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EVALUATION OF SCAPULAR DYSKINESIA IN PATIENTS THAT UNDERWENT A LATARJET PROCEDURE

AVALIAÇÃO DA DISCINESIA ESCAPULAR EM PACIENTES SUBMETIDOS À CIRURGIA DE LATARJET

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ABSTRACT

Objective: To quantitatively assess the scapular movement of patients who underwent Latarjet surgery and to identify if they present scapular dyskinesia (SD), as well as correlate with the clinic state and the elevation degree of the shoulder. Methods: A cross-sectional study was carried out at the Movement Analysis Laboratory (LAM), at the Institute of Physical Activity and Sport Sciences, that quantitatively evaluated, using spherical retroreflective markers, the scapular movements of the control group (10 volunteers) and 22 patients (23 operated shoulders) that had been submitted to Latarjet surgery, between 2011 and 2016, with at least one year postoperative. The results of the control group were used as a parameter of normality and compared to those of the operated group. Posterior inclination, superior rotation, and medial rotation of the scapula were evaluated at angles of 60°, 90°, and 120° of elevation, both in ascending and descending phases. The statistical analysis used was the multivariate variance (MANOVA), comparing the right and left sides of the control group and, subsequently, the control group with the postoperative group (p = 0.05 in all tests). Results: When comparing the mean of the results of the quantitative evaluation of the control group with the operated group, no statistically significant differences were found between the two groups and between the dominant and non-dominant sides of the control group. Conclusion: Latarjet surgery does not cause SD, although there are alterations in some plane of the scapular movements in the ascending and/or descending phase. ***Level of Evidence III, Retrospective Comparative Study.***

Keywords: Dyskinesias. Joint Instability. Scapula.

RESUMO

Objetivo: Avaliar, de forma quantitativa, o movimento escapular dos pacientes submetidos à cirurgia de Latarjet e identificar se apresentam discinesia escapular (DE). Além disso, correlacionar com a clínica e com o grau de elevação do ombro. Método: Estudo transversal realizado no Laboratório de Análise do Movimento (LAM), no Instituto de Ciências da Atividade Física e Esporte que avaliou de forma quantitativa, utilizando marcadores retro-refletivos esféricos, os movimentos escapulares do grupo controle (10 voluntários) e 22 pacientes (23 ombros operados), submetidos à cirurgia de Latarjet, entre os anos de 2011 e 2016, com pelo menos um ano de pós-operatório. Foram utilizados os resultados do grupo controle como parâmetro de normalidade e posteriormente comparados aos do grupo de pacientes operados. Avaliadas a inclinação posterior, rotação superior e rotação medial das escápulas nos ângulos de 60°, 90° e 120° de elevação, tanto na fase ascendente quanto na descendente. A análise estatística utilizada foi a multivariada da variância (MANOVA) comparando os lados direito e esquerdo do grupo controle e posteriormente o grupo controle com o grupo pós-operatório (p = 0,05 em todos os testes). Resultados: Ao compararmos a média dos resultados da avaliação quantitativa do grupo controle com o grupo dos operados, não foram evidenciadas diferenças estatisticamente significativas entre os dois grupos, assim como os lados dominante e o não dominante do grupo controle. Conclusão: A cirurgia de Latarjet não causa DE, apesar de haver alterações em algum plano dos movimentos escapulares na fase ascendente e/ou descendente. ***Nível de Evidência III, Estudo Retrospectivo Comparativo.***

Descritores: *Discinesias. Instabilidade Articular. Escápula.*

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INTRODUCTION

The scapula is essential for the proper functioning of the upper limb.[1] Its posterior position to the costal arches forms a pseudoarticulation controlled by muscles that either originate or insert themselves in this bone[2] and performs as a stable platform for the functioning

