SHOULDER PAIN IN SPINAL CORD INJURY

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SUMMARY

The spinal cord injury (SCI) is one of the most severe forms of disabling syndromes. Patients with SCI usually apply an excessive overload on the upper limbs, especially the shoulders, using them more frequently and in a greater range of activities when compared to healthy subjects. Moreover, the search for the improvement of the quality of life in the last years has led an increasingly number of SCI patients to practice physical activities. Many SCI patients use wheelchairs for functional locomotion and sports practice. However, this functional demand on shoulder's joint may lead to a painful picture, interfering on these patient's daily activities. With the improvements on technology and healthcare life expectancy for SCI patients has been increased. Since then, issues regarding quality of life and age-related diseases are very important for this population. The purpose of this paper was to better understand shoulder pain in SCI patients by reviewing available literature.

Keywords: Shoulder pain; Paraplegia; Spinal cord injuries.

INTRODUCTION

The spinal cord injury (SCI) is one of the most severe forms of disabling syndromes, being a challenge for rehabilitation, because spinal cord is a communication way among various portions of the body, such as the brain, also having a regulator center, controlling important functions such as breathing, blood flow, bladder, intestines, thermal control, and sexual activity[1,2].

Clinical picture's severity depends on the affected site and of the degree of damage to afferent and efferent spinal cord paths. The higher the level and the larger the extension of an injury, the less available muscular mass will be for physical activity and, therefore, the less the physical ability and functional independence will be[3].

The etiology of shoulder pain in individuals with SCI may be partially a result of overload (overuse). The patient with SCI excessively overloads the upper limbs, especially the shoulders, using them more frequently and in a higher number of activities than people without SCI. Those segments are used for performing transferences, wheelchair propulsion, locomotion with crutches and sport-related activities. Also, due to the need to remain in a seated position, many daily activities must be performed with the arms raised above the level of the head, resulting in muscle unbalance and overload[4].

With the emergence of technology and health care, life expectation rates for patients living with SCI have increased. Since then, issues related to quality of life and age-related diseases are being studied[5,6,7].

This search for a better quality of life in the last few years has led to an increasing number of people requiring special care to try to practice some kind of physical activity aiming to get improvements on physical and psychological welfare[8]. That is why the combination of physical activities to the rehabilitation process is so important for people living with SCI. Group activities, competition, simple and therapeutic recreation, improvements of the physical capacity for efforts, function and performance, directly affect emotional, psychological and functional conditions, achieving and improving the quality of life.

By taking part in sports activities, handicapped individuals are subjected to injuries. In an epidemiologic review, it was seen that the injury pattern within this population is similar to that of non-handicapped athletes. Soft parts injuries is the most common one. However, the location of the injury depends on the kind of deficiency, on the equipment used, and of the sport activity itself. In this study, lower limbs injuries were prevalent in ambulant athletes (blind, amputees, and brain palsy patients); in turn, upper limbs injuries most commonly affected athletes with SCI[9].

Many paraplegic and tetraplegic patients use wheelchairs for functional locomotion and sports practice. Some wheelchair users experience pain in upper limbs that interfere on essential daily activities, as when propelling the wheelchair itself, driving, dressing and performing transferences[10,11].

Chronic pain incidence was investigated in 384 SCI carriers. From these, 75.6% referred pain in the upper limbs, limiting function and their independence[12]. Among musculoskeletal complications in SCI patients, shoulder pain was the most relevant one, present in 48% of the 216 studied patients[13].

Shoulder joint is subjected to a heavy load during wheelchair propulsion. Helm e Veeger[14] reported that the strength peak on glenohumeral joint at wheelchair propulsion is higher than 2000N.

Study conducted at the Paulista Medical School – UNIFESP – São Francisco Home-School Rehabilitation Center

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Received in: 07/12/04; approved in: 09/16/05

Nevertheless, this study was conducted in static conditions, making this value doubtful as an indication for wheelchair propulsion on dynamic conditions.

In other study, three male patients with SCI (T11-level) (ages: 22, 27 and 38; weight: 81.5, 80 and 95 kg) practicing sports in wheelchairs at a weekly basis performed tests combining two levels of load and two speeds. Researchers concluded that the wheelchair propulsion in a low intensity seems not to cause strong contact forces on glenohumeral joint. However, muscular forces of the rotator cuff, especially of the supraspinal muscle are strong, which may indicate a risk of muscular involvement and the subsequent development of shoulder complications, as well as the rotator cuff rupture[15].

Functional implications of the shoulder pain have been documented in 11 paraplegic women, who reported that work and school activities, the wheelchair propulsion, housekeeping and children care, and the act of carrying the wheelchair into a car are usually associated to shoulder pain[16].

