CASE REPORT

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Isolated fracture of the lesser tuberosity of the humerus – a rare injury that requires surgical treatment

Izolovani prelom malog tuberkuluma humerusa – retka povreda koja zahteva operativno lečenje

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Abstract

Introduction. An isolated fracture of the small tuberosity is a very rare injury that can often be overlooked. That injury is significant due to the function of the *subscapularis* muscle, which loses its attachment by separating the small tuberosity. **Case report.** A 45-year-old male, former athlete, suffered a left shoulder injury while falling downhill. Although the clinical picture was not convincing, a computed tomography scan showed a fracture. Open repositioning and osteosynthesis were performed. After rehabilitation, the patient regained a full active range of motion in the shoulder joint three months after the operation. We present the mechanism of injury, clinical picture, necessary diagnostics, and technique of surgical treatment of isolated fracture lesser tuberosity of the humerus. The results of other authors whose series are also quite small were analyzed. **Conclusion**. It was concluded that an isolated fracture of the small tuberosity requires surgical treatment to preserve a good range of motion in the shoulder joint.

Key words:
diagnosis; fractures, avulsion; humeral fractures; orthopedic procedures; tomography, x-ray, computed.

Apstrakt

Uvod. Izolovani prelom malog tuberkuluma je veoma retka povreda, koja se često može prevideti. Takva povreda je značajna zbog funkcije podlopatičnog mišića, koji odvajanjem malog tuberkuluma gubi svoj pripoj. **Prikaz bolesnika.** Muškarac, bivši sportista, star 45 godina, zadobio je povredu levog ramena pri padu na nizbrdici. Mada klinička slika nije bila ubedljiva, snimak kompjuterizovanom tomografijom pokazao je postojanje preloma. Učinjena je otvorena repozicija i osteosinteza. Posle sprovedene rehabilitacije, tri meseca posle operacije, pacijent je vratio pun aktivan obim pokreta u zglobu ramena. Prikazujemo mehanizam povrede, kliničku sliku, neophodnu dijagnostiku i tehniku hirurškog lečenja pacijenata sa izolovanim prelomom malog tuberkuluma humerusa. Analizirani su rezultati drugih autora, čije su serije analiziranih slučajeva takođe jako male. **Zaključak.** Izolovani prelom malog tuberkuluma zahteva hiruško lečenje kako bi se očuvao dobar obim pokreta u ramenom zglobu.

Ključne reči:
dijagnoza; prelomi, avulzioni; humerus, prelomi; ortopedske procedure; tomografija, kompjuterizovana, rendgenska.

Introduction

Isolated lesser tuberosity fracture is an extremely rare injury. In the series used as the basis for the Müller AO Classification (AO classification), these fractures represented only 2 of the 730 analyzed cases [1]. In their work, Robinson et al. [2] estimate that this injury occurs in 0.46 cases of humeral injuries per 100,000. As with the greater tuberosity fracture, which occurs due to anterior shoulder dislocation, when it comes to lesser tuberosity fractures, posterior dislocation should be suspected [3]. Lesser tuberosity fracture is often associated with severe trauma, which includes multiple proximal humerus fractures. In order to be isolated, nondisplaced fractures of the anatomical or surgical neck of the humerus should be excluded.

Anatomically lesser tuberosity is significant due to the subscapularis muscle attachment, which represents the dynamic front stabilizer of the joint and provides its internal rotation.

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These fractures are often associated with posterior shoulder dislocation; after its reduction, the fracture of the lesser tuberosity can be overlooked. The clinical picture in the acute phase is also not convincing: less pain in the front of the shoulder, lesser restriction of movement, and minimal swelling and bruising. The anatomical position of the small tubercle is such that its fracture is often not seen on regular X-rays [4]. Therefore, it is considered that the percentage of overlooked fractures is very high. Vezeridis et al. [5] demonstrated that 75% of the initial radiographs were interpreted as normal, with the diagnosis identified only on subsequent magnetic resonance imaging (MRI). Axial X-rays help detect the level of displacement, although today, the supreme method for diagnosis is a computed tomography (CT) scan. If the fracture is not diagnosed and treated adequately, there is an impairment of shoulder function with limited internal rotation.

