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The use of occupational therapy in the rehabilitation of patients with spinal cord injuries

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ABSTRACT

Introduction: Occupational therapy addresses physical and psychomotor disorders through specially selected activities in order to help individuals achieve the maximum level of functionality and independence in all aspects of their lives. The role of the occupational therapy in the rehabilitation of patients with spinal cord injuries (SCI) is complex. Its main goal is to compose and intertwine all the skills so that the SCI patient is able to have an independent, happy and productive life. The purpose of this study is to review the role of occupational therapy in the rehabilitation of SCI patients.

Material and methods: In the PUBMED database the following search was done with the following keywords: "occupational therapy", "spinal cord injuries". The search results showed 413 papers. After checking titles, abstracts and accessibility to full texts, 297 articles were rejected. Of the 116 publications evaluated, 35 were rejected for various reasons. So there are 81 studies left for this literature review.

Results: Occupational therapy has been proven to have a significant role in the rehabilitation of SCI patients as it facilitates motor retraining, basic functional movements, home alterations, gait training, wheelchair use, personal independence, entertainment and return to work to SCI patients. Occupational therapy is an important parameter of SCI patients rehabilitation, as it helps them to regain the skills they possessed before his injury, to be re-trained in the roles of daily life and to learn ways to repair shortcomings. Moreover, it helps SCI patients to fulfilldaily activities, such as clothing, nutrition and personal hygiene, and to improve memory, attention, perception and concentration. Ongoing research gives us hope for further improvement in the care and treatment of SCI, but even when new developments are used in practice on a daily basis, the neurological rehabilitation team is fundamental to tackling these patients, so that they can have a productive life.

KEY WORDS: Occupational therapy, Rehabilitation, Spinal cord injuries

Introduction

Spinal cord injuries (SCI) are caused by a variety of reasons, including trauma. Regardless of their pathogenesis, these lesions lead to significant impairment of motor and sensory function[1]. Patients with a complete SCI are less likely to recover (less than 5%). If 72 hours after the injury, there is still complete paralysis, the chance of recovery is virtually zero. At the beginning of the 20th century, mortality one year following SCI, in patients with complete damage, reached 100%. The improvement in prognosis has since been large-

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ly due to the introduction of antibiotics to treat pneumonia and urinary tract infections. The prognosis is much better for incomplete SCI.If some sensory ability is maintained, the patient is more than 50% more likely to walk. Eventually, 90% of patients with incomplete SCI return to their homes and regain their independence[2].

Traumatic SCI is one of the most serious injuries and, given prolonged survival, rehabilitation is essential. The main objectives of the rehabilitation are the prevention of secondary complications, the optimization of bodily function and the reintegration into the community. Rehabilitation of SCI is most effective when an interdisciplinary, group approach is applied [3-5]. Physiotherapists usually deal with lower limb function and mobility difficulties. Occupational therapists deal with upper limb dysfunction and difficulties in daily life activities. Rehabilitation nurses deal with bowel and bladder dysfunctions and the treatment of bed sores. Psychologists deal with the issues of behavior and emotion that occur in the recently injured patient and with possible cognitive impairments.The rehabilitation team operates under the guidance of a spine-physician. Although each member of the rehabilitation team has his or her own field of employment, they all work together, collectively and in a team spirit, to address emerging problems[6].

The reason for the intervention of occupational therapy is to help SCI patients who have not acquired the required skills at all, or who have lost them or they are no longer sufficient. The main goal of occupational therapy programs is to compose and intertwine all the skills so that the SCI patient is able to have an independent, happy and productive life[7]. The role of the occupational therapy is complex. The occupational therapist, understanding the importance of projects and activities in people's daily lives, works with SCI patients of all ages who have dysfunctions and / or disabilities, restrictions on the execution of projects and activities of their daily lives, and / or difficulties in equal social participation [8,9].The purpose of this study is to review the role of occupational therapy in the rehabilitation of SCI patients.

Material and methods

In the PUBMED database, a search was conducted with the following keywords: "occupational therapy", "spinal cord injuries".

