

CHRONIC INSTABILITY OF THE SHOULDER JOINT: A HISTORICAL OVERVIEW AND A TRENDS IN THE DEVELOPMENT OF SURGICAL TREATMENT

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Summary

The analysis of literature data, which made it possible to characterize the main modern stages in the development and establishment of diagnosis and treatment of shoulder joint instability, was carried out. The purpose of this review was to highlight the main directions in the treatment of chronic instability of the shoulder joint and identify problematic issues requiring further scientific research. The main results of observation of patients undergoing various types of arthroscopic treatment are presented. The modern level of diagnostics makes it possible to accurately determine the indications for surgical treatment. Isolation of all possible links of pathogenesis and individual preoperative planning are the main tasks of preventing recurrence of instability.

Key words: developmental history, shoulder joint instability, surgical treatment, arthroscopy, new shoulder - scapular ligament.

Introduction

During the second half of the 20th century, the term "chronic post-traumatic instability" in English-speaking countries is understood not only as a repetitive dislocation of the shoulder, but also as a specific pathological condition leading to disruption of the normal function of the joint.

However, in the domestic literature for a long time, the term "habitual shoulder dislocation" has been used, in particular, the 1984 Handbook of Traumatology says that "a habitual shoulder dislocation is a repeated dislocation of the shoulder without significant traumatic violence, with certain movements and is considered as a complication of acute traumatic dislocation ". In our opinion, the concept of "instability" is broader and reflects the variety of causes leading to repeated shoulder dislocations.

Formation of ideas about the essence of instability of the shoulder joint and attempts to influence the pathological process, according to the famous historian of medicine M.B. Mirsky (2000), began around the 10th century AD, when the famous Persian physician Razi (Abu Bakr Muhammad ibn Zakaria ar-Razi, 865-925 AD) first mentioned that "dislocation" in the shoulder joint under unfavorable conditions, it can not only repeat itself, but also go "... into a painful and psychologically difficult obsessive state ...", and the selection of a method of sanitation to it "... requires special zeal and remarkable knowledge of the anatomical essence of a person ..." (1).

Towards the end of the 18th century, the famous German surgeon August Gottlieb Richter (1742–1812), the author of a 7-volume manual on surgery, in his monumental work states only the essence of the severity of the condition described and the impotence of conservative measures to cure "... suffering of the shoulder joint ..." (2, 3). Nevertheless, despite the poor development of surgical anatomy, for several centuries the main method of "dealing" with damage to any large joints remained external immobilization in its various variants (Guy de Chaoliak, 1348; Desot P., 1767; Hendrichs R., 1814 ; Basov V.A., 1842; MacLeod N., 1886 - cited by IM Kvetny (2001) [9]). M.B. Mirsky in his famous work in 2000. Indicates that some authors (Mukhin E.O., 1806; Ralitsky I.V., 1861; Turner G.I., 1925), as dissatisfaction with the known methods of fixing the upper limb arises, began to offer its (fixation) improvement, including taking into account the numerous functional features of the shoulder joint and for "... the prospect of an early

restoration of a working hand ... ". Rapid development of anatomical research

man both at the turn of the XVIII-XIX centuries and throughout the entire XIX century, led to the fact that in the currently available medical archives accumulated a solid number of treatises on the surgical anatomy of large joints (Zagorsky P.A., 1802; Bush I .F., 1807; Pirogov N.I., 1837; Inozemtsev F.I., 1840; Buyalsky I.V., 1844), including the shoulder joint (Mukhin E.O., 1806; Pirogov N.I. ., 1852).

Literature review

Almost all of the mentioned researchers, as they delved into functional anatomy, began to offer explanations for some pathological conditions (2), including "... a complex of chronic ruptures of the ligamentous and capsular structures of the shoulder girdle and shoulder region, leading to a regular loss of stability in it ...". The most in-depth studies in the field of normal and pathological anatomy of the shoulder joint are presented in a series of works by J. Cleland (1868), A. Gerster (1884), W. Browning (1891), J.T. Lynn (1893), Ricard T. (1894), R. Russ (1906) only at the turn of the XIX – X centuries. The same surgeons made the first attempts to stabilize the head of the shoulder joint with different results in terms of the method's survival, and the number of operated patients remained extremely small. They also postulated the need for a more in-depth study of the pathological anatomy of chronic instability of the shoulder joint.

This, in our opinion, served as an incentive for a new generation of general surgeons at the beginning of the 20th century to develop surgical anatomy (4,5).

