Bulletin of the *Transilvania* University of Braşov
Series IX: Sciences of Human Kinetics • Vol. 12(61) No. 2 – 2019
https://doi.org/10.31926/but.shk.2019.12.61.2.53

BIOMECHANICAL AND KINETOTHERAPEUTICAL ASPECTS OF THE SCAPULO-HUMERAL PERIARTHRITIS SYNDROME

Florentina NECHITA[1]

Abstract: *The scapulo-humeral periarthritis is the clinical syndrome characterized by pain, joint redness and functional impotence determined by pathological processes located at the shoulder level and affecting the periarticular structures: ligaments, joint capsule, tendons, and muscles. The form of the scapulo-humeral periarthritis successfully benefits from treatment of stabilization and biomechanical and neuromuscular balancing, in kinetotherapy applications. In conclusion, in the recovery of the scapulo-humeral periarthritis, the kinetotherapeutic treatment intervenes to prevent loss of mobility and prevent fibrosis, restoring muscle strength, stability and controlled movements of the shoulder.*

Key words: *syndrome, scapulo-humeral joint, periarthritis, biomechanics, kinetotherapy.*

1. Introduction

The scapulo-humeral periarthritis is a syndrome of particular importance due to its high incidence in medical practice, the limiting effect in the area of work and the progression in time to a capsulitis that leads to severe disabilities before a resolution occurs. The unique feature of this syndrome is that it does not install at the level of the joint other than the shoulder and a "frozen" shoulder has complete ankylosis that can "thaw" spontaneously, leaving behind a relatively normal joint [24].

Due to the complexity and particularities of biomechanics, the shoulder joint is one of the most prone joints to the appearance of pathology. The scapulo-humeral periarthritis is as a clinical syndrome, with symptoms such as pain, redness and functional impotence of the shoulder, in various degrees of movement, due to pathological processes, which affect the periarticular tissues and sometimes the joint capsule. Shoulder impingement syndrome is the common cause of algal impurities and causes significant disability [17].

The scapulo-humeral periarthritis is

[1] Departament of Physical Education and Special Motricity, *Transilvania* University of Braşov.

present in three stages. It is classified in primary (idiopathic) and secondary cases. The etiology for primary syndrome remains unknown.

It is commonly associated with other systemic conditions, most commonly with diabetes, or after periods of immobilization, such as stroke ([12].

Most cases of scapulo-humeral periarthritis can be manager in the onset phase. Physiotherapists are encouraged to begin treatment with the patient's education. Explaining the natural history of the condition often contributes to reducing frustration, to a better understanding of the phenomenon and to alleviating the patient's fears.

It is estimat that the incidence is 2 to 5% in the general population of those affected by this syndrome and more than 20% among those with diabetes. The high frequency occurs in the fifth and sixth decade of life, with a peak age in the mid-50s. The onset before 40 is less frequent, and the non-dominant shoulder is less likely to be affect than like another. In 6% to 17% of patients, the other shoulder will be affected over the next five years (25).

In 2015, Hollmann et al. finally made a scientific experiment on this topic, simple and relevant. Under general anesthesia, five patients diagnosed with frozen shoulder was check before and after the shoulder capsular release surgery. All five had better amplitude of the passive abduction movement, which would be impossible if the articular capsule had been stiffened or cemented or under any physical limitation. Improvement in all axes of movement ranged from a minimum of 44˚ to an increase of 110˚ (to normal) [8].

The researchers reasonably concluded that the loss of passive amplitude of shoulder movements cannot be explained solely by capsular retraction and thickening. The passive shoulder abduction evaluat in the five patients and after anesthesia does not accurately reflect the true amplitude of available movement of the affected shoulder. It seems that active stiffness or muscle protection is a major contributing factor the decrease in movement a patient with the frozen shoulder (27).

2. The Biomechanics of the Arms

2.1. The biomechanics of the scapular belt

In the belt of the level, we distinguish the clavicle joint with the sternum and acromion of the shoulder blade as well as the scapulothorax joint at the shoulder blade level. The two bones of the belt are integral with each other in performing the lifting and lowering movements, the forward and backward projection of the shoulder. The circumcision of the shoulder is achieved by summing these movements. Solidarization is ensuring by the connection at the level of the acromioclavicular joint as well as by the coracoclavicular ligaments [16].