Case report

A 45-year-old male, a former athlete, suffered a left shoulder injury while falling downhill. It has been four days since the injury; the patient complained of pain in the anterior aspect of the shoulder joint. According to the patient, his arm was abducted and in external rotation when he fell. A clinical examination showed local pain on palpation as well as a hematoma in the anterior aspect of the shoulder joint and on the left side of the chest. He actively performed all shoulder movements except total internal rotation. An anteroposterior radiography of the shoulder was performed, on which a larger ossification was seen in the *supraspinatus* tendon, and a fracture of the small tubercle was suspected (Figure 1). Therefore, a CT diagnosis was made, which confirmed the fracture, with separation and caudal displacement of the small tubercle (Figure 2).

Surgery was performed through a 5 cm-long deltopectoral incision, which was sufficient to access the fracture site and the dislocated fragment. The lesser tuberosity was pulled by the force of the subscapularis muscle medially and distally. In order not to damage the bone fragment during repositioning, the tendon of the subscapularis muscle was sutured with the Krackow stitch technique, and, together with the fragment, it was pulled toward the anatomical site. The lesser tuberosity was again placed in the anatomical position and fixed with a 4.0 mm titanium cannulated screw, and one Arthrex PushLock® SP 4.5 mm suture anchor was used for tendon fixation in the humeral head. Calcification in the supraspinatus tendon was identified and removed, while the defect was closed side-to-side with an Arthrex FiberWire® 2-0 suture (Figure 3).

Fig. 1 – X-ray radiograph of the shoulder (anterior/posterior view) shows a large ossification in the *supraspinatus* tendon and a suspected fracture of the small tubercle.

Fig. 2 – Computed tomography image of the shoulder shows the fracture with separation and caudal displacement of the small tubercle.

Fig. 3 – Intraoperative X-ray finding shows fracture-related defect closed side-to-side with an Arthrex FiberWire® 2-0 suture.

The patient wore Desault's bandage immobilization for the next 3 weeks while elbow movements were allowed. After that, shoulder passive motion was started (shoulder continuous passive motion – CPM machine) for the next 2 weeks. A program of exercises to strengthen the rotator cuff muscles followed. The patient returned to the full active range of motion after 3 months.

Discussion

Isolated lesser tuberosity fracture is an extremely rare injury. Therefore, the experience in the treatment is very limited. Rare works in the literature are mostly reduced to case reports [6–20]. The lesser tuberosity is protected from direct injuries due to its small size and its position on the medial side of the humerus. Most authors believe that the main mechanism of injury is excessive muscle pull [7, 8]. When the subscapular muscle forcefully contracts to resist abduction and external rotation of the shoulder, the resultant strong traction force avulses the lesser tuberosity. Less probable mechanisms, such as stress fractures and fractures due to extreme internal rotation and shoulder extension (back-reach position), as well as fractures due to epileptic seizures and during electroconvulsive therapy for psychiatric disorders, have also been described in the literature [10, 11, 21]. Symptoms specific to acute cases include pain in the anterior aspect of the shoulder that worsens with external rotation and limits the internal rotation of the joint. On plain radiographs, these fractures may be misdiagnosed as calcific tendinitis of the rotator cuff or osseous Bankart lesions [12]. An AP radiograph in maximal interior rotation sometimes does not provide a good projection of the lesser tuberosity. Large, displaced fractures can be seen on standard AP radiographs, while smaller fragments need the axillary view in order to reveal the degree of their displacement. An axillary view is sometimes not easy to do due to pain. A supreme method in diagnosis today is CT, and it is most often necessary in diagnosing this injury. Although MRI is not necessary, it allows the evaluation of the entire rotator cuff and better visualization of a minimally displaced fragment [13, 20, 22].