At the turn of the 1910-1920s. Most general surgeons had to admit the insufficient effectiveness of the conservative method of managing such patients, which is dominant in medicine, and the growing new specialty "orthopedic surgery" began to demonstrate high efficiency of narrowly targeted surgical procedures on the shoulder joint (4,5,6). One of the clearest proofs of the success of orthopedists in the area described is dated 1917. It was then that the French orthopedist Eden published a work in which he presented a new and effective method of surgical intervention for post-traumatic instability of the shoulder joint. He operated on a large group of patients who underwent arthrotomy of the shoulder joint from the anterior approach with transection of the subscapularis muscle. After that, the author took an autograft from the tibial crest in the form of a plate and tightly implanted (impacted) it into a depression formed parallel to the joint space in the antero-inferior part of the scapula neck. The aim of the presented operation was to change the angle of anteversion of the articular surface of the scapula closer to the neutral position and at the same time to partially compensate for the lost congruence. In this case, the outer end of the graft should have protruded 1–1.5 cm lateral to the plane of the joint space, thus creating an additional bone-cicatricial obstacle for dislocation of the humeral head (7). Thus, Eden not only laid the foundation for reconstructive surgery for the usual dislocation of the shoulder, but also formed the prerequisites for the development of a whole group of interventions based on free bone grafting. Numerous followers of Eden in the period from the mid-20s. to the end of the 50s. of the last century have repeatedly modified his methodology (8,9,10). For example, one of them, described by the Frenchman F. Andina in 1968, consists in the fact that the graft taken from the wing of the ilium is given the shape of a "yacht keel", which is inserted with a finely sharpened flat end in a similarly formed gap in the neck of the scapula (11). However, the widespread use of the Eden-Andin surgical technique was held back by two important points: first, the need to give the graft a complex geometric shape with a wide and thin stem. This, along with time expenditures, significantly hampered its reliable fixation in the cleft of the glenoid cavity of the scapula. Second, there is an obvious limitation in the ability of the graft to perform a full-fledged barrier function due to the preservation of a minimal "step" that did not provide ideal congruence and did not protect the shoulder head from subluxation (12). Other authors used allograft for similar purposes (13, 14), while achieving similar results, comparable in terms of graft resorption and the number of postoperative relapses. It should be noted that the development of the mentioned methods was significantly limited by the lack of high-quality, compact internal metal fixators (15). Dissatisfaction with the stability of fixation of any displaced tissues gives impetus to the development and implementation of endofixers of various shapes and materials used (16).

Thus, the above authors put in the "piggy bank" of bone transplantation with repeated shoulder dislocation about 50 techniques. In parallel with the development of bone transplantation from about the middle of the 40s of the XX century, we noted the release of a series of publications on soft tissue autotransplantation in the shoulder joint. So H. Osmond-Clarke et al. in 1948 (17) published a joint study in which they proposed a technique for stabilizing the shoulder joint, which was based on tendon-muscle plasty of the periarticular tissues of the shoulder joint using the Putti-Platt technique. The essence of the operation was to strengthen the anterior part of the shoulder joint due to the tension of the joint capsule and the

subscapularis muscle between the anterior surface of the scapula and the base of the small tubercle of the humerus. Thus, in our opinion and the opinion of contemporaries, a powerful impetus was given to the development of a new branch of surgery for habitual shoulder dislocation - tendon-muscle plasty of the shoulder joint with periarticular (local) tissues (Weinstein VG, 1946; Khitrov FM, 1947; Hark FW, 1948; Henderson MS, 1949; Eigenthaler L., 1950; Boychev B., 1961; Kaplan A.V., 1979). It should be noted that only half of the authors mentioned in their works noted the shortcomings and traumatism of bone grafting, using them as theoretical prerequisites to justify their methods. The remaining half of the authors, giving an overview of the surgical treatment of habitual dislocation, ignored the existence of bone grafting as such, thereby indicating the shortcomings of the literature on the problem of that time. Active introduction of this group of interventions by the end of the 50s. of the last century, according to B. Boychev (1961), made it possible to single out from the general direction of surgical techniques two main trends that laid the foundation for the formation of independent subsections of surgery for shoulder dislocation (18).

