Anatomical Considerations of The Acromioclavicular Joint for the Application of Mobilization-With-Movement: A Narrative Review

Júlio Guilherme Silva a,b*, Diego de Faria Magalhães Torres c, Carlos Alberto Araújo Chagas d, Fernando Silva Guimarães a,b.

Introduction:

Mulligan’s concept for treatment of musculoskeletal diseases was introduced by Brian Mulligan that defend the hypothesis of a positional failure evoked in conditions of unbalanced musculoskeletal system.1 Such process occurs as a function of a minute positioning failure of the joint surfaces resulting in arthrokinematic disturbances.2 Clinically, the positional failure manifests mainly with pain, reduced range-of-motion (ROM) and compensatory adjustments on postures. Joint mobilization – associated or not with muscle contraction – can restore the accessory movement, eliminate the positional failure and recover the physiological movement1,3. The efficacy of manual therapy techniques for increase of ROM and hypoalgesia had been investigated by several trials.4-7 Among the principles used for treatment using Mulligan’s concept, the mobilization-with-movement (MWM) is applied through active movements during joint mobilization1,3,4,8,9.

Last years, there was a pronounced increase in researches aiming to elucidate the real mechanisms that lead to hypalgesia and/or analgesia due to Mulligan’s concept application on peripheral joints1,3,6,7,10-11. Studies using image analysis presented contradictory results concerning the positional failure hypothesis12. For instance, a case report evaluated the effects of the MWM on a thumb hyperabduction with magnetic resonance images (MRI)13.

Key words: Mulligan’s Concept; Mobilization-with-movement; Acromioclavicular joint; Anatomical Variation.

Authors’ information:

a- Professor of Rehabilitation Science Program / Analysis of Human Movement Lab. Augusto Motta University Center (UNISUAM), Rio de Janeiro-RJ, Brazil
b- Adjunct Professor, Physical Therapy Department - Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro-RJ, Brazil
c- Physical Therapy Service – Clementino Fraga Filho Hospital University / UFRJ, Rio de Janeiro-RJ, Brazil
d- Adjunct Professor, Department of Morphology – Federal Fluminense University (UFF), Niterói – RJ, Brazil.
* Corresponding author. Rehabilitation Science Program - Analysis of Human Movement Lab, Centro Universitário Augusto Motta – UNISUAM, Address: Praça das Nações nº 31 - 3º andar Bairro: Bonsucesso, Rio de Janeiro – RJ, Brazil. CEP 21041-020; Telephone: 55(21)3882-9797.
E-mail for correspondence: jglsilva@yahoo.com.br or jgsilva@hucff.ufrj.br

ABSTRACT

Mobilization-with-movement (MWM) was described by Brian Mulligan and has wide applicability on joint disorders based on positional failure theory. Among the applications for the shoulder, one of interest for increase range of motion and reduce pain in this area is through mobilization of acromioclavicular joint (ACJ). Research on this subject had not stressed the applicability of the technique on the presence of anatomical variations regarding ACJ. The aim of this study was to discuss the anatomical variations present on ACJ and the possible contribution of such structural variations on MWM from Mulligan concept on the ACJ. Disk of ACJ and acromion present important anatomical variation and can influence maneuver e/or mobilization of ACJ. After review the point that deserves attention is type of disk in ACJ. Principally joint disk type VIII that has two internal ligaments and probably keep the ACJ with reduced mobility. Although, the MWM concept has focus in symptoms and functional qualitative outcomes, the MWM’s application in ACJ has a strong discussion about anatomical variation. This way, the hypotheses of difficulties and possible contraindications for MWM should be on joint disk type VIII and presence of os acromiale. Hence, anatomical variations and their influences on the application of manual therapy techniques may enlighten the direction of new discussion, especially on possible contraindications for MWM on ACJ.
weeks of treatment, before and after MWM, yielded no change in joint surfaces positioning despite the reported analgesia. This work suggested that others hypothesis related to joint physiology should be argued to explain the therapeutic effect of MWM. In fact, there is a poor understanding about hypalgesia and ROM increase due to the limited knowledge about the impact of MWM. In this context, the aim of this work is to discuss the implications of such variations on MWM technique. The work is divided in three-sections, as follows: ACJ surface anatomy; anatomical variations of ACJ (joint surface and articular disc); and Mulligan’s concept of MWM on ACJ anatomical varieties.

