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Review Article

Return to sport after capsuloplasty with a bone block in shoulder instability

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Abstract

Objective: Propose a post-surgical rehabilitation program identifying the steps necessary for a progressive recovery of the joint function in compliance with the surgical needs.

Material & method: In the anterior and posterior glenohumeral instability, the presence of bone defects, especially at the glenoid side requires surgery and the use of the bone block, associated with the repair of the soft tissues (capsuloplasty). The arthroscopic technique, compared to open surgery, allows respecting the periarticular anatomical structures, essential for optimal functional recovery.

Results: The post-surgical rehabilitation program follows a progressive recovery timing, divided into 3 phases: phase 1 pain control and joint mobility recovery, phase 2 the recovery of strength and specific sport movements and finally phase 3 the return to sports activities. The rehabilitation progress must achieve two objectives: ROM recovery without disturbing the bone graft area, to achieve its integration.

Conclusion: the rehabilitation program is ultimately guided by the surgeon considering the strategy adopted in the operating room, the use of the bone-block technique and above all the sealing of the grafts. The physiotherapist following the proposed steps will optimize the final functional result.

Introduction

In shoulder instability, glenoid and humeral bone defects represent a common problem. Anterior glenoid defects, which cause recurrent instability, have an incidence of up to 88% and glenoid bone loss weakens the bone arch that resists axial forces [1]. Posterior glenoid defects (reverse bony bankart, erosion or posterior glenoid dysplasia, reverse hill Sachs) can cause posterior instability [2]. Imaging techniques allow to quantify the glenoid and humeral bone loss and in the post-operative period allow to control the bone graft integration. Arthroscopic or open capsuloplasty alone may not resolve instability so sometimes the use of a bone graft harvested from the various sites is necessary (iliac crest, tip of the coracoid or whole coracoid, clavicle, tibia) [3-5] and fixed on the glenoid neck, with open techniques or recently with arthroscopic techniques. The benefits of arthroscopy are important because of respect for the periarticular tissues, unlike open surgery. The correct indication and surgical technique then influence the rehabilitation process it requires preliminary evaluation of the surgical complexity, for the presence of bone loss repaired. Re-aestheticization and the return to the sport require evidence of complete healing of the surgical repair and the completion of the rehabilitation project, before exposing the glenohumeral to maximum stresses.

Surgical techniques

The correct typing of glenoid bone defects and soft tissues in anterior or posterior instability allows you to plan the most appropriate surgical treatment, about repair bone and soft

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tissues. Treatment algorithms depend on many factors, but the size and type of glenoid bone loss (fragment or erosion) are a priority. If a mobile bone fragment is associated with al capsulolabral tear, the arthroscopic repair is indicated despite a fragment size, both in acute and subacute bony bankart [6]. If the bone loss is greater than 20% compared to healthy controlateral glenoid, an open or arthroscopic bone block procedure is recommended [7]. A bone loss of less than 20% associated with a Hill Sachs tear appearing off the glenoid track can be treated with bone block procedures [8,9]. The harvest of an autograft from the iliac crest is historically the most used, both in the anterior instability with a bone loss greater than 25-30% and in the failure of the Latarjet procedures [10]; the 3-year follow-up results show no dislocations [11] or recurrence of instability at 7.5 years [12] and with an integration of the bone graft harvested from the distal tibia in 89% of cases [13]. Arthroscopy allows the repair of capsule -labral tissues [14] and the reconstruction of glenoid bone defects and the osteosynthesis of some fractures of the glenoid, stabilizing the bone block with sutures anchors, with cannulated titanium or biodegradable screw [15-17] or end button [18]. A biomechanical study assessed the differences in pressure and contact between a distal clavicle graft and a coracoid bone graft showing the same results [20]. In posterior dislocations, bone defects are more common on the humeral side than in the glenoid. Bone block procedures have been proposed with open autografts to treat both humeral and glenoid defects [21], starting from an extension of the damage of 10% of the glenoid surface [22]. The posterior translation of the humerus is very sensitive to small posterior glenoid defects or to retroversion which increases significantly; 5° of posterior glenoid bone loss, corresponding to about 2.5° of glenoid retroversion [23] Open techniques require extensive access and can cause partial postoperative insufficiency of the deltoid muscle [21]. In posterior instability, there is a high recurrence rate after soft tissues repairs alone, even in the absence of posterior bone loss [24-26]. The homolateral iliac crest is the usual donor site for harvesting a bone graft to extend the glenoid surface, rather than to reconstruct an anatomical defect; posterior and inferior capsule -labral repair then improves overall inferior joint stability. Unlike the anterior instability, the relationship between the effect of the posterior bone loss and the severity of the instability has not yet been determined. for the traumatic type has been described as a triangular bone defect (Delta), for the atraumatic type, a defect of rounded shape (Lazy) [27,28].

