



## RESEARCH ARTICLE

# Damage to the Rotator Cuff of the Shoulder and Tendon of the Long Biceps Head during Chronic Posttraumatic Instability of the Shoulder Joint

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## Abstract

**Aim:** The aim of our study was to study the frequency and relationship of damage to the rotational cuff of the shoulder and tendon of the long biceps head in the post-traumatic instability of the tendons of the long biceps head.

**Objective:** By analyzing the data of clinical and instrumental examination methods, determine and describe the main damage options for the rotator cuff of the shoulder and tendon of the long head of the biceps in the post-traumatic instability of the shoulder joint by determining the frequency and nature of their friendly damage.

## Introduction

The dislocation of a shoulder joint according to the data of different authors in the population accounts from 8.2 to 44 cases per 100,000 person-years, here-with, traumatic dislocations of a shoulder joint account for up to 1.7% of all injuries of the skeleton [1-3]. Athletes engaged in contact sports, military personnel and persons of heavy physical labor [1,4-6] suffer from this disease most often. Some authors point out that in a group with chronic instability of a shoulder joint, patient under 40 years make up 96% [7,8]. Thus, the disease affects the most able-bodied and socially active contingent of the population, this determines its practical, economic and social significance.

According to modern biomechanical concepts, the stability of a shoulder joint is ensured by the stabilizers [9,10], which are static (the shape and orientation of the

glenoid, articular lip, etc.) and dynamic stabilizers (elements of the rotator apparatus and tendons of the long biceps head). To date, quite a lot of studies have been accumulated, indicating close relationship in the provision of the function and stability of the shoulder joint of such anatomical formations as the tendon of the long bicep head (TLHB) and the rotator cuff of the shoulder (RC) [9-11]. These soft-tissue elements, according to many authors, belong to the leading dynamic stabilizers. Despite the findings on shoulder biomechanics, orthopedic practitioners often do not take into account the results of these studies when analyzing the causes of post-traumatic instability, planning and performing surgical interventions. Even at the timely diagnosis of lesions in the case of surgical treatment, they are not eliminated, the techniques developed in the early and middle of the 20<sup>th</sup> century are still used, such as the operation of Bankart and Latarje, which, in our opinion, determines a large percentage of failures in the treatment of instability of the shoulder joint, reaching in some cases 67% [12,13].

The pathology of a shoulder joint, associated with the defeat of the RC and its combination with changes from the TLHB, is the subject of active research [11,12,14,15]. The description of these injuries is the subject of many studies published in modern literature. However, their systematization and interconnection within the framework of modern views on the biomechanics of stability and joint function are, in our view, insufficiently reflected.



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The given paper reflects the authors' experience in performing complex diagnostics of damage of the elements of the "rotator- bicipital complex" (RBC) in chronic post-traumatic instability of a shoulder joint [16,17].

## Materials and Methods

We analyzed the results of a survey of 290 patients who applied for admission from 2004 till 2017. The study was agreed with the ethics commissions on the basis of medical institutions and had a continuous open character. The study, therefore, was multicenter (3 centers). The statistical totality was not continuous (selective) in nature and was carried out on the basis of criteria determining the patient's consent to the use of the proposed diagnostic and therapeutic approaches, the anamnestic connection of the identified pathology with the injury, the absence of pronounced damage from the static joint stabilizers, the availability of further observation (more described in groups). The work used historical, clinical, instrumental, statistical research methods. The methodological and theoretical basis was the basic research in the field of traumatology and orthopedics and the works of famous domestic and foreign scientists. The study of clinical data was carried out using retro-and prospective studies. The exclusion criteria of the study were as follows: sizes of an impression defect of type 2 or more according to the Rowe classification, connective tissue dysplasia syndrome, proven mental and behavioral disorders of patients diagnosed by a specialist as a psychiatrist, pregnancy regardless of the timing, established syndrome of dependence on alcohol and drugs, symptomatic and primary epilepsy with the presence of seizures and attacks, concomitant diseases in decompensation stage.