One long-term study with 64 SCI carriers using wheelchair has shown a high incidence of shoulder pain during functional activities requiring an extreme range of motion on the shoulder when the arm was positioned above the level of the head and when performing a high level of upper limbs force. The most painful activities for those patients included climbing slopes, reaching something with the arm above the level of the head, sleeping, moving to unequal surfaces and washing their backs[17,18].

As tetraplegic individuals usually experience a higher level of functional and strength restraints on upper limbs when compared to paraplegic individuals, it is not of surprise that tetraplegic wheelchair users experience a high prevalence and incidence of shoulder pain during functional activities when compared to paraplegic people[19,20]. This corroborates with the study by Sie *et al*.[6] who observed a higher prevalence of shoulder pain after SCI in tetraplegic (46%) than in paraplegic individuals (36%).

The prevalence of shoulder injuries is also a time-dependent phenomenon. A percentage of 78% of tetraplegic individuals and of 35% of paraplegic individuals experience shoulder pain during the first 6 months after injury. After initial trauma, prevalence decreases, so that 33% of tetraplegic patients and 10% of the paraplegic patients experience shoulder pain 6 – 18 months after injury. But, overtime, prevalence increases, so that 20 years after SCI upper limbs pain, paresthesia - or both - is still common. This is accompanied by a functional decrease and by the replacement of a traditional wheelchair to an electric wheelchair[10].

Studies have investigated the prevalence of specific musculoskeletal pathologies among SCI carriers presenting painful symptoms at shoulder joint. Among those, imaging diagnosis (magnetic resonance and X-ray), questionnaire and physical examination focusing shoulder joint were used to detect the prevalence of pathologies in paraplegic patients. a total of 28 patients were studied, with average age of 35 years and average SCI time of 11.5 years. By magnetic resonance analyses, only a rotator cuff rupture was found. Five patients presented with distal osteolysis of the clavicle on the X-ray study, two of them bilaterally [21].

However, the highest incidence and functional compromise is the subacromial pinch syndrome (impingement) or impact syndrome[22,23,24,25,26,27]. Neer[28] implemented the impingement terminology for the set of progressive changes related to the reduction of subacromial space and rotator cuff's tendon compromise.

By the end of evaluation with 94 paraplegic individuals, a rate of 33.3% of shoulder pain was verified. Within the symptomatic group, approximately 75% had symptoms consistent with subacromial pinch syndrome (SPS) and in 65% rotator cuff rupture was found at the arthrography[22].

This indicates SPS progression as described by Neer[28], occurring after SCI with a concomitant rupture of the rotator cuff and subsequent joint degeneration. Although the aggressive rehabilitation program relieves those shoulder issues, the function and independence of people living with SCI remain compromised[4].

One study investigated the role of muscular strength unbalance as a factor for the development of this syndrome. Nineteen paraplegic athletes and 20 male controls were submitted to clinical and isokinetic tests in both shoulders with the measurement of torque peak values for abduction, adduction, inner rotation and outer rotation. In 10 (26%) paraplegic individuals SPS was diagnosed (SPS subgourp). The results of isokinetic tests have shown that the shoulders of the paraplegic group had greater torque than the control group for all movements; the paraplegic group demonstrated a muscular strength unbalance between abduction and adduction, with a relative weakness of shoulder adduction, in a higher prevalence within SPS subgroup. Comparing the SPS subgroup to control subgroup, the SPS subgroup was more impaired at adduction, inner rotation and outer rotation than the control subgroup. Furthermore, shoulders in the SPS subgroup had a relative inner rotation weakness when compared to abduction. Shoulder muscular unbalance with relative weakness of the humeral head depressors (rotators and adductors) may be a factor for the development and perpetuation of SPS in athletes using wheelchairs. The findings in this study also apply to non-athlete wheelchair users[23].

In addition to the factors related to soft tissues and anatomical factors, such as changes on acromion bending and kind, it is believed that kinematical changes of the shoulder complex exacerbate the pain and pathology associated to SPS.

Scapular and humeral movements during body weight lifting and transference maneuvers were studied in 25 asymptomatic volunteers. Findings of this study related to body lifting include the increase of protraction and inner rotation of the scapula and reduction of lateral bascule and humeral outer rotation. Those kinematical findings are similar for transference activities; however, they are higher at the supporting upper limb than at the non-supporting one. This kinematical pattern identified by scapula (increase of protraction, reduction of the lateral bascule and increased inner rotation) and by humerus (reduction of outer rotation), suggests that the performance of those tasks may expose shoulder joint to damaging positions for the SPS due to the reduction of the subacromial space[30].

It is important to highlight that the limitation of the previous study is on the inability to direct the outcomes to individuals with SCI. This study assessed healthy people who were not used to routinely perform those activities, by selecting techniques that are similar to motion patterns of paraplegic patients who would have full innervation of the scapulothoracic musculature. People with SCI can perform such activities in a number of manners in order to allow for a higher level of effectiveness of a painless movement. This kinema-

tics can be changed also by thoracic kyphosis and/ or soft tissues' contracture.

