

Surgical treatment of scapula body fractures extending glenoid fossa: Surgical technique and early results

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ABSTRACT

BACKGROUND: The aim of this study was to describe the surgical technique and evaluate functional outcomes following open reduction and internal fixation in patients with scapular fractures.

METHODS: In this study, ten patients with scapular fractures with Ideberg type four and five, who had undergone operatively with the Judet approach in three different orthopedic centers between March 2014 and October 2018, were evaluated retrospectively. By the end of at least a 2-year follow-up period, postoperative Disabilities of the Arm, Shoulder and Hand (DASH), Constant questionnaires were evaluated by all participating patients.

RESULTS: Three of these patients had fractures on the left; seven patients had fractures on the right side, and the average patient age was 35.1±9.75. Mean Constant and DASH scores were 87.9±13.68 and 5.57±5.21, respectively. In two patients, about 2 cm adjacent to the suprascapular notch, perioperative suprascapular nerve injury was stated and sutured using the epineural technique. By the end of the 2-year follow-up of these two patients, infraspinatus muscle atrophy had occurred. However, external rotation muscle strength was 4/5 in both patients.

CONCLUSION: This study suggests that scapula fractures extending glenoid articular surface can be safely fixed through the Judet approach and had satisfactory results. In addition, two patients with traumatic suprascapular nerve injury were encountered during the surgery and repaired which may be hard to diagnose with modified or minimal incisional approaches.

Keywords: Judet; scapula fracture; suprascapular nerve.

INTRODUCTION

The scapular fractures are about 0.5% of all fractures.^[1-3] Ninety-nine percent of isolated scapula body fractures treated non-operatively have 86% success rate.^[4] Therewithal 83% of scapula neck fractures have also 77% success rate by conservative means.^[4] However, several rare complications may be seen after conservative treatment such as rotator cuff injury secondary to non/malunion, impingement, glenohumeral instability, scapulothoracic dyskinesia, and chronic pain.^[5] Furthermore, there are reports with good results of surgical treatment of scapular fractures.^[4,6-9] Surgical indications may

include glenoid fossa fracture displacement of more than 3–5 mm, recurrent instability of the humeral head due to large glenoid rim fractures, glenopolar angle <22°, medialization of glenoid part, concomitant floating shoulder injuries, or disruption of superior suspensory shoulder complex.^[4,5,8-13]

The extensile posterior (Judet) approach, described by Judet in 1964, is being used in the surgical treatment of scapular fractures, has some advantages and disadvantages as well.^[14] The main advantage of this approach is to allow a quite well exposure to the scapular posterior body, posterior of the glenoid, and fractures extending into the glenohumeral

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joint. Furthermore, allows proper evaluation of suprascapular nerve injury. However, over-traction of the infraspinatus flap may cause secondary suprascapular nerve injury, involvement of full-thickness and wide posterior muscle flaps leads to an increased postop risk of seroma or hematoma formation. Modified Judet, minimally invasive, and reverse Judet approaches have also been described but have limited access to the whole scapular body, neck, and articular surface at once.^[15-17]

The aim of this study was to describe the surgical technique and evaluate functional outcomes following open reduction and internal fixation in patients with scapular fractures.

MATERIALS AND METHODS

All procedures performed in this study involving human participants were by the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. This study was approved by the Ethics Committee of the University of Health Sciences Ümraniye Training and Research Hospital (decision no: 8.10.1.TKH.4.34.H.GP0.01/33, dated: February 11, 2021).

Study Population

In this study, 22 patients with scapular fractures, who had been operated in three different orthopedic centers in the

period between 2014 and 2018, were evaluated retrospectively. The inclusion criteria in this study group were adult patients older than 18 years of age who have Ideberg type four or type five scapular fractures, being operated with Extensile Judet approach, having the necessary medical records, a minimum 2 years of clinical and radiological follow-up, and not have had any surgical intervention of the shoulder joint before. Twelve patients were excluded because of; Ideberg type three or lower types (n=7), follow-up in different medical centers (n=2), and exitus of patients (n=3) in the post-operative follow-up due to cranial or visceral organ traumas.

Finally, ten patients (ten male), with the standard pre and postoperative assessment consisting of proper radiographs, fulfilled the criteria of the present study were included. The fracture patterns were located on the dominant side in 80% (n=8) of the patients and the associated injuries were pneumothorax in two patients, rib fractures in six patients, lower extremity in one patient, upper extremity fractures in five patients, and pelvic injuries in two patients (Table 1).

