiratory problems. Proper postural drainage is ensured by physiotherapist, through focusing on breathing out and forced coughing. The individual who will perform this preventative technique is taught how to perform it regularly, including in cases of bronchopulmonary obstruction²⁸.

Occupational therapy:

Occupational therapy is especially useful to the paraplegic patient. It helps patients to perform daily activities independently. It includes learning and training in personal hygiene care, dressing up, eating and transportation adaptations, such as wheelchair and adapted car. Occupational therapy will help the individual to find ways to perform some daily activities independently. This help may include using assistive devices or showing the patient a different way to accomplish tasks than is normally employed²².

Preparation for returning home:

Preparation for returning home is settled immediately after the prognosis is known and was announced to both patients and his/her family. All rooms in the house must be accessible

for the patient. If patient cannot achieve full independence assistance for personal care and for daily living tasks is required. For manual wheelchair access door width should be 81.5 cm and 86.5 for battery assisted wheelchairs. The height of electric switches should be 91.5 cm. Insulation and heat must be provided adequately 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 paraplegic patients. Floor should be hard and without carpet in order to ease wheelchairs movement. Bath tubs should be mounted on the wall and must have handles. The kitchen tools height should be accessible for the patient. Ramp at the entrance to the house is obligatory¹².

Transportation:

Rehabilitation team prescribes and adjusts wheelchair for appropriate pressure distribution with safe and easy driving. Height, pelvic width, seat length, backrest, seat and arm support of the wheelchair should be specifically prescribed for each patient. Upper segment injuries require battery assisted wheelchairs and manual wheelchair is preferred at lower segment injuries¹⁸.

The most common mode of transportation is the car, which can be use either by adapting the driving space for paraplegic patients (hand controls), or adapting the car to allow wheelchair access.

COMPLICATIONS:

The results of SCI bring damage to independence, physical function, and cause many complications. Frequent complications after SCI include neurogenic bladder, neurogenic bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, fractures, deep vein thrombosis, spasticity, heterotrophic ossification, contractures, autonomic dysreflexia, pulmonary and cardiovascular problems, and depressive disorders. The patient's life expectancy and quality of life are directly related to these complications. In the very first hours and during the resuscitation phase, especially in cases of multiple traumas, the risk of death is present in traumatic spinal cord injuries with para- and quadriplegia. It is critical to avoid any complications of the spinal cord injuries including during casualty collection and transportation, as well as in positioning of the patient for complementary examinations. Using positioning devices such as eggshell mattresses to immobilize patients is the standard for any transportation until fractures are reduced and fixed (with lateral restraint devices or through osteosynthesis). Prevention of pressure sores should start at the same time in the desensitized areas (special mattresses, frequent position changes every 2 or 3 hours), particularly as blood pressure and thermal disorders may be present. Protecting patients against

bronchial obstruction is often a priority in quadriplegia due to paralyzed abdominal muscles and inability to cough. Subsequent onset of pulmonary atelectases (area of the lung that is no longer ventilated) causing infection is very common. Frequent position changes and sessions of guided breathing exercises and chest percussion therapy can prevent this^{6,12}.

Afterwards, the complications that may become frequent are urinary tract (pyelonephritis, cystitis) and genitourinary infections (prostatitis, urethritis), kidney and bladder calculi, as well as thrombophlebitis. Other rare complications include: osteomas (abnormal bony outgrowths) or paraosteopathies in large joints (risk of ankylosis), pathologic fractures occurring at the level of injury and causing minor trauma due to bone demineralization and the postponed diagnosis due to analgesia, as well as bowel obstruction caused by a lack of proper fecal discharge.

Circulatory disorders such as edemas, phlebitis, embolisms are generally avoided by wearing compression stockings, placing the person in a slight sloping position during the night (elevated feet), as well as avoiding clothes that are very tight around the knees and hips. Monitoring by a specialized physician should be made once every year or two, or more if required. As for general follow-up, an attending physician who is aware of the clinical history should be helpful for every intervention at home and in treating intercurrent conditions^{12,26}.

PROGNOSIS:

The prognosis will depend upon the severity of the injury. At the clinical level, it is more likely that individuals who have sustained an incomplete injury recover immediately compared to those with a complete injury.

An important feature is the speed of recovery. During the first weeks following the injury, the prognosis emerges. The recovery potential decreases very quickly over time after two months without recovery. Conclusions can be drawn formally after a post-traumatic follow-up period of 8 months in the case of spinal cord injuries. This period is 18 months for associated root and peripheral nerve injuries.

Paraplegics with non-progressive conditions who use manual wheelchairs for many years tend to rely exclusively on their arms and shoulders for mobility and transferring. Later in life this will often cause problems. Their shoulders will have problems due to the abnormally heavy use. Use of mechanical assistive devices throughout life helps to preserve their abilities before damage to the shoulders occurs^{9,12,33}.

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