Rehabilitation protocol and return to sport

The shoulder is an inherently unstable joint. The width of the humeral head is three times the radius of the glenoid and this fact explains the intrinsic glenohumeral instability. Neuromuscular control of the scapulothoracic joint is very important for the glenohumeral function. The scapula, therefore, plays a key role, allowing to position the glenoid in an optimal relationship with the humerus. The rehabilitation of scapular dyskinesia must be included in the preoperative or postoperative treatment, through specific protocols. The purpose of the rehabilitation in the treatment of shoulder instability operated by the bone-block procedure is to restore normal and painless motor control of the shoulder. The muscles that control the shoulder movement can be grouped into 3 distinct categories: the muscles that control scapular movement, the muscles that act on the humerus, and the muscles directly related to the glenohumeral joint. In the shoulders operated for instability, there is a dysfunction of some or all of the muscles, due to multiple factors, such as a structural breakdown of the musculotendinous unit, a proprioceptive deficit, insufficient motor recruitment secondary to pain or disuse, excessive motor recruitment to maintain stability [29]. The surgical difficulty linked to the bone-block surgical technique and to the postoperative management, above all of the pain, constitute the premise for the rehabilitation program. Unlike the conservative rehabilitation programs or in post-surgery of the soft tissues, rehabilitation protocol with bone block must consider the presence of the hardware and the integration of the bone block. The primary post-surgical objectives must concern the global approach to the operated shoulder, divided into three phases: phase 1 pain control and joint mobility recovery, phase 2 recovery of strength, proprioception and sport-specific gestures, and finally phase 3 the return to sports activities. The technical-rehabilitative steps follow a related timing to the integration of the bone graft, with the progressive increase of room and stresses on the joint.

Phase 1: The use of the post-surgical orthopedic brace, especially in the first week, protects the joint, allowing the integration process of the bone block, although the patient after one week after the operation, starts performing passive exercises to recover the range of motion to avoid adhesions and postoperative capsulitis. Pain is a variable parameter for each patient and should be controlled with Fans, cryotherapy and gradual, not invasive rehabilitation. Taverna et al. confirm the need for immobilization in a brace in neutral rotation at 10 ° of abduction for 3-4 weeks, with a subsequent increase for passive mobilization [18]. Hydrokinesitherapy finds one precise indication in the initial rehabilitation phase, since it allows good control of pain and muscles contractures, minimizing the secondary effects of prolonged immobility. ROM recovery under the control of the therapist allows to gradually overcome the antalgic resistance of the joint, enhancing the external help. The patient will repeat the basic movements at home, without increasing the joint range beyond the therapist's indications. ROM recovery exercises can be started early, without stressing the bone graft site [30]. The recovery of resistance begins in the early "protected" phase, especially for the scapular muscles (serratus anterior, rhomboid and trapezius), while involving all the kinetic chains, with shoulder strengthening and core stability exercises, taking particular care of the correct balance between the deltoid and the rotator cuff, for optimal positioning and stabilization of the scapula during exercise. The exercises against mild resistance are started during the 4th week; the exercises in external rotation and/or in horizontal abduction are gradually inserted according to the surgical technique and the individual patient because they can damage the integration of the bone graft.

Phase 2: The muscle strengthening and demanding joint mobilization begin from 6-7 weeks, i.e. in safe conditions

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after the integration of the bone block. Intense training begins at the twelfth week, adding specific exercises if necessary and modulating and increasing resistance and load, avoiding joint overstresses. According to the classification of Jobe, et al. we believe that optimal and correct muscle recovery should be organized in successive steps [31]. Exercises under load are started during the 3rd week. Exercises for the scapula with a glenohumeral opening below 60° elevation are useful. The progression of the loads follows functional criteria, such as dynamic scapular-thoracic stability, recovery of the glenohumeral rhythm, and the absence of pain and apprehension for movements between 0°-90 ° of elevation. The strengthening of the rotator cuff begins with isometric exercises and continues with light exercises and with elastic resistance not earlier than 6 weeks. The exercises continue and are performed with a glenohumeral angle below 45° with concentric and then eccentric contractions. Subsequently, the absence of pain allows ever wider angles of elevation [32,33]. Most authors prefer exercises in a horizontal prone position with an abducted arm and external rotation. This type of exercise allows an early rehabilitation approach, using the free ROM present and "usable" early. The humerus must be kept in line with the scapula or slightly anterior and the glenohumeral joint without extra-rotating beyond the surgical suture safety limit. The proprioceptive exercises begin from the 1st postoperative week and include a cautious and partial initial load, with progressive lifting movements of the arm with the hand resting on the wall and on a table, with rhythmic stabilization exercises for the recruitment of the scapular muscles and facilitation of the scapular muscles proprioception. The patient can control the amount of load through the support of the contralateral arm. Rhythmic stabilization is carried out at 90° of flexion with exercises in submaximal resistance of the upper limb, in all movement planes, both in internal and external rotation, with the arm in 45° of abduction on the level of the scapula. The proprioceptive neuromuscular facilitation of the shoulder carried out with manual resistance can be implemented from the first post-operative sessions, through exercises in movement and diagonal translation of the arm after the 6th week. Various aids for work against resistance and for neuromuscular stimulation are proposed in the rehabilitation process, but in general, activities requiring an excessive load of weights must be carefully limited, preferring functional exercises. The proprioceptive training can be carried out with an open or closed kinetic chain, using various tools of the rehabilitation setting. The progression and ease of execution of the exercises proprioceptive testify to the progression towards healing.