The search results showed 413 papers. After checking titles, abstracts and accessibility to full texts, 297 articles were rejected. Of the 116 publications evaluated, 35 were rejected for various reasons. Thus, there are 81 studies left for this literature review.

Results

Occupational therapy is one of the major pillars of rehabilitation, focusing on improving activities of daily living performance and fine motor activities [10-14]. Its benefits on the functional independence of SCI patients have been proven by many high-quality studies [6,15-25]. The greatest amount of time of occupational therapy is spent on interventions for improvement of muscle power, walking and hand rim wheelchair propulsion [26,27]. The timing of occupational therapy is important, as decreasing the time from SCI to initiation of occupational therapy, may improve final outcome [28]. Its contribution to the management of pressure injuries is significant [29]. The results of occupational therapy seem to depend on age of SCI patients, as older patients may experience a different clinical pathway in comparison to younger patients. Older people teen to spend less time in occupational therapy and have higher rates of rehospitalization [30]. However, little is known about the exact timing, nature, therapeutic dose, cost-effectiveness and efficacy of occupational therapy following acute and subacute SCI [31].

Initial Motor Retraining

Once the spine has been stabilized and general conditions allow, patients are allowed to sit in bed before sitting in the wheelchair. A brace is usually needed for 2-3 weeks, to avoid intense bending until spinal muscles are strengthened. Patients with cervical lesions use a collar holding the neck in the anatomical position. Initial motor retraining includes static sensation retraining and muscular retraining [32].

The patient with complete SCI has not only lost the sense of touch, pain, temperature and motor strength of the torso and limbs, but also the sense of posture and kinesthesia below the level of the lesion. The retraining of static sensation is achieved by balancing exercises in the sitting position and in the wheelchair [33]. They are mainly performed with the patient sitting on a bench (or wheelchair) in front of a mirror. A pillow is placed under the buttocks as a precaution against excessive pressure. The thighs and legs are well supported so that a right angle is formed in the hips, knees and ankles. The occupational therapist supports the patient from behind with his hands, constantly providing instructions and en-

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couragement. Gradually the patient proceeds to exercises in a self-supporting sitting position, as well as to exercises of the upper limb unilaterally and then bilaterally.It is important for patients with complete lesions to strengthen latissimus dorsi, upper limb muscles, shoulder muscles and abdominal muscles [34,35]. Occupational therapists possess a special role in the selection and management of SCI patients with tendon transfers [36,37].

Basic Functional Movements

Immobilization in bed for weeks will cause some degree of trunk stiffness. In order for the patient to learn the activities of daily life, adequate mobility is necessary. For this reason, the mobilization of the trunk in all directions and the stretching of the tight muscle groups are part of the early recovery. The use of the head and shoulder girdle is essential in many functional activities, especially in quadriplegics [38]. In order for the patient to feel confident, the activities must be done on a wide bench. Lifting the buttocks with a push from the hands is the basis of most activities of daily living. Particular attention should be paid to the practice of the following movements, which form the basis for functional activities such as clothing, bed rotation and transport: movement of paralyzed limbs, moving to the sitting and supine position, rolling in the prone position and turning to the side [4]. In the movement of paralyzed limbs, the quadriplegic patient needs to be able to move the lower extremities along the bench, cross one ankle over the other, cross the ankle at the knee and bend the lower extremity in the sitting position. The balance can be maintained when moving the lower limbs by tilting the trunk forward. This position leaves the hands free to lift, push or pull the lower limb. The pelvis should be straight and the patient tilted slightly to one side and forward to keep the center of gravity above the static lower limb. Rolling is achieved by bending the head and shoulders to place the upper limbs to one side and then placing them on the opposite side after a short quick movement. The direction of the upper extremities is transmitted to the lower extremities and the lower half of the body is also rotated [39].