The movements at the level of the scapular belt are shoulder movements and are most often associated with the movements performed by the member itself at the scapulo-humeral joint level [16].

a) Lifting and lowering movements

In the shoulder lifting movement, the collarbone moves upwards, and with a horizontal angle of 30-40°, its distal extremity rises approximately 8-10 cm and will train through the acromioclavicular joint and the scapula, which performs a translational movement; up and the

shoulder blade slides on the muscle planes. The superior sternoclavicular ligament limits these movements [9].

The shoulder muscles are for the collarbone the trapezoid and the sternocleidimastoid and for the scapula the entire trapezius and the elevator of the shoulder blade; the descending ones are for the clavicle - subclavicular, the great pectoral and deltoid, and for the shoulder blade - the small pectoral, the trapezoid (its lower fascicles), the great dorsal etc. [14].

b) Movement of forward projection

It occurs in the act of pushing forward, forcing and striking, usually accompanied by some degree of forward rotation. The lateral muscle of the collarbone is anteriorly and with it, and the shoulder blade will be project forward. The movement is limit by the anterior sternoclavicular ligament. The anterior clavicle movement is performed by the large pectoral and deltoid, and for the anterior pectoral and small pectoral blades [19].

c) Backward projection movement

It is the reverse movement when the shoulders are pull back the clavicle and shoulder blade are pull back by the trapezius and stenocleidomastoid muscle, respectively by the trapezoid and rhomboids. The extension has limited amplitude of the coraco and glenohumeral ligaments, therefore the movement measures 50-60° [14].

d) The movements of tilting the scapula

There are rotational movements that occur around an anteroposterior axis passing through the acromioclavicular joint. They actually occur at the level of the scapulo-thoracic joint. By rotating forward and upward of the shoulder blade (lateral tilt), the superoexternal angle together with the glenoid cavity is directed upward, the superointernal angle downward, and the inferior angle forward, describing a 45° circle arc. [9].

2.2. **The Biomechanics of the Scapulo-humeral Joint**

The shoulder joint is the most mobile of all body joints. The arm executes a series of wide movements - fig1, to which are add the possibilities of mobilization of the shoulder blade and thus, at the level of the three joints of the scapular belt, it confers the mobility of the whole member in the three planes [16].

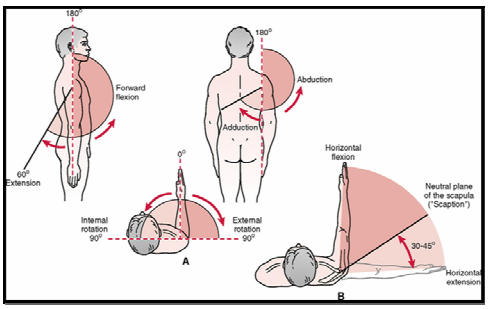

Fig.1. *Shoulder movements*, (26)

a) Abduction and adduction

In the abduction movement, the first 90 degrees are due to the involvement of the gleno-humeral joint, and when exceeding 90 degrees the scapula movement intervenes. The last 30 degrees of abduction is due to the involvement of the thoracic spine, by lateral flexion, and the cervical spine, by a slight lateral flexion in the opposite side of the flexion of the thoracic spine (the flexion of the cervical spine is finish to maintain the physiological posture of the head). When both arms are abducted, the column remains motionless [1].

The adduction is the reverse movement, the return of the arm and is, in the strictly frontal plane, limited by the trunk, passed in the oblique plane before the arm can be continue through the front of the chest.

The abductor muscles are represented by the deltoid with all its bundles, but initially by the super-spine, which is at the same time a tensor of the articular capsule [16].

Adductor muscles: the most important are the great pectoral, the great dorsal, the large and small round, the subscapular, the infraspinosus, the coraco-brachial and the brachial biceps [16].

b) Flexion and extension

The flexion reaches the amplitude of approximately 180°, up to 90° acting glenohumerally. Above this value, those that block is the coraco and glenohumeral ligaments and the following degrees are favorit by rotations in the acromio-clavicular and sterno-clavicular joint and the antepulsion of the scapular belt. The last 30° of the movement are benefit by lumbar hyperlordosis [20].

The anteductive muscles is the deltoid through the clavicular and acromial bundles; the great pectoral by the clavicular, coracobrahial and the biceps brachial fascicle (short end). The retrospective muscles are the deltoid, through the spinal bundle, the great dorasl, the large round, the triceps (long end) [16].

