

## Prevalence of shoulder discomfort in paraplegic subjects

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**Abstract.** *Introduction:* The annual incidence of acute spinal cord injury, as reported in the National Spinal Cord Injury Statistical Center, was estimated to be approximately 40 cases per million, or approximately 11.000 new cases in the United States each year (1). In subjects with spinal cord injury, overstress of the upper extremities occurs not only during daily life activities, but also utilizing wheelchair. The aim of this study is to determine the prevalence of shoulder discomfort in subjects affected by paraplegia living in our country area and evaluate the associated risk factors negatively affecting the shoulder function. *Material and Method:* A computerized database search for paraplegic patients was performed at the Department of Orthopedic Surgery, Trauma Surgery and Rehabilitation Medicine. Among the 54 selected paraplegic patients, 47 accepted to participate at the study. Once the patients were contacted, the medical records were reviewed to obtain information regarding shoulder, elbow and spine region pain and discomfort. *Results:* The 60% of all the patients who answered to the questionnaire complain shoulder pain, 90% bilaterally, and the 30% referred elbow pain, 20% bilaterally. 77% complains back pain, involving particularly lumbar region. Only 2% of this population undergoes a shoulder surgery treatment for cuff tear and shoulder disability. *Discussion and Conclusion:* The present study is the first in our country that gives an overview of prevalence of upper limb discomfort in paraplegic patients. We have shown the interplay between shoulder elbow and spine with pain, age of patients and type of wheel chair utilized. The previous factors can be corrected and upper limb discomfort relieved. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** shoulder discomfort, paraplegic, prevalence, pain

### Introduction

The annual incidence of acute spinal cord injury, as reported in the National Spinal Cord Injury Statistical Center, was estimated to be approximately 40 cases per million, or approximately 11.000 new cases in the United States each year (1). The aforementioned data perfectly matches with the Italian National Registry Report with 40 cases per million and 1600 new cases per year (2). As the life expectancy of patients with spinal cord injury continues to increase, a crucial attempt a medical doctor would like to achieve

is to guarantee a better quality of life (3). In subjects with spinal cord injury, overstress of the upper extremities occurs not only during daily life activities, but also utilizing wheelchair. In fact, arms strength and coordination are required to propulsion and to weight-relief raises when transferring into and out of their chair by themselves (3, 4). Consequently, a more prominent prevalence of rotator cuff lesions (5) and shoulder pain is reported as a common shoulder discomfort in long-term wheelchair users (6-8). Upper limb overstress was demonstrated to be more intense in paraplegic subjects than in the able-bodied popula-

tion, causing shoulder pain, functional disorders, and the subsequent loss of independence leading to undesirable social and psychological problems.

Unfortunately, very few comparative data regarding the demographic and the morphologic characteristics of shoulder discomfort and rotator cuff tears in paraplegic patients are available.

The aim of this study is to determine the prevalence of shoulder discomfort in subjects affected by paraplegia living in our country area and evaluate the associated risk factors negatively affecting the shoulder function.

## Materials and methods

Between October 2011 and February 2012 a computerized database search for paraplegic patients was performed at the Department of Orthopedic Surgery, Trauma Surgery and Rehabilitation Medicine in our hospital area, founding incomplete tetraplegia in 35% of the subjects, complete paraplegia in 25%, incomplete paraplegia in 20%, and an incidence of 20% with complete tetraplegia. Surprisingly, our data perfectly matches the ones reported in the current literature (1).

The inclusion criteria, adopted to select the study group were: history of spinal cord injury with a complete paraplegia and a completely dependence of a wheelchair for a minimum of one year; a value of body mass index lower or equal than 40 kg/m<sup>2</sup>; absence of active infection; not previous surgery of the shoulders; physically and mentally willing and willingness and ability to comply with the scheduled telephone examination; absence of cervical disc herniation, cervical or thoracic syringomyelia, tetraplegia, or advanced degenerative joint disease of the spine; not history of previous soft-tissue injury involving the upper extremities.

Among the 54 selected paraplegic patients, 47 accepted to participate at the study. Once patients were contacted, the medical records were reviewed to obtain the following information: type of injury, demographic information, concomitant medical conditions, and total time of wheelchair dependence. A question-

naire (Appendix) was administrated after patients' approval investigating shoulder and elbow activity.

The questionnaire includes four different sections. The first part is intended both to collect demographic data and to investigate specific type and mechanism of spinal lesion. In the second part the subjects were requested to answer about the presence or not of shoulder, elbow and spine pain; furthermore data concerning previous orthopedic examinations, radiological exams and pharmacologic treatment were collected.