The choice of the optimal surgical technique and the timing of its implementation for the treatment of chronic instability of the shoulder joint remains an urgent topic for discussion. The ongoing search for a relapse-free treatment has led to the fact that over the past century, about 200 methods and over 300 modifications of surgical treatment have been proposed (19). Depending on the point of application, existing surgical techniques can be conditionally divided into two main groups (20): 1) bone grafting of the shoulder joint (isolated or in combination with various types of tendon grafting (operations of Eden, Andin, Quadard, Wilmouth, Bristow, Bristow - Latarge) and others); plastic surgery with non-free bone-tendon grafts (methods of Sakha - Weber, Akhmedzyanov, Lange, etc.); 2) tendon-muscle plasty of the shoulder joint with periarticular (local) tissues (without violating the integrity of the displaced structures (Bankart, Krasnov, Friedland, Galeazzi, Khitrov, etc.); with partial or complete excision of the transposed periarticular tissues (Weinstein, Putti-Platt operations, Menguson, Andreev, Boychev, Sverdlov, Seidel, Gergolav, Geimanovich I, II, etc.)). These techniques have been tested and put into practice by hundreds of domestic and foreign scientists. However, as shown by numerous observations, none of them gave 100% effectiveness and no relapse. Since the introduction of shoulder arthroscopy for therapeutics, the arthroscopic lip fixation technique has undergone many revisions and improvements.

Described by L.L. Johnson in 1980, the technique (21) consisted in the use of retaining brackets and was proposed as an alternative to the open Bankart operation. In 1989 R.J. Hawkins (22) conducted a retrospective review of 50 patients who underwent this operation and found 16% relapse of relapses. He noted that one of the reasons for such a high percentage was non-compliance by patients with the terms of postoperative immobilization and violation of the regimen.

In a 1993 retrospective study by J. Lane and colleagues (23) of the treatment outcomes of 54 patients who underwent arthroscopic capsulorrhaphy for stabilization, 33% of relapses, 18.5% of repeated reconstructive surgeries and migration of staples, including to the area brachial plexus in 26% of cases. The arthroscopic transosseous suture technique was first described by Morgan and Bondenstab in 1987 (24). They observed 25 patients with anterior instability,

who were subjected to surgical treatment using a transosseous suture. The authors proposed the following technique: when damage to the glenoid lip is detected, the edge of the

glenoid is processed before bleeding for better increment of the scapula neck, the suture material is passed through the glenoid lip and glenoid from front to back using a modified pin, then the pin is used to pierce the lower humeral ligament. After a two-year follow-up, they reported that this technique was 100% effective and there was no relapse at all. Other researchers have tried to replicate their results with varying degrees of success. K.P. Benedetto and W. Glotzer (25) reported 31 relapse-free patients followed for 2 years, W.A. Grana et al. (26) followed 27 patients for over 3 years and identified 44% of dislocation recurrences. In 1998, Wiley and colleagues (27) used arthroscopic rivets to fix the elements of the severed capsule-labral complex. The rivet was developed as a metal device to anchor the severed lip and lower humeral ligament to the edge of the glenoid, which was removed after 4–6 weeks.

Orthopedists from the United States (Massachusetts) used cannulated devices (Suretac rivets) in 1995, which resolved after 4 weeks; fixation of the lower articular-humeral ligament was performed with two Suretac devices after preparation of the bleeding surface of the articular cavity edge (28, 29). The severed articular lip was also fixed with two additional rivets. C. Kartus et al (30), summarizing the results of using Suretac in 81 patients during 107 months of follow-up, reported relapses in 38% of cases.

The next technological advance in the treatment of anterior shoulder instability was suture anchors, first described and used by E.M. Wolf in 1993 (21), who reported only one case of relapse with their use in 50 operated patients. S.H. Kim and colleagues in 2003 (31), in a retrospective review of the results of anchor arthroscopies, evaluated the treatment outcomes in 167 patients. Relapses were recorded only in 4% of cases. Cole and Romeo (32) observed 45 athletes for 2 years, also operated on with anchors. They received 96% of good and excellent results, all athletes returned to contact sports. Among the Russian studies, which make it possible to judge the experience of using arthroscopic stabilization and the long-term results of arthroscopic treatment of shoulder joint instability, the observations of S.P. Mironov, S.V. Arkhipov should be noted. (33). He performed the following types of arthroscopic stabilization of the shoulder joint: 1. Arthroscopic fixation of the Bankart injury with transglenoid suture technique; 2. Arthroscopic stabilization of the shoulder joint using anchor fixators ("mini Rove, Mitek, FASTak"); 3. Arthroscopic stabilization of the shoulder joint using self-absorbable fixators ("Suretac", "Tissue Tak").

According to R.M. Tikhilova et al. (34), the effectiveness of the results of performing an arthroscopic suture of a damaged capsule using anchor fixators in 46 patients with anterior recurrent instability of the shoulder joint over a period from 6 months to 4 years was 93.5%.