In the structure of patients, men predominated - 187 (64.48%). In the study group, the minimum age was 16-years-old, and the maximum age was 88-years-old. The mean age of the study group was  $46.1 \pm 12.5$  year,  $M \pm SE$ . The distribution by age was as follows: from 16 to 65 years - 235 (81.03%), over 65 years - 55 (18.97%). When forming approaches to diagnosing and describing the damages arising from instability from the RBC position, we divided it into 3 types: Horizontal, vertical, combined. To determine the extent and nature of damage of RBC elements and to assess the size of the defect in preoperative examination, radiography and MRI were performed for all patients (100%), ultrasound - 59 (20.3%). MRI made it possible not only to clarify the diagnosis, the size of the impression, but also to plan the scope of the forthcoming surgical intervention. Ultrasonography was performed of patients with suspected co-instability of TLHB.

With positive tests for vertical instability of the shoulder (sulcus test), patients were assigned to subgroup 1, to the second subgroup when a positive test for horizontal instability (translational test) of the shoulder was detected, and subgroup 3 to identify 2 positive

tests. Based on the results of the diagnostic activities, all patients were divided into 3 subgroups: 1 subgroup (n = 15) - patients with prevailing vertical component of instability, 2 subgroups (n = 62) - with prevailing horizontal component and 3 subgroups (n = 213) - with combined version of instability. Each variant of instability was accompanied by characteristic changes in certain areas of the shoulder joint, which we distributed by sector, in analogy with the classification of Habermeyer P (2006): Sector 1 - tendon of the scapular muscle, extraarticular part of the biceps tendon, bicipital furrow; sector 2 - rotator cuff interval, articular part of the tendon of the long biceps head, tendons of the supraspinatus; sector 3 - tendon of the sub access, the tendon of the small round muscle.

## Results and Debates

In the analysis of MRI data and subsequent arthroscopy of the joint, the patients of subgroup 1 showed damage to the rotator cuff of the shoulder, the bicipital element, and an impression defect of the head of the humerus, localized in the region of the superior facet of the large tubercle, not exceeding in size 1 the Rowe type in all cases. As can be seen from the table, the methods of MRI and arthroscopy are the most sensitive in the diagnosis of injuries to rotator and intraarticular injuries of the bicipital element. In the diagnosis of extraarticular changes from the biceps side, the most valuable in the diagnostic plan is MRI and ultrasonography (allows dynamic investigation of instability).

When examining the patients of subgroup 1, SLAP damage was identified, signs of lateral instability of the tendon of the long biceps head, damage to the rotator element and pulley were identified in all cases.

Changes on the part of the rotator element in group 1 represented a complete or partial separation from the attachment site in the zone of the supraspinatus and stretching the tendons of the subscapular and subacute muscles in the lower part. The lesions of the extraarticular part of the biceps in sector 1 were lateral instability in four patients' cases.

The pattern of the revealed lesions in the patients of the 2<sup>nd</sup> subgroup had significant differences from 1 subgroup. SLAP damage according to MRI data was detected at 43 (69.4%) patients, with Snyder type 1 and type 2 lesions being the most common among those subjected to arthroscopy. A significant difference was observed in the nature of damage to the rotator apparatus.

MRI and arthroscopic picture identify at patients in this subgroup partial or total damage to the cicatricial lengthening of the tendon of the subscapularis muscle, the gap between the humeral head in the area of the greater tuberosity infraspinatus muscles and partial damage to the anterior supraspinatus muscle instability TLHB different types with a break pulley, and 15 cases - the Rotator cuff interval break.

Changes most characteristic instability of the shoulder joint with predominant horizontal component, localized at the 1<sup>st</sup> and 3<sup>rd</sup> sectors of Habermeyer. At horizontal type of instability (anterior variant), damage and cicatricial lengthening of the tendon of the scapular muscle were detected, a detachment in the zone of the large tubercle of the subacute muscle and an overgrowth of the anterior sections of the subscapular muscle, instability of TLHB of different types, and in some cases, intertotal interval fracture, articular lip damage in the anterior department, SLAP-damage. In the forward version, a partial detachment of the anterior portion of the tendon of the scapular muscle and pulley rupture, SLAP-lesion, TLHB lateral instability, the Bankart injury in the anterior part of the joint are formed, the impression defect is localized in the zone of the large tubercle along the posterior surface.