The extension reaches the amplitude of 50-60°, around a transverse axis, through the large tubercle, and in the sagittal plane, through the glenoid cavity cavity [20].

c) Internal and external rotation

It takes place transversely, around a vertical axis. The amplitude is 85 ° for external (lateral) rotation, the limitation starts by the tension of the anterior portion of the capsule, the glenohumeral ligaments and the muscles. The internal amplitude is 90°, its limitation due to the tension of the posterior part of the capsule, the glenohumeral ligaments and the muscles [21].

External rotator cuffs are super-spine and small round, and internal rotators: deltoid, large pectoral, large round, and large dorsal. Circumcision summarizes previous movements. The humerus describes in motion a cone, the humeral head (tip of the cone), rotating in the spleen, and the lower extremity draws an oval representing the base of the cone [15].

The average normal amplitudes of movement, specific to the shoulder complex, is present in the following table, by three authors: Clement Baciu, Charles Rocher (cited by Tudor Sbenghe) and David Magee [5].

Table 1

Average normal amplitudes of movement, [5]

Movement	**Cl. Baciu**	**Ch. Rocher**	**D. Magee**
Flexion	180°	180°	170-180°
Extension	35°	50-60°	50-60°
Abduction	180°	180°	170-180°
Adduction	180°	180°	170-180°
External rotation	80°	80-90°	80-90°
Internal rotation	95°	90-95°	60-100°

3. The Scapulo-humeral Periarthritis

The scapulo-humeral periarthritis is a clinical syndrome, where the pain, redness and functional impotence of the shoulder appear, all of them, associated in varying degrees of the amplitude of the movements, of pathological cause, which

especially affect the periarticular tissues (tendons, pouches) and - in some cases - joint capsule [22].

The scapulo-humeral periarthritis is a painful clinical syndrome, accompanied by redness and limiting movements, due to damage to the periarticular structures by degenerative and/or inflammatory lesions [2].

The scapulo-humeral periarthritis is one of the most common disorders for which patients refer to the specialist doctor, this being found in both sexes, in patients of active age, especially targeting people over 40 years [3].

Among the injuries that can cause periarthritis includes severe shoulder injuries (fractures, dislocations, bruises, violent muscle exertion). Cervical spondylitis can promote scapulo-humeral periarthritis, by radial irradiation [23].

3.1. Symptoms

In the first phase, pathologically, the scapula-humeral periarthritis has as a substrate the degenerative lesions of the tendons, especially of the biceps, which is characterizet by necrosis that can lead to partial ruptures and through calcification. These wear processes are common in subjects over 40-50 years old, asymptomatic for a long time [4].

In some cases, the migration of the calcium material with its penetration inside a stock exchange (in the subacromiodeltoid scholarship) can cause a very strong inflammatory process, which could be due to the presence of predominantly pressing pain [13].

Symptoms may be mild or more severe:

- Shoulder pain, without limiting its movements caused by tendonitis of the supraspinatus muscle / of the long muscle of the biceps;
- Acute pain of the shoulder with total limitation of its movements due to inflammation of the serous exchange (bursitis);
- Blocking the shoulder caused by a retractable capsulitis (retraction and thickening of the joint capsule of the shoulder), severe pain and a stiff shoulder;
- Pseudoparalitic shoulder (frequently in athletes) due to a tendon rupture, the pain is weak and the person cannot move the shoulder (28).

3.2. Diagnostic

The objective examination, upon inspection of the shoulder, may reveal a swollen and red shoulder, amyotrophy (especially of the deltoid and trapezoid), the fall of the shoulder, changes of the hand (in something-dystrophic syndrome; shoulder-hand). In addition, the palpation shows the existence of painful spots on the large tuberosity (on which the super-spine is inserted), in the bicep groove, on the coracoid apophysis [6].

The rotational movement can also be achieved by bringing the hand to the neck (external rotation) or back to the dorsolombar column (internal rotation), the forearm being semi-flexed on the arm (at a right angle). The active mobility examination is then performed, the examiner opposing resistance [13].

The pain, which appears only on the abduction, suggests a tendency of the super-spine, the pain that appears on the internal rotation is specific to the tendon of the subscapular, the one that appears on the external rotation is related to the tendinitis of the subspin, and the one that appears only on the extension suggests a bicipital tendon.