According to V.M. Prokhorenko, S.M. Fomenko and colleagues (35) proposed the restoration of a bone defect in the glenoid with porous titanium nickelide printed on a 3D printer. According to V.V. Monastyreva et al. (36) proposed an open restoration of the glenoid bone defect with an iliac crest graft. And Dokolin S.Yu. (37) performed the same operation arthroscopically.

Arthroscopic technologies have also found applications in the treatment of multidirectional shoulder instability. Techniques such as arthroscopic movement of the inferior capsular shift (38), plication (reduction of the capsule volume by forming folds) (39), thermal and laser capsuloraphy (40, 41) are now effectively used when necessary. effects on the enlarged capsule of the shoulder joint. The arthroscopic technique "remplitting" (filling significant defects of the head of the humerus with elements of the posterior part of the capsule and the tendon of the

infraspinatus muscle) is also widely used worldwide in the treatment of Hill-Sachs injuries. B. Haviv et al. (42) followed 25 patients on average for 2 years, who underwent casulotenodesis

according to the remplitting technique, and in all cases noted positive results of surgical treatment, while M.J. Park and colleagues (43) reported relapses in three (15% of cases) out of 20 operated patients.

A number of studies have been devoted to a comparative analysis of the effectiveness of the open and arthroscopic technique of Bankart surgery. C. Fabbriani et al (44) followed 60 patients with isolated Bankart injury for 2 years. The authors showed the absence of relapses in both groups, but since the best range of motion in the operated joint in the long-term period was in the group of the arthroscopic anchor suture of the labrum, they concluded that there was no advantage of the open technique compared to the arthroscopic one. C.R. Bottoni and colleagues (45) studied 61 patients with anterior instability for 2 years, 29 of whom were operated using the open technique, and 32 - using the arthroscopic technique. They also did not find differences in the effectiveness of surgical treatment, evaluating the results on the SANE, SST, Rowe, WOSI scales, but noted the best results in the range of motion in the joint in patients of the arthroscopic group.

In order to strengthen the anterior wall of the shoulder joint in patients with chronic shoulder abnormalities until 2013 in the Samarkand branch of the Republican Specialized Scientific-Practical Medical Center of Traumatology and Orthopedics Krasnov A.F. and Sverdlov-Azizov surgical methods were used. The reason for such an approach to pathology was the lack of modern examination methods and the inability of surgeons to clearly visualize the pathological process in the shoulder joint. Since 2013, patients with shoulder joint instability have been initially rated according to the ISIS index. Patients with a score of 3 or less on the ISIS index underwent an MRI (magnetic resonance imaging) scan. Patients 3 and older underwent MSCT (multispiral computed tomography) examination. In patients with capsule-labral injuries, Bankart surgery was performed in an open manner until 2018. Since 2018, it has been performed by the arthroscopy method. Smith-Nephew Bioraptor anchors were used in the arthroscopic operation. Since 2014, the operation of stabilization of chronic instability with bone defect by the method of Latarjet has been launched. Starting in 2015, the following innovations were introduced to optimize Latarjet surgery and reduce intraoperative trauma:

1. 2/3 of the lateral part of the coracoid process was osteotomy and transplanted to the site of the glenoid defect. The advantage of this osteotomy is that a) the integrity of the m. Pectoralis minor and m. coracobrachialis that attach to the coracoid process was preserved and as a result n. musculocutaneus was not observed. b) at the same time in the received transplant the surface of the wound appeared.

2. Caput brevis m attached to the transplant after coracoplasty. The stake from the biceps tendon – muscle flap was removed, transosserrally sutured to a small tubercle of the humerus and a new shoulder - scapular ligament was formed.

Materials and research methods. From November 2015 to October 2020, in the Samarkand branch of the Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics, a study was carried out in 38 patients who were on inpatient examination, diagnosed with chronic post-traumatic anteromedial instability of the shoulder joint with a bone defect of the glenoid. The study group included 31 men and 7 women aged 15-44 years (mean

22.4 years). The inclusion criteria for the study were more than 20% glenoid bone defect. In 26 cases, the shoulder joint of the dominant hand was damaged, in three cases the stabilization was of a revision nature: in 2 patients after previously performed stabilization according to Sverdlov - Azizov, in one after stabilization according to Krasnov.