The third section takes in exam the type of wheelchair and the use and the level of independence performing daily and sport activities, and driving car.

The last part includes questions about physical therapy in terms of prevention and rehabilitation.

## Results

Among 54 subjects selected patients living in Rimini and in the neighborhood, 47 answered the questionnaire.

The group of patients, 38 males and 9 females, with a middle age of 49±21 years underwent a spine cord lesion 19±14 years ago.

20 subjects (42,6%) of our population presented a high level of spinal cord injury (D2-D8), while 27 (57,4%) presented an inferior level of injury (D9-L2). All the subjects we tested used the wheel chair from the very beginning after the injury. 41 subjects (87,2%) employed a super light wheel chair while 12,8% (6 subjects) utilized the standard light one.

The 65,9% of all the patients who answered to the questionnaire (31 subjects) complain shoulder pain and only 4 subjects had shoulder discomfort before the accident. The 27 subjects with shoulder pain complain in 90% of case bilateral discomfort, and the 29,8% (14 subjects) referred elbow pain, 20% bilaterally. Moreover 36 patients, 76,6% complain back pain involving particularly lumbar region. In the group of subjects positive for shoulder pain, 29% (9 subjects) referred pain even during the night and rest.

80,9% of all the population (38 subjects) is able to drive and 57,4% (27 subjects) manage the wheel chair by getting independently inside the car.

10 patients (21,3%) of the patients referred to practice frequent amateur sports activity such as basketball, tennis, tennis table, and kayak.

The 33,3% of the patients positive for shoulder pain (9 subjects) answered to be followed by an orthopedic surgeon and the 61,7% (29 subjects) answered to perform a specific rehabilitation protocol for shoulder and elbow.

Just the 1,8% of this population (4 subjects) undergoes a shoulder surgery treatment for cuff tear and shoulder disability.

## Discussion

Shoulder and elbow pain is common in subjects with spinal cord injury, ranging between 30% and 67% (9-12), and significantly affects upper-limb function. Occurring more often in disable subjects than in able-bodied individuals (4, 8, 9, 11-16), could limit the normal wheelchair use ultimately compromising the quality of life. Consensually to what is reported in literature, the wide range in prevalence rates may be explained by the heterogeneity of study population consensually with the discrepancy of diagnostic criteria adopted, and by the lack of inter-examiner and intra-examiner consistency between many items in the physical examinations.

Our study is the first that correlates spinal cord injury to the prevalence of shoulder, elbow and spine pain in our country.

Patients' compliance in answering the questionnaire was higher than 95% demonstrating that this population complains upper limb pain and disability and is interested in understanding the origin of their discomfort. To be mobile, paraplegic patients must perform tasks that highly stress the shoulder, such as wheelchair propulsion and transfers. They often perform weight-relief transfers to relieve their buttocks from the body weight. In fact most subjects have a daily use of wheel chair suggesting that this device overstresses the upper limb and the type of wheel chair could play a key role.

In our study a high percentage of patients complain bilateral shoulder pain. This is an important issue that confirms the wheel chair responsibility in bi-

lateral shoulder overstressing. Not only wheel chair management but even performing overhead tasks while sitting is difficult and determine upper limb deterioration overtime. This unfavorable obliged biomechanical condition, resulting in subacromial structures impinging against the acromion, is described as "weight-bearing shoulder" by Bayley et al. (5), and explains how there is no difference in the prevalence of rotator cuff tears between the right and left shoulders (9) in literature as in our patients' group.

Several common physical stress factors such as repetition, force, posture, and duration have been found to lead to activity-related musculoskeletal problems of the upper extremity (17-22). Kulig et al (23) developed a three-dimensional model to determine the magnitude and direction of the forces and moments acting on the shoulder during wheelchair propulsion. The results of that study (23) clearly showed that propelling a wheelchair imposed an upward force at the shoulder.

Because of the anatomy of the gleno-humeral joint, stability is established by soft tissues and alignment rather than bony containment (3). The type of wheel-chair plays a key role in developing of shoulder dysfunction giving to this population an additional stress, as we found in our patients. All the subjects with an old injury refer to use a standard light wheel chair and were more prone to develop shoulder and elbow pathologies. The study shows that subjects' age and type of wheel chair are strictly related to shoulder pain giving the patients with a daily use of heavier wheel chair a higher prevalence of shoulder discomfort (5 patients, the 83,3% using a standard wheel chair and 26 patients, the 63,4% using a superlight one). This is confirmed, in literature, by Yamaguchi et al (17) who show in their study that the presence of bilateral rotator cuff disease increasing consensually with age.