Phase 3: Before reproducing the sports-specific movements it is essential to have recovered 90% of the strength with respect to the contralateral shoulder, assessed with an isokinetic or isometric machine; these tests will reduce the risk of recurrence of the instability by overuse. Measuring recovery of strength allows to increase your commitment in performing strengthening exercises; an 80% recovery of the rotator cuff strength allows activating the sports-specific exercises preparatory to the return to the field, in the 4th and last phase. Sport-specific exercises must be modulated according to the type of injury, the type of surgery, and performance needs. Pleometry plays an important role for athletes and should be carried out in the final phase of rehabilitation. Plyometric exercises allow developing an increase in muscle power, speed, and maximum strength, based on function specification of sport and exercise. In the shoulder, they are commonly used to switch from slow analytical strength training to high-speed power training, more challenging to return to the game phase after a trauma or surgical procedure. They are used to increase the muscle strength of the posterior rotator cuff and periscapular muscles and simulate positional needs and stress in athletes [34]. Some activities must be of increasing difficulty and require the involvement of different muscle groups in different functions . In athletes, the return to sport is generally recommended approximately around the 6th-month post-surgery.

Discussion

In both open and arthroscopic bone-block surgery, it is necessary to avoid the recurrence of the instability and simultaneously the loss of external rotation to ensure the return to competitive sports [35]. The surgical repair, therefore, finds its qualifying moment in the correct indication and in the precise execution. In athletes, the non-surgical solution of instability is not a guarantee of improvement and often prevents the return to sport. Although conservative rehabilitation is often attempted in the beginning, recurrence rates are high, particularly for patients practicing high contact sports [36]. In these cases, surgery has shown better results at least in the short term [37]. The presurgery joint condition must be considered in the planning of the surgical procedure and in the post-surgery rehabilitation program. Magnusson, et al. identified a clinical evaluation system called FEDS (frequency, etiology, direction, surgery) used to provide a prognostic vision also for rehabilitation [38]. Open or arthroscopic surgery influences the outcome related to the stability of the bone graft rather than to the rehabilitation process. Russo and coll. have shown that there are statistically differences significant between the Latarjet open and arthroscopic techniques, regarding the coronal positioning of the bone block in favor of the open Latarjet [39]. The bone-block technique associated with capsuloplasty seems to be an optimal choice since capsule-labral reconstruction with suture-anchors restores the anatomy of soft tissues damaged by instability, with a better clinical result [16,17]. The two associated techniques influence the rehabilitation process. Arthroscopic techniques using metallic screws of fixation can cause potential tissue damage of the subscapularis muscle, nerve injury, or bleeding [17,18], as well as the partial failure of the deltoid muscle following traditional open posterior bone block techniques that require a wide surgical approach [24]. The steps of the rehabilitation of the operated shoulder are slow and progressing, in a period of 4-6 months to regain movement and strength, without overloading the bone block; this guarantees good clinical results and a low recurrence rate [40]. The rehabilitation protocols for repair according to Latarjet, compared to Bankart's technique, have a high degree of variability regarding the exercises and recommendations on movement goals [41]. The therapist

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must necessarily interact with the surgeon not to generally adopt autonomous rehabilitation strategies also for the post-operative aspects, but use every means of information, such as written information, flowcharts, figures, and a table of management parameters to implement the best possible program [42]. As part of the planimetric recovery, Finally, the search for explosive shoulder stabilization exercises must be very careful and chosen over time [33]. They are based on the athlete's intrinsic neuromuscular structure but can be influenced by positive adaptations that improve the efficiency of the execution of the activity, with less energy expenditure, maximum force delivered, and protection of the joints concerned to improve the effectiveness of the activity's performance [43].

Conclusion

Although there are no first-level multicenter trials about the best rehabilitation outcome after surgical stabilization with bone block procedures, the most common evidence relates to the early recovery of joint and muscle strengthening. Rehabilitators must be able to combine knowledge about the biological healing of the operated shoulder with the principles of biomechanics for the individual patient, in order not to stress the repair of the tissues. The exercises should be gradually implemented with specific sports proprioceptive and functional exercises. No single protocol can be satisfactory, but it must always be adapted in accordance with the physical structure, the type of injury and the surgery suffered, as well as the type of performance required and the sport practiced, to allow the best possible recovery (44). After wound healing work and swimming, activities are allowed, after 6–8 weeks a specific progressive rebalancing and muscle strengthening program begins, while the resume of the contact sports are allowed 4-6 months after surgery.

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