The most numerous was group 3 of the patients with combined instability of the shoulder joint, where a combination of lesions was identified by sector, depending on the prevalence of vertical or horizontal instability components. A significant difference was observed in the nature of damage of the rotator apparatus.

MRI and arthroscopic picture revealed partial cicatricial lengthening in these patients or complete damage to the tendon of the scapular muscle, detachment from the head of the humerus in the zone of the large lump of the subacute muscle and partial damage to the forelimbs of the supraspinatus, instability of TLHB of different types with rupture of pulley, and also in some cases, the intertotal interval is broken. Damage to pulley is noted in all cases.

Patients with combined instability of the shoulder joint are most common. Methanogenesis of damage is caused by the direction of dislocation and represents a combination of damage by sector, depending on the severity of the vertical or horizontal components of instability. The impression defect of the head of the humerus, as a rule, was located in the posterior surface of the large tubercle. In the most frequent variant of the anterior dislocation, injury of the tendon of the subscapular muscle in its lower part was noted, but it was more often less marked than with vertical instability, the tendon of the supraspinatus and subacute muscle was damaged in the attachment zone to the superior facet of the large tubercle with the transition to its posterior part.

## Discussion

Thus, according to our ideas, which are supported by biomechanical studies of recent years, the rotator cuff of the shoulder and TLHB have a stabilizing impact on both the vertical and the horizontal components of the shoulder joint stability, varying depending on the position of the limbs, to a greater extent on its rotation and abduction. In the most frequent embodiment of the combined (anteroinferior dislocation) instability tendon

damage subscapularis muscle in its lower section occurs, though it is less obvious according to our observations, than when an isolated vertical component of instability, the supraspinatus tendon separates in the attachment zone to the upper facets of large hillocks with the transition to its back part. TLHB with this variant of dislocation undergoes maximum load at the zone of its attachment and, while stretching, quite often tears the holding device in the lateral department and the medial portion of the tendon of the supraspinatus, which leads to lateral instability of TLHB.

At embodiment instability with prevailing vertical component the following complex of lesions is typical: cicatricial elongation bottom of tendons subscapularis, infraspinatus and small round muscles partial separation over from the top facet greater tuberosity supraspinatus tendon, impression defect in the tendon area of the long head of the biceps, partial tear with cicatricial elongation and lateral dislocation of the latter, detachment of the joint lip in the lower segment.

The following damages are typical for the embodiment of instability with predominant horizontal component: at the front embodiment - partial separation front portion tendon subscapularis muscle rupture, damage pulley, SLAP, lateral instability TLHB damage Bankart and labrum in front of the joint section, impression defect localized in zone of the large tubercle on the posterior surface; in the back version - the damage was mirrored. In order to study the relationship between the lesions of the rotator and the bicipital RBC element in the whole population of patients (n = 512), a statistical analysis was performed using the D. Yul association coefficient. The analysis was based on an approach that determines the qualitative character of changes in the trait, in which, in case of damage in one of the sectors of the bicipital or rotator element, the trait received a grade of - 1, in the absence of damage -0. Structural changes on the part of the rotator element according to MRI data were detected in all 512 patients, bicipital 345. When assessing the relationship of nominal signs of damage to RBC elements using the D. Yul association coefficient, its value was 0.84 (p < 0.05). For a qualitative assessment of the strength of the connection when using the D. Yul association coefficient, the Chedoke scale was used, which determined this value as a strong, direct, statistically significant relationship.

## Conclusion

Chronic posttraumatic instability of the shoulder joint is the most common of people of working age, which determines the social significance of this problem. Damage to the rotator cuff of the shoulder and tendon of the long biceps head in different departments is revealed in all cases of instability of the shoulder joint. Methanogenesis, underlying the occurrence of damage, allows us to identify 3 main clinical types of posttraumatic instability of a shoulder joint with characteristic

anatomy-morphological manifestations. The damage of the rotator apparatus and the tendons of the long biceps head noted during this observation determined our surgical treatment tactics and formed the basis of the new methods of treatment developed by the authors (patents RB No. 20959, 9763, 20571, 9732 and Eurasian patent No. 201600049 A1).

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