In addition, our study shows that all patients are predisposed to develop elbow pain, in most of the patient bilateral and highlights that the entire upper limb is overstressed not only due to an altered biomechanical condition but also due to postural compensation. In fact, patients with spinal cord injury represent a heterogeneous group of patients characterized by different spine lesion patterns resulting in different muscle weakness and reduced spine function. More-

**Table 1.** Data collected by telephone questionnaire

Population	47 Subjects
Age	49±16
Time from Injury	19±14
Spinal cord injury level T2-T8	(20) 42.6%
Spinal cord injury level T9-L2	(27) 57.4 %
High light wheel chair	(41) 87.2 %
Standard light wheel chair	(6) 12.8%
Shoulder pain	(31) 65,9%
Shoulder pain before trauma	(4) 8,5%
Elbow pain	(14) 29.8%
Spine region pain	(36) 76.6%
Rehabilitation program	(29) 61.7%
Car driving	(38) 80.9%
Sport activity	(10) 21.3%
Orthopedic care	(9) 33,3%
Shoulder surgery	(4) 1,8%

over the percentage of patients with an high spinal cord injury, at T2-T8 level, who complain shoulder pain was lower than patients with a T9-L2 maybe linked with a greater use of shoulder after trauma for people with a lower spinal cord injury.

More than half of all patients (61,7%) answered to perform a specific rehabilitation protocol for shoulder and elbow indicating their requirement to a high activity level with upper extremities. In contrast with this data only the 33,3% of this population has been followed by orthopedic surgeon. This suggests that these patients are reluctant to consider a program of shoulder surgical treatment. In supporting to that our study show that just the 1,8% of our patients underwent to shoulder surgery that means at least 3 weeks of immobilization and 2-3 months of upper extremities disability. Due to their high activity request, the surgery treatment is still a challenge for patients affected by paraplegia.

Sport activity was performed only by 21,3% of our patients even if in literature is well reported how people with spinal cord injury can have an improvement in social reintegration and psychological and cardiovascular disease control by practicing sport activity (24).

Being a study based on a telephone interview a limitation is that it did not distinguish between specific clinical disorders of the shoulder joint.

Moreover this study could underestimate the issue of painful cuff disease in the paraplegic population by excluding shoulders that might already have had surgery for a rotator cuff tear.

## Conclusion

Since patients with spinal cord injury have a scarce tendency to consult an orthopedic surgeon the management of this population is very difficult and the prevalence of their shoulder discomfort can be underestimate.

The present study is the first in our country that gives an overview of prevalence of upper limb discomfort in paraplegic patients.

We have shown the interplay between shoulder elbow and spine with pain, age of patients and type of wheel chair utilized. The previous factors can be corrected and upper limb discomfort relieved. Moreover the study highlights that patients affected by paraplegia complain shoulder discomfort are not sufficiently supported in the management of their disability. This could be a social challenge in order to better assist people with spinal cord injury. Further investigations are mandatory focusing on how a better clinical evaluation can detect related factors improving quality of life in patients with disability.

### Questionnaire of Shoulder discomfort in paraplegic patient

Center  
 Examining physician  
 File number  
 Last name  
 Date of birth  
 Sex  
 Time from spinal cord injury

**Dominance**                     Dominant                     Not dominant                     Ambidextrous  
**Shoulder involved**         Right                             Left                                 Bilateral

#### Level of spinal cord injury

- D2-D8
- D9-L2

#### Type of wheel chair

- Standard light wheel chair
- Super light wheel chair

#### Activity level pain

- Chest
- Shoulder
- Head
- Above the head

#### Sport activity

- Basketball
- Tennis
- Tennis table
- Kayak
- Other

#### Shoulder discomfort

- Right pain shoulder                     No                     Yes                     No info
- Left pain shoulder                     No                     Yes                     No info
- Right pain elbow                     No                     Yes                     No info
- Left pain elbow                     No                     Yes                     No info
- Pain at night                     No                     Yes                     No info
- Pain before spinal cord injury                     No                     Yes                     No info
- Spine pain                     No                     Yes                     No info
- Car driving                     No                     Yes                     No info
- Independence in wheel chair management                     No                     Yes                     No info
  
- Pharmacologic therapy for pain                     No                     Yes                     No info
- Rehabilitation therapy                     No                     Yes                     No info
- **Shoulder surgery**                     No                     Yes                     No info

If Yes, Specify



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