The physical examination should also include the analysis of the acromio-clavicular joint, the edges of the glenohumeral joint, the rotator cuff, the subacromial bursa and the bicipital slide. An eventual axillary adenopathy should also be sought and an examination of the cervical spine and the respective upper limb performed (reflexes, sensitivity) [6].

3.3. Evolution and Prognosis

The evolution can take quite a long time, even a few months, but the prognosis is generally favorable, and can be obtain after an early treatment, well developed but also more complex and difficult movements [10].

Other times the spontaneous evolution to healing requires 1-2 years, as in the case of the blocked shoulder. If a well-defined program is not established, and in the absence of proper treatment, the shoulder blockage may be delayed for several months; however, with the passage of time, sometimes after about 6 months, the shoulder may begin to gradually release and most patients will regain full mobility [18].

The evolution of scapulo-humeral polyarthritis usually ends in a few weeks, after which the patient can resume his activities, but there is a possibility that there may be a feeling of embarrassment that may occur due to fatigue or from cold and moisture [10].

3.4. Modern Therapies used in the Treatment of the Scapulo-Humeral Periarthritis

Shockwave Therapy or Shockwave Therapy is a modern technology that uses shock waves to treat chronic pain in the musculoskeletal system. It is base on the generation of a very intense energy in a very short period of time (10 milliseconds), thus shock wave crossing the tissues at a speed greater than the speed of sound. In shoulder disorders, shockwave therapy has proven effective, so in 81% of cases it reduced pain and increased shoulder mobility [11].

High-power laser therapy is base on the principles of low-power laser, but with a maximum power 50 times higher. The wave stimulates free nerve endings and immediately relieves pain (biostimulation and analgesia program). If used immediately after sockwave applications, the pain is greatly alleviated (29).

3.5. The Kinetic Therapy in Scapulo-humeral Periarthritis

The kinetic treatment of shoulder recovery in rheumatic disorders has the following objectives in the functional recovery of the shoulder:

- Pain control, objective achieved mainly through positions and postures in functional position;
- restoring/maintaining mobility, through passive, active, active exercises with resistance;
- restoring the strength and stability of the shoulder, through exercises with resistance;
- restoring the controlled movement of the shoulder;
- maintaining or improving the ability for daily gestures, by training the arm [22].

During the recovery sessions, the kinetotherapeutic program contains exercises, from simple to complex, with breaks between 30 seconds one-minute series. Thus, in the first session, passive movements, pendulum exercises,

exercises performed antigravitationally and with the help of the cane can be perform, following which in the following of the session new exercises will be add, by loading their own body, with progressive resistance and with the help of the objects in the recovery room. (Sandbags, mattresses, shoulder wheel, medicine ball), within the functional limits of the patients. On the movements of the return to the initial position, the exercise is slow and controlled, taking care at the same time to acquire a proper breath-expiration breath.

4. Discussion

It is of vital importance to participate in the recovery process of a specialized framework, respectively a trained kinetotherapist who places his imprint on both the kinetic program, its mode of accomplishment, and on the patient's psychic.

Improvement of the functional rehabilitation techniques through kinetic programs, as well as the good patient-kinetotherapist-doctor cooperation, lead to an improvement of the recovery within the limit of the functional remaining of each patient.