Although the literature describes cases of nonsurgical treatment with a satisfactory result [23], our opinion is that surgical treatment must be considered in dislocated fractures, primarily due to the active role of the subscapularis muscle in the internal rotation of the shoulder joint. If such an injury is neglected, the patient will certainly not have the full range of motion in the shoulder, primarily the internal rotation. It is clinically manifested by positive tests for damage to the subscapularis (lift-off or belly-press test). The stability of the joint should not be forgotten, as cases of instability resulting from the lack of a dynamic role of the subscapularis muscle have also been described [14]. Medial dislocation of torn fragments reduces the coracohumeral distance, which can restrict movements, create coracoid impingement, and cause pain [15].

Most of the acute cases that have been reported in the literature were treated by open reduction and internal fixation, resulting in an excellent clinical outcome (Table 1).

For acute nondisplaced fractures of the lesser tuberosity, nonoperative treatment can provide satisfactory results. It is necessary to be careful as a contraction of the subscapularis muscle can lead to retraction of the fractured tuberosity, which requires operative treatment [8]. Operative treatment is recommended for patients with displacement greater than 5 mm, fragment angulation greater than 45°, limited joint mobility, significant clinical weakness, or continued pain [16].

Research has shown that pediatric patients have excellent outcomes after lesser tuberosity fractures and may benefit more from surgery in comparison to nonoperative treatment. While the outcomes of adults are also acceptable, the fact that one-third of patients do not regain the full range of motion without surgery implies the advantage of surgical treatment [17].

The surgical approach to treatment is anterolateral-deltopectoral. A long head of the bicep should be identified to make sure that it is not medially displaced into the joint. There is a possibility of dislocation of the biceps tendon in fractures of the lesser tuberosity, which affects sulcus bicipitalis. In the case of an acute fracture of a small tubercle, the subscapularis is freely mobile, and if the bone fragment is large, it should be repositioned and fixed with two 4.0 cannulated screws. If the fragment is small and soft, the fixation is performed with strong non-absorbable sutures and anchors, using a similar technique used in the reconstruction of the subscapularis tear. In old cases, the subscapularis becomes shorter, and the bone fragment is retracted medially, so there is a need for its release and mobilization of muscle and tendons. Repairing such a condition is usually difficult due to scars, retraction of the bone fragment, and muscular fatty degeneration. The result may be slightly less external rotation after reconstruction.

Table 1

Characteristics of the patients that have been reported about the topic in the literature

Authors	Number of pts.	Age-gender	Duration	Method of treatment	Outcome
Kanso and Bricout [4]	1	31-f	acute	ORIF	excellent
Tosun and Kesemenli [6]	2	19-m, 33-f	acute	ORIF	excellent
Ogawa and Takahashi [12]	10	12-m, 56-m, 68-f, 28-m, 17-m, 50-f, 13-m, 31-m, 15-m, 11-m	6 acute 4 chronic	ORIF in 5 pts. (3 acute, 2 chronic) 5 non-operative (3 acute, 2 chronic)	6 excellent 4 very good
Paschal et al. [16]	2	14-f, 15-m	chronic	ORIF	1 excellent, 1 good
Cheng et al. [19]	1	15-m	chronic	ORIF	excellent
Levine et al. [20]	1	14-m	acute	ORIF	excellent

pts – patients; m – male; f – female; ORIF – open reduction and internal fixation.

Rehabilitation after this operation is individualized and similar to the rehabilitation after surgical treatment of a torn rotator cuff [18].

Conclusion

Isolated lesser tuberosity fracture is a rare injury that most often requires surgical treatment. Additional diagnostic is needed because the fracture can easily be overlooked. This injury affects the function of the rotator cuff. Separation and poor healing of the lesser tuberosity reduce the role of the subscapularis. The prerequisite for a good functional outcome of isolated lesser tuberosity fractures is anatomical reposition and stable fixation. Only then can we expect a good range of motion of the shoulder joint.

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