Physical Evaluation

A post-operative Disabilities of the Arm, Shoulder and Hand (DASH) and Constant questionnaire were completed by all participating patients.^[18,19] Active range of motion in degrees of shoulder forward flexion, abduction, and external rotation was measured with a goniometer. All patients' images were evaluated by two senior orthopedic surgeons taken at the

Table 1. Patient demographic information and postoperative clinical outcomes

| N | Sex | Age | Side | Ideberg classification | DASH score | Constant score | Associated injuries | ABD/ADD/ER | *IR |
|-----|------|-----|-------|------------------------|------------|----------------|--|------------|-----|
| 1** | Male | 43 | Left | Type 4 | 2.5 | 98 | Ipsilateral clavicle, iliac wing fractures | 170/35/70 | T10 |
| 2 | Male | 21 | Left | Type 5 | 3.5 | 94 | Lumbar vertebral, ipsilateral humerus shaft fractures | 170/40/80 | T8 |
| 3 | Male | 26 | Right | Type 4 | 16.7 | 90 | Rip, ipsilatera distal radius, ipsilateral tibia shaft fractures | 150/40/70 | T12 |
| 4 | Male | 35 | Right | Type 4 | 16.7 | 90 | Ipsilateral acetabulum posterior wall, clavicle fractures | 170/40/80 | T10 |
| 5** | Male | 25 | Right | Type 5 | 6.7 | 94 | Pneumothorax, rib fractures | 165/40/60 | L1 |
| 6 | Male | 45 | Right | Type 5 | 2.5 | 94 | Rib, ipsilateral acromion fractures, pneumotorax | 170/40/80 | T10 |
| 7 | Male | 28 | Right | Type 5 | 10.8 | 72 | Rib fractures, pneumotorax, | 150/40/70 | L3 |
| 8 | Male | 47 | Right | Type 4 | 8 | 90 | Ipsilateral coronoid, clavicle, contr. distal humerus fractures | 170/40/80 | L1 |
| 9 | Male | 35 | Right | Type 5 | 3.5 | 70 | None | 170/40/80 | L3 |
| 10 | Male | 46 | Left | Type 5 | 5 | 65 | Bilateral distal radius fractures | 150/40/70 | L5 |

ABD/ADD/ER: Fractured-side postoperative abduction/adduction/external rotation; DASH: Disabilities of the Arm, Shoulder and Hand.

*Injured-side postoperative shoulder internal rotation endpoint. **Patient with suprascapular nerve injury.

time of emergency consultations and clinical follow-ups in each case and classified according to the Ideberg classification on adequate pre- and post-operative shoulder roentgenographies and Computed Tomography through Picture Archiving System. Detailed neurological examination and muscle motor function were assessed; no visible muscle contraction as 0, visible muscle contraction with no or trace movement as 1, limb movement, but not against gravity as 2, movement against gravity but not resistance as 3, movement against at least some resistance supplied by the examiner as 4, and full strength as 5, according to Medical Research Council Manual Muscle Testing Scale.

Operative Technique

After prophylactic antibiotics and general anesthesia were administered, the patient was positioned in the lateral decubitus leaning slightly anteriorly, which aided in exposure and manipulation of the scapula. Posterior Judet incision (boomerang incision), which extends from the scapular medial border to the spina of the scapula, was utilized. Sharp dissection was done down to the fascia of deltoid and infraspinatus muscles. The posterior deltoid was dissected from the spina scapula and the flap of the infraspinatus was drawn anteriorly. The suprascapular nerve and artery, passing through the posterosuperior part of the neck of the glenoid, were dissected (Fig. 1). The posterior joint capsule was explored to obtain better visualization of fractures extending to the neck of the glenoid or articular surface, if necessary. First, reduction and fixation of intra-articular glenoid fracture must be established and afterward fracture extending through the glenoid neck. Initial scapula body fracture fixation may prevent glenoid articular surface reduction and forceful maneuvers may cause new fracture patterns. The 2.5–3.00 mm locking scapula plates (TST Medical Device Ind. Tra. Ltd.) were applied to the fracture lines of the glenoid neck and scapular body (Fig. 2). Temporary K-wires were used to achieve reduction before plating. Another point to note in scapula fracture plating, the length of the screws applied is vital due to the proximity of the thorax (Fig. 3). The size of the screws placed in the distal and medial scapular area should be chosen cautiously. Finally, the glenohumeral joint motion was examined to check for any screw penetration to the glenoid articular surface. The deltoid flap was repaired through the spina scapula and the posterior rotator cuff was sutured to the medial border of the scapula. Two separate drains were placed to prevent post-operative seroma.

Postoperatively, a sling was given for comfort and physical therapy was started. Sutures were removed by the 2nd post-operative week and follow-up of the patient with continuous use of the sling for 4 weeks except for daily exercise. By the end of the 4th post-operative week, the patients were allowed passive pendular shoulder and scapulothoracic joint exercises. In the 6th-week active and the 3rd-month, resistive rehabilitation protocol was allowed.

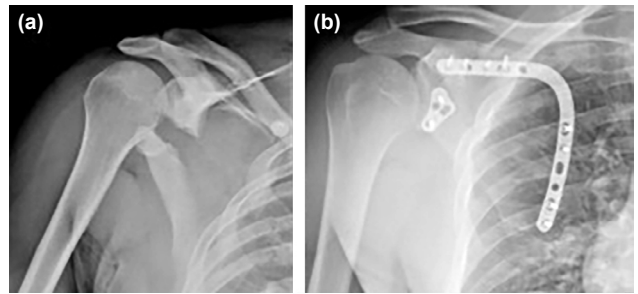


Figure 1. 47-year-old male patient with right scapula Ideberg Type 4 fracture (a) pre-operative shoulder X-ray (b) post-operative antero-posterior shoulder X-ray.