Anatomy of the Acromioclavicular Joint

The ACJ is a plane joint, composed by the union of the acromial extremity of clavicle and acromion, both covered by cartilage. It presents a low-resistant articular capsule covered by a synovial membrane and reinforced by the acromioclavicular ligament transversally disposed. The articular surfaces of the clavicle and acromion present variations both in size and orientation. Mulligan proposed the following classification (Figure 1):

- **Overriding**: overriding of the articular surface of clavicle on acromion articular surface;
- **Vertical**: articular surfaces of both acromion and clavicle are verticalized and at the same plane;
- **Underriding**: the lower border of the clavicle articular surface is under the upper border of the acromion;
- **Incongruous**: articular surfaces are incongruous due to: a) the clavicle overriding the acromion; b) there is no contact between clavicle and acromion; c) lower border of the clavicle is under the upper border of the acromion.

Anatomy of the Acromioclavicular Disk

Several authors reported the presence of a rudimental articular disk at the ACJ with variable occurrence and shape. Anatomical variations may occur at this structure; age, sex, biotype, functional activities and ethnic are factors related to such variations. The degenerative process of the ACJ increases with age and becomes faster after the fourth life decade. The articular surface is mainly composed by hyaline cartilage until the age of 17 years, changing its composition to fibrocartilage around 23 years-old. The anatomical variations of the articular disk are reported with relevant frequency of occurrence, but
its exact function remains unclear. The first description of such articular disk reports just a fibrous structure between the acromion and clavicle. Testut described eight fundamental anatomical variations of this articular disk:

- **Type I:** the fibrocartilage of the disk is disconnected from the revestment of the acromial joint surface; it is a part of the shaft with the upper portion of such revestment and presents no movement inside the articulation (Figure 2);
- **Type II:** Completely independent of the fibrocartilage of the acromion surface; presents a coin shape in which the basis corresponds to the upper acromioclavicular ligament (Figure 2);
- **Type III:** The fibrocartilage is connected to upper acromioclavicular ligament and the lower clavicular surface. The articular cavity is subdivided in two distinct cavities: a) medial cavity, between the meniscus and the clavicle; and b) lateral cavity, between the acromion and the meniscus (Figure 2);
- **Type IV:** this type also creates a complete separation in sagittal direction, departing from the superior acromioclavicular ligament to the inferior counterpart. Likewise type III, two cavities are present (Figure 2);
- **Type V:** The meniscus resembles the shape of a wall in the sagittal plane, with a centered orifice in the anteroposterior axis (Figure 3);
- **Type VI:** It is compounded by a double lamina. Each triangular laminae are fixed to the correspondent acromioclavicular ligament by their adherent border. The free borders correspond to the center of the articular cavity (Figure 3);
- **Type VII:** The meniscus is represented by strong, thick fibrocartilagenous laminae. This structure joins the acromion and clavicle, but there is no articular cavity (Figure 3);
- **Type VIII:** A thick fibrocartilagenous laminae connects the upper and lower acromioclavicular ligaments. Thus, a well-developed articular cavity is formed between the meniscus and the clavicle, and a non-developed articular cavity between the meniscus and acromion (Figure 3).

**Mulligan’s Concept of Mobilisation-With-Movement and the Acromioclavicular Joint**

The principle of mobilisation-with-movement (MWM) is founded on the conceptual model developed by Kalteborn. This technique promotes an accessory movement with passive mobilisation (glide) while the active movement is being executed by the patient. The glide can be performed in translational or rotational directions, and is applied on the perpendicular or parallel plane of the movement to be performed. The MWM technique is based on the positional failure theory, which states that misalignments of the articular surfaces cause articular dysfunctions. The objective of MWM is to correct the articular positional failure and allow the execution of physiological movements without pain, therefore increasing the ROM. Several clinical investigations of MWM tried to elucidate the mechanisms of reestablishment of the articular surfaces position and consequently articular function.

ACJ presents from 5° to 8° during arm elevation and 180° abduction, respectively. During this movement, the clavicle rotates 40° to 50° around the axis at the external extremity and glides in the anteroposterior plane. Those accessory movements are necessary to promote a posterior gliding of the articular surface of the clavicle and to elevate the acromion due to the upper rotation of the scapula during abduction. The MWM on the shoulder is applied with a single glide, which is sustained during the execution of the active movement. The glide is directed downwards at the middle clavicular portion. The lifting of the arm is executed fast on the frontal plane (Figure 4). This maneuver is indicated to patients that
Urist\textsuperscript{23} analyzed 100 shoulder radiographies and founded an approximate prevalence of 50\% of the overriding ACJ type (Figure 1). This result could be the starting point to propose inclusion/exclusion criteria for indication of MWM on the ACJ. Articular surfaces may change the glide kinematic during the maneuver. Subjects with the underrinding ACJ type may present an early approximation of the acromion and clavicle during the scapular rotation, limiting the gliding of articular surfaces with consequent unsuccessful MWM maneuver. It was not found reports on the prevalence of anatomical variations of the articular disk of the ACJ. The several types of articular disks must also be considered when using MWM on the shoulder. According to Testut\textsuperscript{27}, the type VII is remarkable since this ligament would increase the articular stability. Execution of MWM in patients with articular disk type VII may increase the tension on the interosseous ligament due to both clavicle stabilization and natural elevation of acromion.
Clinical commentary