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The study was conducted at Grupo de Cirurgia de Ombro e Cotovelo, Departamento de Ortopedia e Traumatologia, Faculdade de Ciências Médicas da Santa Casa de São Paulo and Laboratório de Análise do Movimento, Instituto de Ciências da Atividade Física e Esporte, Universidade Cruzeiro do Sul.
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of the muscles of the scapular waist, promoting a kinematic balance in three planes, allowing the humerus to move efficiently.[3] The three planes of movements of the scapula are: coronal, in which the upper and lower rotation of the scapula occurs; axial, in which lateral and medial rotations occur; and sagittal, in which anterior and posterior inclinations occur.[4]

Kibler and Sciascia[5] determines as scapular dyskinesia (SD) any change in scapula movement, regardless of the cause. The dynamic alteration of scapular control is present in 67-100% of athletes with shoulder alterations, but are often asymptomatic.[6] The term SD is very generic and any change in the proper functioning of the shoulder girdle may be the cause of the alteration, such as muscle fatigue, neurological dysfunction, postural changes, diseases of the glenohumeral joint (instability, labial lesions, impact syndrome, rotator cuff tendinitis, and adhesive capsulitis), or as a response to muscle inhibition due to a painful stimulus.[7,8] The association between SD and shoulder pathology is uncertain, since the relationship between cause and effect is still unclear.[9]

The Latarjet surgery consists in performing permanent disinsertion of the pectoralis minor muscle tendon, of the medial part of the coracoid process, as well as the coracoacromial and coracohumeral ligaments, followed by an osteotomy and transfer of part of the coracoid process, together with the short head of the biceps brachial muscle and the coracobrachialis muscle, to the anteroinferior edge of the glenoid cavity, securing it with two screws parallel to the articular surface.[10] This is one of the most popular techniques for the treatment of shoulder instability, with good and excellent results in 82.7% of cases.[11] It is considered a non-anatomical technique and is possibly associated with the alteration of the position and motricity of the scapula, evolving to an SD.[12]

Cerciello et al.[13] were the first to investigate the effects of the Latarjet surgery in the scapula positioning, using computed tomography images. Currently, several methods are used for scapular evaluation, including qualitative and quantitative methods. Qualitative scans are simpler to perform, they are based on an inspection from the patient's back while they make repeated movements of elevation of the upper limbs as the examiner observes for any indications of SD.[14] Quantitative methods are more reliable than qualitative ones.[15] Although complex and costly, they offer a more objective and accurate way to evaluate the movements of the scapula in the three planes.[16] The insertion of intracortical pins associated with an electromagnetic device is evidently the most accurate; however, it is an invasive and painful method.[16] Other noninvasive methods, based on optical or electromagnetic tracking devices, have been developed to analyze scapula movement and have been used for diagnostic and evaluation purposes.[17,18] In this study, we used the method developed by Salvia et al.[19] which consists of capturing, with special cameras, spherical retroreflective markers fixed on the skin in specific anatomical references in the trunk and upper limbs. We believe that patients in the postoperative period of Latarjet surgery may develop SD. Our study aims to quantitatively evaluate the scapular movement of these patients, identify patients with SD, and correlate with the clinical status and the elevation degree of the shoulder.

MATERIAL AND METHODS

A cross-sectional study was conducted, in which the participants were divided into a control group and a group of operated patients. The control group had, as inclusion criteria, adults without any alteration, symptoms, or previous surgical procedures to the shoulders. The participants were subjected to qualitative evaluation by the method described by Roche et al.[14] Patients who did not have SD according to this method were included in the control group, totaling 10 participants (20 shoulders). The quantitative evaluation of these were then performed by the method developed by Salvia et al.,[19] with the standard deviation of these results as parameters of normality. In this group, six men and four women were evaluated, with a mean age of 28.5 years, ranging from 21 to 54 years. All 10 patients were right-handed and showed no statistically significant difference between the dominant and non-dominant sides.