Home alterations

The two major problems of patient resettlement are ensuring a proper home and work. The majority of quadriplegic patients return home, often with full support from social services and the family.The home may need modifications or extensions, or it may be completely unsuitable, in which case the only solution is to relocate the patient [40,41].The need for home adjustment varies greatly, depending on the patient's level of damage, age and gender [8]. The most common conversions are those in the bathroom, which are usually small, and in the kitchen. Access to the toilet and bathtub is essential for patients who can be transported independently. In order to cook without unnecessary risk, some adjustments are needed in the cupboards, the electric stove and the height of the kitchen surfaces.Free access to the house from the outside is essential and those who are able to drive will need a parking space wide enough to accommodate the wheelchair next to the car for independent transport.Some patients will need little, if any, special equipment at home, while others will need a lot [40,42].

Gait training

Patients with lesions from C5 to C8 use a standing frame or stand upright inside the parallel bars. Unsupervised standing position in the parallel bars promotes static sensation retraining, even for patients with low cervical lesions, because the patient employs all the innervated muscles of the upper limbs and trunk to maintain balance. It is therefore an excellent exercise, even for those who will not be able to walk. Robotic-assisted gait training is an innovative and effective method for the rehabilitation of SCI individuals [43,44].

Wheelchair Use

The right choice of wheelchair allows patients to expand their environment and increase community accessibility [45]. For quadriplegic patients, hand-driven wheelchairs are suitable, either the standard light wheelchair or the sports wheelchair. The standard lightweight wheelchair is manufactured by most companies as a variant of the standard models. It weighs about 2/3 of the standard model. Some patients who put the wheelchair in the car all the time prefer this type. The sports wheelchair is a very lightweight wheelchair, weighing less than 12.5 kg and is designed for intense use in sports activities with wheelchairs. Its frame is disassembled and stored in a special box [46]. Proper placement of the patient in the wheelchair is important, so as not to create bedsores and deformations, and the patient to gain maximum stability for independent activity [47]. Protective pads and cushions are important for the prevention of pressure injuries [48-50]. Small tilt angles are suitable for postural control [51]. The posture should be as symmetrical as pos-

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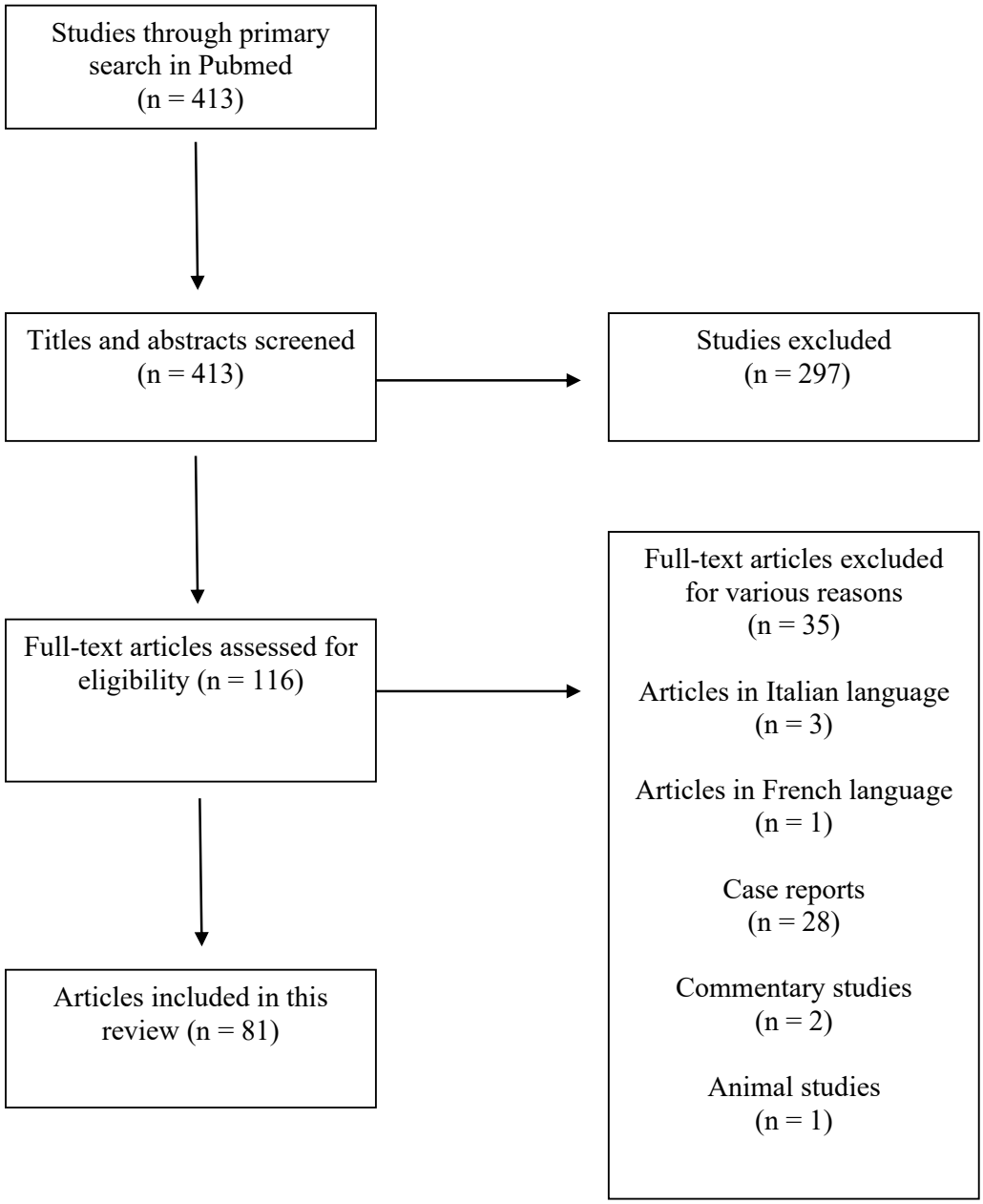
Table 1. Flowchart