References

1. Anton, S.: *Assessment of pain in the patient who cannot communicate*, 2014. http://www.viata-medicala.ro/ Evaluarea-durerii-la-pacientul-care-nu-poate comunica.html* articleID_ 8980-dArt.html. Accessed: 22-01-2019.
2. Antonescu, D., Dinu, M.: *The pathology of the locomotor system*, vol. I. Bucharest, Medical Publishing house, 2006, p. 1036-1037, ISBN 973-39-0559-3.
3. Baciu, C.: *Pre and postoperative kinetotherapy*. Bucharest, Sport-Turism Publishing house, 1981, p.150;
4. Baciu, C.: *The clinical semiology of the locomotor system*. Bucharest, Medical Publishing house, 1975, p.238, ISBN 9102439.
5. Balint, T.: *The evaluation o the locomotor system*. Iaşi, Tehnopress Publishing house, 2007, p. 132.
6. Bratu, A.: Gymnastics for the prevention and correction of physical deficiencies. Bucharest, Sport-Turism Publishing House, 1977, p.84-88; ISBN 973-39-0559-3
7. Hollmann, L., Halaki, M., Haber, M., Herbert, R., Dalton, S., Ginn, K.: *Determining the contribution of active stiffness to reduced range of motion in frozen shoulder*. Available at: https://www.physiotherapyjournal.com/article/S0031-9406(15)03442-2/abstract. Accessed: 10-10-2019;
8. Ingraham, I.: *Frozen shoulder guide*. Vancouver, Canada, 2019, https:// www.painscience.com/tutorials/frozen-shoulder.php. Accessed: 17-01-2019;
9. Jeffrey, R., Campbell, A.: Anatomy and dimensions of rotator cuff insertions. *J Shoulder Elbow Surg*, vol. 11, number 5, 2002, p. 498-500.
10. Marcu, V.: *Theoretical and practical basis of physical exercises in physiotherapy.* Oradea, Universității Publishing house, 1997, p. 57.
11. Morrissey, P.: *Schockwave Teraphy*. https://shockwave-therapy.co.uk/. Accessed: 08-01-2019.
12. Nagy, M.T., MacFarlane, R., Khan, Y., Waseem, M.: The frozen shoulder: myths and Realities. *Open Orthop. J.*,

2013. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3785028/. Accessed: 07-10-2019.
13. Nica, A.S.: Medical Recovery (revised and added edition), Bucharest, Universitiy Carol Davila Publishing House, 2004, p. 116-117;
14. Niculescu, Th., Cârmaciu, R.: *Human anatomy and physiology – compendium*. Corint Publishing house, 2009, p. 95-97. ISBN: 978-973-135-429-3.
15. Papilian, V.: *Human anatomy: The locomotor system*, vol.1, ed XII. Bucharest, All Publishing House, 2010, p. 129, ISBN: 973-571-690-9.
16. Pop, L.., Nicu, A.: *Clinical and muscular evaluation.* Cluj, Medical Publishing House Universitary "Iuliu Haţieganu", 2002, p. 10-47.
17. Popa, F.L., Banciu, A., Rotaru, M.: *The diagnostic and therapeutic approach of the painful shoulder*, Vol. II, Nr. 3, University "Lucian Blaga", Sibiu, 2013, http://www.amtsibiu.ro/Arhiva/2013/Nr3-ro/Rotaru_Popa_pdf.pdf. Accessed: 14-01-2019.
18. Popescu, E., Ionescu, R.: *Compendium of rheumatology,* the third edition updated and added. Bucharest, Tehnic Publishing house, 1998, p. 376, ISBN: 973-31-1115-5.
19. Ranga, V., Exarcu, T.: *The human anatomy and physiology*. Bucharest, Medical Publishing house, 1970, p. 236-238.
20. Raţă, M.: *Functional anatomy and biomechanics undergraduate course*. Bacău, Alma Mater Publishing house, 2014, p. 98.
21. Rinderu, E.T.: *The anatomical basis of the movement: practical course for students of the kinetoteraie faculties*. Craiova, The typography of the University of Craiova, 2003.
22. Sbenghe, T.: *Practical, therapeutic and recovery kinetology*. Bucharest, Medical Publishing house, 1987, p. 501-502.
23. Vasile, C.: *Physical exercises in the treatment of joint rheumatism*. Bucharest, Sport- Turism Publishing house, p. 23-30.
24. Wright, V.: Periarthritis of the shoulder. *Ann Rheum. Dis*., 1976, https://ard.bmj.com/content/annrheumdis/35/3/213.full.pdf. Accessed: 16-01-2019.
25. https://www.uptodate.com/contents/frozen-shoulder-adhesive-capsulitis#H4000969. Accessed: 16-01-2019.
26. https://www.mmrm.com.au/adhesive-capsulitis-myotherapy/.Accessed: 10-10-2019.
27. http://highered.mheducation.com/sites/dl/free/0073025828/461945/Chapter04.pdf. Accessed: 14-03-2018.
28. https://www.csid.ro/dictionar-medical/periartrita-umarului-periartrita-scapulohumerala-11320073. Accessed: 08-01-2019.
29. http://www.equilibrium-on.ro/laserul-de-inalta-putere-o- revolutie-tehnologia-laserului-terapeutic. Accessed: 12-01-2019.