In the operated group, 23 shoulders of 22 patients were included, all with more than one year of Latarjet surgery, performed between 2011 and 2016. These patients were referred to the Movement Analysis Laboratory (LAM), at the Institute of Physical Activity and Sport Sciences, Universidade Cruzeiro do Sul, for evaluation. Initially, 51 patients had undergone Latarjet surgery with the Shoulder and Elbow Group of Santa Casa de São Paulo. Of these, 26 patients attended LAM and underwent clinical and quantitative evaluation. Four patients were excluded: three of which had associated diseases that prevented the elevation of the upper limbs of at least 120° and one had sequela from head trauma and was not able to remain in an orthostatic position without assistance. One patient had both shoulders operated, totaling the 23 shoulders that entered the study. In the group of operated patients, 20 men and 2 women were evaluated, with a mean age of 35.7 years, ranging from 18 to 68 years. The mean postoperative time was three years and five months, ranging from six years and eight months to one year and three months. Only two patients presented postoperative pain and six remained with 90° abduction apprehension. Surgery was performed on the dominant side in 69.5% of the cases with a 156° postoperative mean movement arch, 57° lateral rotation, and medial rotation at the height of the tenth thoracic vertebra.

The quantitative evaluation was performed by means of spherical retroreflective markers fixed with appropriate adhesive tape in specific anatomical references in the trunk and upper limbs, following the recommendations of the International Society of Biomechanics.[20] To define the trunk segment, markers were fixed in the spinous process of the seventh cervical vertebra (C7), in the spinous process of the eighth thoracic vertebra (T8), in the jugular notch, and in the xiphoid process. The scapula was defined using markers at the lower and upper angles of the scapulae, at the posterior angle of the acromions, and in the coracoid processes. The lateral and medial epicondyle of the humerus and the more distal and lateral portion of the styloid processes of the radiuses and ulnas were used to define the segments of the arms and forearms. In addition to these markers, rigid sets with spherical retroreflective markers (*clusters*) were fixed with appropriate adhesive tape in the flattest region of the acromions and between the markers of C7 and T8, and with elastic band on the side of the arms (Figure 1).

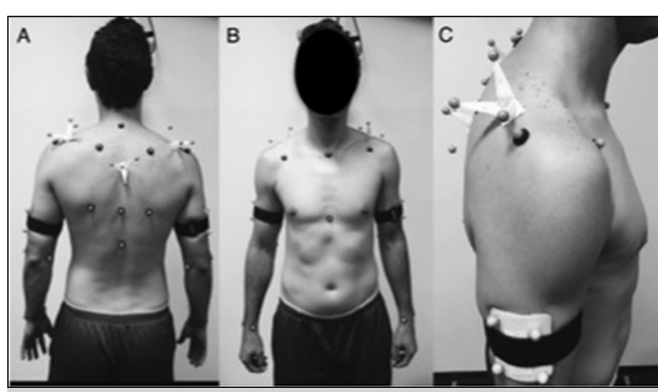

Figure 1. Arrangement of spherical retroreflective markers (dark base) and clusters (light base).

A: posterior view; B: anterior view; C: side view.

The three-dimensional recording of all markers was performed by eight special cameras (Vicon, Inc.), controlled by a specific unit (Giganet Lab Unit, Vicon, Inc.) that allows the synchronization of these cameras and sends the acquired signals to a computer via a specific computer program (Nexus, Vicon, Inc.). Initially, data were collected from the participants in orthostatic, neutral, and static position to record the reference position. The participants were then subjected to the dynamic part of the evaluation, performing unilateral circumduction movements to estimate the articulation center of the shoulders. Subsequently, with the upper limbs close to the body, following verbal command, they performed six repetitions of maximum elevation and return to the initial position in a comfortable time interval, ranging between three and five seconds. The first elevation for each patient was discarded and the last five were considered. The posterior inclination, upper rotation, and medial rotation of the scapulae (Figure 2) were evaluated at the angles of 60°, 90°, and 120° elevation, both in the ascending and descending phase.