sible and the weight should be equally distributed through the ischial tuberosities, buttocks and thighs [52-54].

The basic movements in the wheelchair in which the quadriplegic patient should be trained are: use of brakes, subtraction of an armrest, obtaining objects from the floor, extent to the feet and lift the buttocks forward in the wheelchair. The initial maneuvers in which the quadriplegic patient should be trained are: advancement in ground level, use of the wheelchair on sloping ground, turning thewheelchair.In case of advanced maneuvers, the patient should be trained in advancing the wheelchair over a 5-cm step. Instead of the wheelchair, occupational therapists may train SCI patients to use mobility scooters [32,55].

Falls have a major psychological impact for SCI patients [56]. Proper training of wheelchair use has been shown to reduce fall incidence and improve quality of life of SCI patients

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[57,58]. Moreover, it increases the comfort and the satisfaction of SCI patients [59,60].

Personal independence

For feeding, SCI patients begin using a strap to hold the fork or spoon, extending and relaxing the wrist. After some practice, the strap is removed and the fork is held in place by balancing it on the thumb and against the palm of the hand or over the little finger [61]. A plate protector can help a lot. For drinking, a cup or mug with a large handle is held in place by hooking the thumb through the handle and extending the wrist. A glass without a handle can be lifted by sliding the fingers and thumb around the glass with the wrist extensors loose, and then the wrist extension will provide the necessary grip. Coated mugs are preferred during training. The most skilled patients will then use regular mugs [62].

For teeth cleaning, the toothbrush is used inside the strap or tied between the fingers. In order for the patient to unscrew the cap from the tube, he holds it with his teeth and rotates the tube with both hands. Teeth can be used to push toothpaste out. The patient can be supplied with special tubes by companies that specialize in the production of products for people with disabilities [62,63]. For hair brushing, most patients find it easier to use a large brush with a long handle.To allow the patient to shave on their own, a soft leather case can be sewn around the razor and a strap can be attached around the dorsal surface of the hand. Many patients learn to handle the razor without this case. The patient moves the razor in place between the fingers and palm of the right hand, with the razor's head projecting between the thumb and forefinger. He then places the left hand around the right, to strengthen the handle [64].