The push-up maneuver (elbow extension) is commonly performed by patients with SCI for avoiding soft tissues' ulcers (skin and subcutaneous tissue), caused by a non-relieved pressure and by friction forces (Figure 1). The influence of the SCI level on shoulder muscles activation during the push up maneuver was studied in 57 SCI volunteers. Intramuscular electrodes recorded the electromyographic activity (EMG) of twelve muscles of the shoulder. For paraplegic and C7-level tetraplegic individuals, the dominant EMG activity was recorded at the large dorsal, pectoralis major and triceps muscles. The results show that tetraplegic patients had a significantly stronger activity on anterior deltoid and infraspinatus muscles when compared to paraplegic patients. The authors concluded that tetraplegic individuals need normal strength of the primary muscles (large dorsal, pectoralis major, and triceps) used by paraplegic individuals during the push up maneuver. However, a stronger activation of the anterior deltoid aided by elbow extension potentially contributes to glenohumeral joint pinch[26].

Figure 1 - *Patient with SCI performing a push-up maneuver for pressure relief.*

In a study on shoulder kinematics in patients with SCI during manual wheelchair propulsion, it was observed that the strength of the flexor muscles was superior for tetraplegic patients when compared to paraplegic patients with high injury. For the authors, the superior strength of the flexor muscles in tetraplegic patients associated to thoracic-humeral weakness increases the susceptibility for subacromial structures compression. The result of this study has shown that wheelchair propulsion imposes a moderate load on shoulder joint and, for being a cyclical activity, the continuous demand of that activity may contribute to localized muscle fatigue[24].

The relationship between wheelchair propulsion forces and the progression of shoulder injuries was studied by using biomechanical data for moment and force obtained from both shoulders during manual wheelchair propulsion in 14 patients with SCI. Magnetic resonance (MR) images were recorded at baseline and approximately two years later. Patients were divided into two groups based on the scores for MR images changes. There was no difference regarding age, body mass index and time of injury. Results demonstrated more strength being generated for wheelchair propulsion in women and, in addition, a higher number of changes on the MR images, thus, allowing for the conclusion that patients performing wheelchair propulsion with a high percentage of strength are at higher risk of injury progression as for MR findings[27].

By this study it is possible to notice that injuries affecting shoulder joint in SCI patients using wheelchairs are commonly seen both in athletes and in non-athletes. This indicates a fragile connection between the trunk and upper limb when there is a reduction of the functional capacity in other parts of the body[29].

Patients with SCI use limbs for performing daily activities in order to be independent, whether for locomotion actions, or transference, self care or others. However, a high prevalence of pain in that so essential joint is a serious problem for this population.

Pain and shoulder range of motion disorders lead the patient to a significant functional limitation, directly affecting daily activities, professional activities, and sport-related activities, whether for recreation or professional purposes. Shoulder pain may limit the access of SCI carriers to the community, thus reducing social integration. Additionally, this can influence the self-perception of health to a more negative status[30].

The painful picture on the shoulder and the problems related to this joint are usually attributed to excessive activities and functional demand on that site. More attention should be given to exercises and preventive measures[4], even because rest, which is frequently prescribed for the rehabilitation of soft parts injuries, may be difficult to perform, because it leads to the loss of functional independence required for performing daily activities; thus, recovery time may be longer than expected for a not-disabled person[8].

The very use of a wheelchair may trigger a vicious circle of pain[18]. Clinical instructions to patients regarding the technique for making wheelchair propulsion effective, especially for women, must be provided, because the reduced use of force during wheelchair propulsion may minimize the development of shoulder injuries[27]. In addition, changes in the wheelchair design together with efforts to strengthen muscles and to make them more resistant may be considered for preventing the development of shoulder pain.

Some studies addressing the conservative rehabilitation for people with SPS focus the correction of wrong scapular and humeral movement pattern, targeting the normal restoring of scapulothoracic rhythm[4,25]. Muscular strengthening of adductors, inner rotators and outer rotators targeting a muscular balance of the shoulder joint is also considered as an important approach for SPS prevention and treatment in paraplegic athletes[24]. Another important aspect in prevention and in rehabilitation programs is the incorporation of exercises for overall cardiovascular and muscular conditioning to minimize fatigue[4]. Additionally, alternative methods should be studied as a replacement for push up maneuver in tetraplegic individuals[26].

It is important to highlight that chronic shoulder pain in patients with SCI is multifactorial. A significant relationship between pain strength and difficult resolution potentially acts in reducing quality of life. Multidisciplinary assessments and treatment strategies should include a medical, physiotherapeutic, psychological and psychosocial view.

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