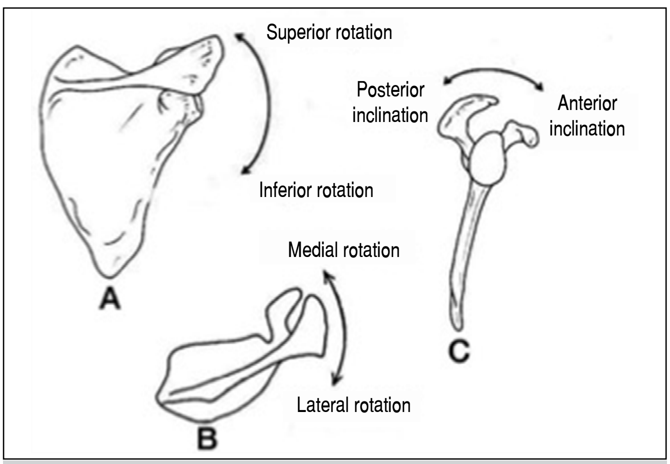

Figure 2. Scapular movements in all three planes.
A: coronal plane; B: axial plane; C: sagittal plane.

The data acquired during the evaluations were reconstructed in the Nexus program (Vicon, Inc.), and the trajectories of each spherical retro-reflective marker were stored for further analysis in the MotionMonitor (Innovative Sports Training, Inc.) and Matlab (Math Works, Inc.) programs.[21]

The rotations in the three planes of movement of the right and left scapular thoracic joint were calculated by Euler angles representations and following the convection recommended by Van Der Helm[22] and Wu et al.[20]

The statistical treatment of the data was performed using multivariate analysis of variance (MANOVA) to verify possible differences between the right and left sides of the control group and later to compare the control group with the postoperative group. The significance level was maintained at $p = 0.05$ and all tests were conducted in the *Statistical Package for the Social Sciences* program (SPSS Inc, IBM Company, Chicago, IL, USA).

The study was approved by the Research Ethics Committee (CAEE: 73695317.4.0000.5479) and does not present a conflict of interest.

RESULTS

Figure 3 shows the results used as parameters of normality, which were defined by the mean of the five attempts considered for the 10 patients (20 shoulders) of the control group, after comparing the values of the dominant side with the non-dominant side (no statistically significant differences were found). It is important to highlight that the values shown in Figure 3 refer to the degrees of inclination of the scapula in its three movement planes. Zero angulation represents the neutral position of the scapula; the positive values represent the anterior slope, lateral rotation, and superior rotation; and the negative values represent the posterior slope, medial rotation, and lower rotation, as shown in Figure 2.

When comparing the mean of the results of the quantitative evaluation of the control group with the postoperative group, for the elevations angles of 60°, 90°, and 120°, both in the ascending and descending phase, it was found that there was no statistically significant difference between the two groups; therefore, patients who underwent the surgical procedure were within the normality interval determined by the control group, as shown in Figure 4.

During the qualitative evaluation, SD was observed in 52.1%, totaling 16 patients in the operated group. The quantitative results of