During the period of absence of reflexes, the bladder can be emptied in various ways, such as catheterization of the ureter (intermittent or permanent). As the absence of spinal reflexes subsides, which can last from days to several weeks, two main types of bladder condition develop, the overactive (spastic) bladder and the underactive (flaccid) bladder. Both types of bladder can be emptied, as long as their function is understood; there is gradual training and avoidance of active bladder infection. Bladder training absorbs much of the patient's time, which can be discouraged. But persistence is necessary, because the bladder will gradually be trained. The same training is done for both sexes, but it is absolutely necessary for women as there is no satisfactory catheter on the market. Incontinence diapers are the only protection in case of leaks between discharges or catheterizations. When bladder training is ineffective, the patient learns self-catheterization with anintermittent, but not always regular schedule [64]. For bowel care, the correct training program begins as soon as the patient is on a complete diet. The goal is to transfer the contents of the intestine to the rectum at the same time each day or every other day and remove them with reflex defecation when the patient is prepared. The evacuation takes place either on the bed or in the toilet. For most patients, this procedure is done with aid [64,65].

Computers can be used for work and entertainment. Most patients use a small rod with a plastic edge, attached to anextension splint in the 1st or 2nd finger. Wherever possible, both fingers are used [62,63]. Electronic aids include assistive technology interventions that may facilitate daily activities and improve quality of life [66-68]. Robotic therapy and virtual reality, issued by occupational therapists, has been suggested as a useful tool for upper limb training and improvement of daily living of SCI patients [22, 69-71].

Occupational therapists initiate clothing training as soon as the spine is stabilized. SCI patients need to regain some balance in the sitting position before attempting to get dressed and it is common for them to start by dressing their upper limbs in the wheelchair. Each patient, after learning the basic methods, will find a personal way that will best suit his requirements and daily routine.All clothes must be comfortable. Pants must be at least one number larger than normal to fit the urine collector and not cause injury. The zippers on the side are convenient if the patient has a urine collector. A skirt that folds over and elastic shorts that open at the front is a good choice for women patients who find it difficult to remove their clothes in the toilet. SCI patients usually need shoes that are ½ - 1 number larger than before paralysis, to prevent bedsores and to have space for swelling and spasticity. The inner seams should be smooth and the shoes should stay in place when the legs are raised and should be chosen according to the patient's needs. Since the thumb is used as a hook, in many cases loops or open rings are attached to the movable part of the zipper. The bras should be elastic and free of balloons due to the risk of compression [64,72].

For use of telephone, a telephone device can be modified to allow SCI patients to operate the device without assistance. A special handle can be placed on the handset so that it can catch it and use a typing splint when it wants to make a phone call [62,63]. To facilitate writing, there are several

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small devices for using pencil and pen. It is easy to make small splints that support the thumb and finger [73]. Some quadriplegic patients give up these devices over time and tie the pencil through their fingers or hold it with one hand and put the other on top to strengthen the handle.

Driving

SCI patients with injury below C6level are able to drive a car with full independence in transport and in placing the wheelchair inside the car. Getting in the car is done independently, with or without the use of an auxiliary board. Driving requires certain modifications.The transmission should be automatic.A fork or ball on the steering wheel mayreplace the deficit in the catch. The brake and accelerator should be handled with the upper limb [74]. The ability of SCI patients to drive depends on the level of the lesion and the toilet transfer ability [75].

Sports

Exercise in clinical practice has made a significant contribution to the rehabilitation of SCI patients. It helps to restore the patient's strength, balance, synchronization and endurance. It stimulates the activity of the mind and promotes self-confidence and interaction [76]. Adapted sports are beneficial for SCI patients as they improve functionality, oxygen uptake, agility, motor skills and quality of life. Moreover, they reduce risk of complications and hospitalizations [77].