The size of the glenoid bone defect was assessed by 3D scans and averaged 22.8%. Most accurately and simply, you can calculate the size of the bone defect in the articular cavity of the scapula using the formula (by Sugaya H. 2003):

$$b \text{ (defect size)} / A \text{ (glenoid diameter)} \times 100 = \text{defect size in percent.}$$

Defects of the glenoid are divided into 3 stages: up to 15% - a small defect, 16-25% - a medium defect, 26% and a larger defect.

During 3D reconstruction of the shoulder head in the area of the posterior-outer surface of the head, Hill-Sachs defects of two types were revealed: wide and flat with a maximum depth of 3-4 mm and a narrow deep one with a width and depth of up to 10 mm.

Di Giacomo G., Itoi E., Burkhart S.S. (2014) determined that not the entire glenoid, but only 83% of its diameter, contacts the head of the shoulder at different degrees of shoulder abduction. Therefore, the glenoid pathway (GP), being 0.83 of the diameter for the intact glenoid, for the damaged GP glenoid is additionally reduced by the size of the defect: $GP = (0.83 \times \text{glenoid diameter in mm}) - \text{defect size in mm}$. Whether Hill-Sachs (HS) is within the glenoid pathway was determined by comparing 2 values — the width of the HS and the GP. In the conclusion on the MSCT study, the nature of the instability of the shoulder joint, the Bankart degree, the Hill-Sachs dimensions (width and depth), the conclusion "HS on track / off track lesion" were indicated. In all 23 operated patients, HS off track lesion was proved.

To stabilize the shoulder joint, all 38 patients underwent Latarjes surgery and the creation of a new shoulder-scapular ligament.

Results. There were no complications in the early postoperative period. In all patients, the joint was stable, which was confirmed by the load-shift test, as well as the test for foreseeing anterior shoulder dislocation.

Measurements of the range of motion in the shoulder joint before surgery and after 6–12 months. Patients routinely underwent repeated examinations every 3 months. Joint function and results were assessed using the Rowe scale, ASES, UCLA, WOSI index. Recurrence of dislocation after surgery was not observed.

All patients underwent MSCT with 3D reconstruction of the operated shoulder joint 6 months after the operation as planned. Bone fusion of the graft was obtained in 30 patients, fibrous fusion of the graft was obtained in 7 patients. Partial resorption of the graft was found in 1 patient, but in this patient the function and stability of the shoulder joint was not impaired. All operated patients returned to their daily work.

Discussion

The proposed surgical technique of non-free bone autoplasty according to Latarjes with the creation of a new humeral-scapular ligament with a deficit of the articular surface of more than 20% of the anterior-inferior angle of the glenoid, cicatricial thinning of the capsule or deep defects of the humeral head, makes it possible to effectively stabilize the shoulder joint, while restoring the anatomy of the damaged bicipito-labral complex ... The peculiarities of the

proposed technique are the reduction of the size of the surgical approach, the preservation of the integrity of the pectoralis minor and coracohumeral muscles, in connection with this, the n.musculocutaneus is not damaged, and the creation of a new shoulder-scapular ligament. In addition, it makes it possible to achieve precision in the positioning of the graft relative to the articular surface of the scapula, which reduces the risk of its non-union and resorption, and also improves the articulation of the humeral head.

conclusions

Thus, the historical aspect clearly demonstrates the historical development of surgery in the treatment of post-traumatic instability of the shoulder joint.

The modern world level of arthroscopy allows to perform almost all types of surgical interventions indicated for various pathologies of the shoulder joint. However, so far, both in domestic and foreign literature, there is no sufficient number of published long-term observations of patients who have undergone surgical treatment using modern anchor fixators, which does not allow fully assessing the long-term results of the ongoing surgical treatment. Further accumulation of experience and generalization of observational data are priority and promising areas of work. There are no long-term observations of the treatment outcomes of patients with multidirectional instability who underwent arthroscopic capsuloraphy operations with thermal and laser action on the elements of the shoulder joint capsule. Capsule shrinkage and limited range of motion remain the main side effects of this procedure. The study of the effects of various physical factors on the capsule of the shoulder joint in patients with dysplastic instability, as well as congenital and acquired hypermobility of the shoulder joint is an urgent topic for further scientific research.

Non-free bone grafting of the scapula according to Latarjes, as well as the creation of a new humeral-scapular ligament in the surgical treatment of patients with instability of the shoulder joint and large defects of the articular surfaces can reduce the trauma of the operation, increase its stability and anatomy. The proposed operation is indicated in patients with chronic instability of the shoulder joint with an accompanying bone defect of the glenoid, where the bone defect is 20% or more.

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