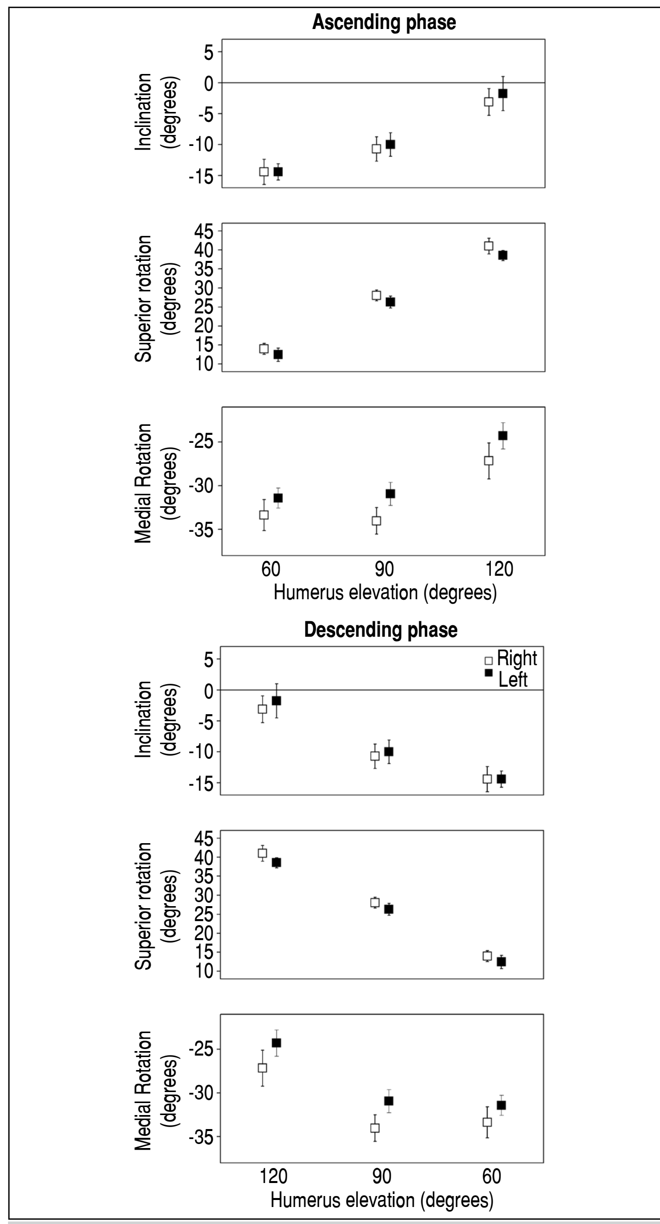

Figure 3. Mean (± standard error) of the inclination, upper rotation, and medial rotation of the scapula relative to the trunk during the ascending (left) and descending (right) phases of the shoulder elevation movement to the right (white squares) and left (black squares) sides of the control group participants.

these patients were compared with the those of the control group, no statistically significant differences were seen between both groups. In the individual quantitative evaluation of these 16 patients, we observed that seven (43.75%) presented values outside the standard deviation of normality (showing acceptable variance for more and for less, from the mean of the results), as determined by the control group, at some point in the ascending and/or descending phase. However, only one patient presented results outside the standard deviation in the three measurement angles, in both the ascending and descending phase, and another patient in the three angles of the descending phase.