Swimming, archery and table tennis have a special value in recovery. Swimming increases muscle strength, improves synchronization, reduces spasticity and contractions, while mobilization in the water is often the only experience of independent body movement for quadriplegic patients, thus promoting the development of independence and personal expression. It also offers an additional opportunity to socialize with the community [78]. The Halliwick method of water independence training suggests that the swimmer must first adapt to the water and then learn to change his position in the water so that he can move on his own in positions where he can breathe [79].

Archery has been shown to be an ideal sport for SCI patients, both for medical and recreational purposes. Special equipment is required for the quadriplegic patient to shoot with an arc. A hook is used to release the arrow without bending or stretching the fingers. A small hook is attached to the edge of a metal splint, which is attached to the palmar surface of the middle finger and extends to the wrist of the hand that stretches the string. The archer performs a slight prolapse of the forearm to release the string [80].The therapeutic value of table tennis includes improvement of hand-eye synchronization, and wheelchair agility. For quadriplegic patients, an adjustable racket has been developed, in which the angle of the racket surface changes with respect to the handle. The racket is firmly attached to the hand using an elastic glove [81]. Hand-cycle training has proven to be beneficial for SCI patients, as it improves physical capacity [38,82].

Entertainment

Entertainment activities require special attention. The accessibility of these activities is a primary goal. Therefore, the occupational therapist should facilitate the adaptation of the activities to the skills of the SCI patient, especially when there is no possibility of work. Entertainment activities take place either inside or outside the home. At home, leisure activities include reading, watching TV, playing games, listening to music and crafts. Outside the home, there are plenty of activities such as meetings, conferences and visits to cultural venues such as theater, cinema, museums, libraries and art galleries[8]. Listening to and creation of music has been proven to be quite beneficial for SCI patients as it promotes self-esteem, emotional expression and encourages their reintegration into the community [83].

Occupational employment

Occupational employment is highly meaningful to SCI patients [84]. Return to work is not possible unless the duties of the job correspond to the functional capacity of the SCI patient and the possibility of regulating issues such as accessibility, the organization of the workplace, the organization of daily care and the possibility of freedom of movement [85]. In the opposite circumstances, it is necessary to change the situation, which is achieved by the change of job within the same work environment or retraining. This can happen either in a specialized rehabilitation center or in the form of a seminar on workplace training. In any case, patient motivation is a key factor in the success of such programs [8,86,87].SCI patients without higher education or lack viable employment to return to after SCI seem to be vulnerable in return to work [88].

Sexual Health

SCI has heavy impact on sexual health of patients, causing temporary or permanent sexual dysfunction. An occupa-

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tional therapist may serve as a sexual health clinician, who can assess and manage sexual problems of SCI patients [89].

Complementary therapy

It has been shown that complementary therapies provided by occupational therapists (yoga, Pilates, tai chi, aromatherapy and relaxation techniques) are beneficial for SCI patients in terms of pain reduction [90].

SCI remains a devastating damage to the nervous system. Modern treatments have not been shown to be particularly effective in preventing or reversing SCI. In addition, every effort should be made to maintain the remaining operation and prevent complications. The treatment of these patients has improved significantly with the development of special centers. The emphasis in this treatment is on restoring and adapting to disability as well as preventing secondary disabilities. SCI patients are initially completely dependent on their surroundings and need special care in order to become independent members of the community again.

The involvement and contribution of the occupational therapy is a fascinating challenge. Occupational therapy is an important parameter of a SCI patient's rehabilitation, as it helps him to regain the skills he possessed before his injury, to be re-trained in the roles of his daily life, to learn ways to repair his shortcomings, and ways to ergonomically adjust home or professional space. The goal of occupational therapy is to enable SCI patients to engage in daily activities, such as clothing, nutrition and personal hygiene, and to improve memory, attention, perception, concentration. Ongoing research gives us hope for further improvement in the care and treatment of SCI, but even when new developments are used in practice on a daily basis, the neurological rehabilitation team is fundamental to tackling these patients. It is important that efforts continue to be made to integrate people with disabilities into society so that they can lead a full and productive life.

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