Figure 4 – Intermediate position (90º mobilisation-with-movement on the abduction). Departing from this position acromioclavicular joint the patient executes the shoulder elevation.

Figure 5: Schematic representation of mobilisation-with-movement on the acromioclavicular joint and possible tensions on the anterior portion of articular capsule.
Clinical commentary

Figure 6: Os acromiale.

Figure 7: Morphological types of Acromion and facet articular positional. (a) square tip. (b) intermediate. (c) cobra.

square tip  intermediate  cobra

Depending on the grade of shoulder elevation and abduction, the tension and a possible disk dislocation could compromise articular physiology during MWM. Possible consequences include maintenance of pain and ROM, and lesion on the interosseous ligament. From another point of view, the rupture of the acromial portion of the interosseous ligament is also possible. The concomitant clavicle stabilization and scapular rotation during the shoulder lifting on MWM may imply a widening of the anterior articular aspects, increasing tension at the anterior portion of the articular capsule (Figure 5). The adherence of the articular disk with the upper and lower portions of the ACJ capsule may also influence the positional failure of ACJ and the respective application of MWM. Klimkiewicz et al. performed biomechanical analysis and reported significative effects on clavicular translation when the upper and lower acromioclavicular ligaments are injured. This result is in accordance with the study of Sellards that found that upper and lower acromioclavicular ligaments contribute with 56.1% and 24.9% for posterior stability of the ACJ, respectively. Other structures (acromioclavicular, coracoclavicular, and coracoacromial ligaments) also act as static stabilizers in synergy with the dynamic stabilizers (trapezius and deltoid muscles). Due to lack of information on the functional aspect of interosseous ligament and type VII articular
disk, our observations present characteristic limitations of cadaveric observational studies.

Moreover, the action of deltoid and trapezius muscles in the presence of the discus was not addressed in this study. We hypothesized that accessory movements would be restricted due to absence of articular cavity in type VII articular disk. The increased tension is not characterized between the type VII articular disk. The absence of articular cavity in the scapula (articular surface of ACJ is 5 to 10 mm posterior to the acromial anterior border), and b) cobra discus was not addressed in this study. We hypothesized that accessory movements would be restricted due to presence of the os acromiale. That ossification center appears around the age of 14-15 years and is completely closed on 25 years-old. The structural variations of the ACJ due to the os acromiale were not considered in this study.

Edelson & Taitz evaluated the morphology of the coracoacromial arch and identified three acromion types: a) square-tip (articular surface of ACJ is anterior to the apophysis); b) cobra (articular surface of ACJ is 5 to 10 mm posterior to the acromial anterior border), and c) intermediate (with characteristics between the two preceding groups). Based on this preliminary study, Gumina et al. pointed the relationship among the three types of acromion, the os acromiale, and painful complaints related to the shoulder. The relative position of the ACJ is considered one of the major factors for the presence of the os acromiale (Figure 7). Altogether, the results of Guima et al. and Testut suggest that the association of these two facts may influence the applicability, efficacy, and indication of the MWM on ACJ.

Descriptive anatomical studies represent a valid tool for the understanding of indications or contraindications of manipulative therapy. The study of the prevalence of anatomical variations, as well as the mechanisms of their identification on physical examination, is also needed on population level (including confounding variables, i.e., age, sex, and ethnic). Those knowledge would allow better resources for the indication of MWM for the treatment of positional failures of the shoulder, or any articulation under evaluation. According to recent literature and our observations, it is plausible to emphasize the image exams as a starting point to evaluate the ACJ treated with MWM.

Conclusion:

The analysis of the positional failure of the ACJ and the possible anatomical considerations can be identified, thus allowing a better understanding of the MWM effects, indications, and contraindications.

CONFLICTS OF INTEREST

None identified and/or declared.

References

Clinical commentary