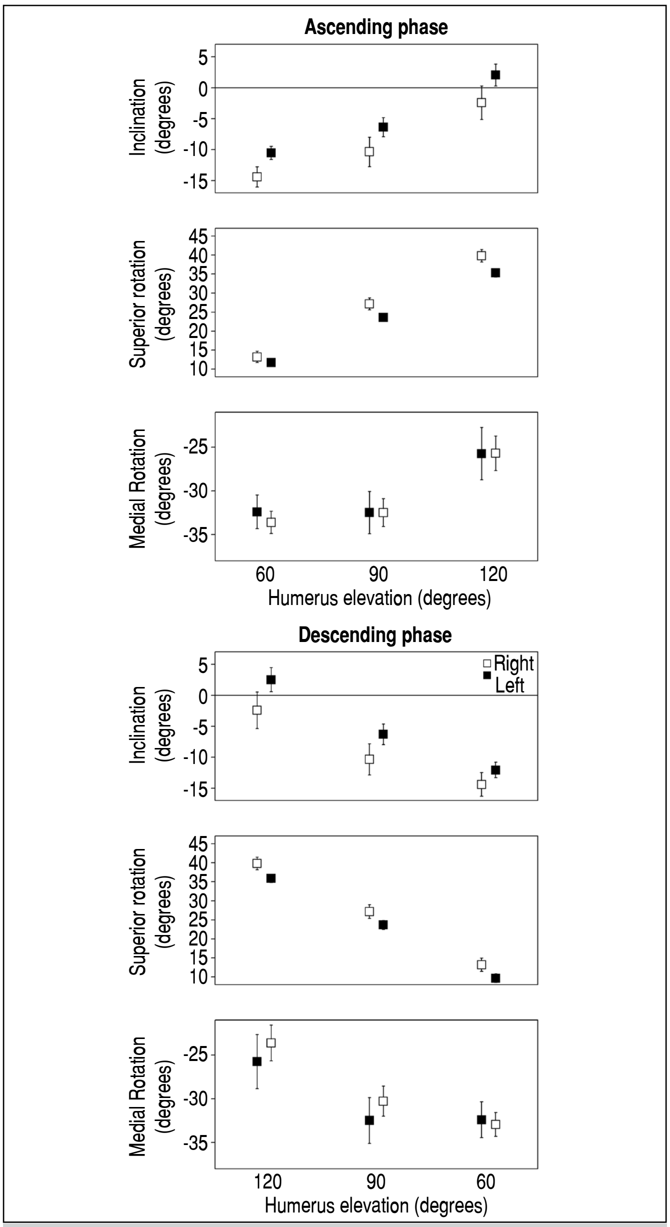

Figure 4. Mean (± standard error) of the inclination, upper rotation, and medial rotation of the scapula relative to the trunk during the ascending (left) and descending (right) phases of the shoulder elevation movement. Control group (white squares) and operated group (black squares).

DISCUSSION

One of the greatest difficulties in evaluating SD is the subjectivity of the tests. Studies evaluating the intra- and inter-observer results of static, radiographic, and recorded clinical examination tests, i.e., in qualitative ways, concluded that the reproducibility of the results is poor or unsatisfactory.[15,16]

The difficulty of performing a precise and reproducible measurement by qualitative methods can be due to the lack of standardization on scapular positioning in healthy individuals during rest; of a method that has clinical application, capable of providing measures related to the actual scapular kinematics; and lack of standardization in the nomenclature used to describe movements, plans, and axes.[23]

When we survey the literature for the existence of SD after the Latarjet surgery, we found divergences in the results. Burkhart et al.[24] concluded that Latarjet surgery does not alter the movement of the scapula; Cerciello et al.[13] concluded that SD occurs in the first weeks, but the patients no longer present changes in scapular movements after six months postoperatively; and Carbone et al.[12] concluded that 25% of the patients had SD, with clinical repercussions.

The mean results of our study showed no statistically significant difference in scapular movements between the control group and the operated group. However, when we made an individual evaluation of each operated patient, separating the results of each plane from the scapular movements, in both the ascending and descending phase, we observed that all presented values outside the standard deviation in at least one plane of the scapular movements at some point in the ascending and/or descending phase. These results, however, were not sufficient to significantly alter the balance of forces during the movement of the scapula.

Only two patients in the operated group had divergent results from the others. One patient (4.3%) presented results outside the normality pattern determined by the control group in two planes of scapula movement, both in the ascending and descending phase, in the three measurement angles. Another patient obtained similar results, but only in the descending phase. When the means of the results were made, it was observed that these alterations were not sufficient to lead to an imbalance of the scapular movement and consequently to a SD. Both patients returned to their previous activities without limitations, pain complaints, or recurrences of glenohumeral dislocation.

As a limiting factor of the method, we highlight the difficulty, during clinical evaluation, to evaluate SD in overweight patients, since the adipose layer made it difficult to adequately visualize scapular movements. Patients who practiced sports and had a more developed muscle mass were also more difficult to evaluate SD.

We highlight the importance of this study as the pioneer in quantitatively evaluating scapular movements after Latarjet surgery. Another limitation is that we did not evaluate the movement and the shoulder position prior to the operation. Since SD could be present in some patients before surgery, a pre-surgery evaluation could have avoided this limitation.

CONCLUSION

The Latarjet surgery does not cause SD, although there are changes in some plane of the scapular movements in the ascending and/or descending phase. In this case, a compensation mechanism occurs by rebalancing the forces that act during the movements of the scapula, preventing the patient from presenting SD.

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