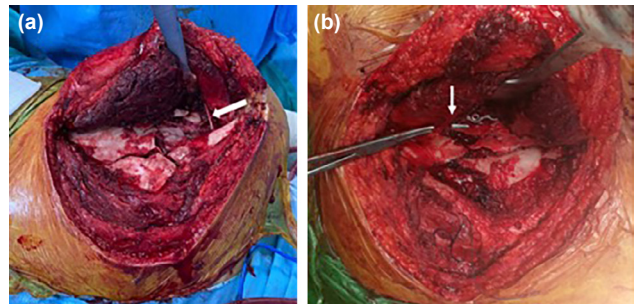


Figure 2. (a, b) Perioperative view of a 45-year-old male patient with right scapula Ideberg Type 5 fracture (dissected suprascapular nerve with white arrow).

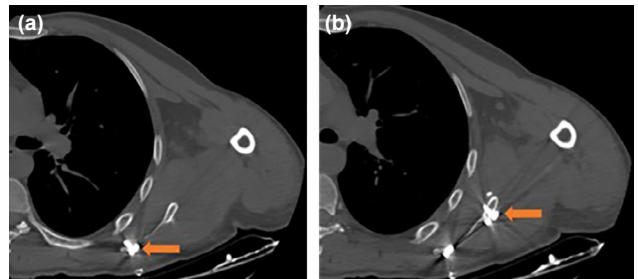


Figure 3. 35-year-old male patient with Ideberg Type 4 fracture. Post-operative axial views of the scapula and thorax (a) the proximity of the medial scapular screw to the thorax (b) safer lateral scapular screw placement (orange arrow points to the screw location).

Statistical Analysis

The use of attitudes of quantitative variables and measurements of centralization and variance were pointed out. To show the differences in the attitude of group averages, if the normality and equality assumptions were fulfilled ANOVA t-test. For all of the samples, the statistical significance was found at $p=0.05$. The statistical analysis was completed by the program IBM SPSS (for windows and social sciences statistic package, version 21.0, Armonk, NY, IBM Corp.).

RESULTS

The average length of time from admission to operative stabilization was 8.45 days (range, 5–13). The mean follow-up period was 43.7 months (range, 26–71). Three of these patients had fractures on the left; seven patients had on the right side,

Table 2. Comparison of patients due to fracture type and concomitant fracture pattern

| | | Mean±SD/Median (Min–Max) | | p-value |
|----------------------------------|----|--------------------------|---------------------------|---------|
| | | Unjuired side (n=10) | Injured side (n=10) | |
| unjuired-injured side comparison | CS | 92.33±10.69/96 (72–98) | 81.25±16.52/80 (65–94) | 0.229 |
| | DS | 4.75±2.4/4.25 (2.5–8) | 6.12±6.67/4.6 (2.5–16.7) | 0.709 |
| | | Type 4 (n=4) | Type 5 (n=6) | |
| Ideberg type | CS | 94.5±5.26/94 (90–100) | 83.5±16.2/83 (65–94) | 0.233 |
| | DS | 6.8±7.4/5.25 (2.5–16.7) | 4.75±3.73/4.25 (2.5–10.8) | 0.573 |

CS: Constant score; DS: DASH score; SD: Standard deviation. Anova T-test.

and the mean patient age at the time of injury was 35.1 years (range, 21–47). Trauma mechanisms were falling from height in three patients; motorcycle accidents in three patients and pedestrian traffic accidents in four patients. Mean Constant and DASH scores were 87.9±13.68 and 5.57±5.21, respectively. The Constant ($p=0.22$) and DASH ($p=0.7$) scores of patients between injured and uninjured sides were not significant (Table 2).

In two patients, about 2 cm adjacent to the suprascapular notch, perioperative suprascapular nerve injury was stated and sutured using the epineural technique. Of these two patients in the 6th-month follow-up, infraspinatus muscle atrophy was obvious and the strength of shoulder external rotation was 4/5 (Fig. 4). The DASH and Constant scores were 6.7/94 and 2.5/98 in these patients, respectively. There was no complaint regarding nerve injury in daily lives, so it is considered that there was no need for operative tendon transfer in these patients.

There were not any early or late post-operative complications reported and bone healing was completed in all patients. Seven patients had returned to the previous performance at their

practice after a mean 6 months follow-up, three patients (two patients with pelvic ring fracture and one patient with Galeazzi fracture-dislocation) could not get back to their former working condition and needed to change the working position.

DISCUSSION

The results of this study demonstrated that the extensile posterior approach may be the preferred surgical choice in patients with scapular fractures extending glenoid fossa with post-operative satisfactory clinical results. The primary drawback of the Judet approach is the extensive posterior skin incision and broad muscle flap may cause seroma or hematoma due to deep dissection. However, the main advantage is the good visualization of the overall fracture pattern including the glenoid fossa and the ability to detect concomitant injuries related suprascapular nerve entrapment in fractures extending throughout the supraglenoid notch.

Previously, various approaches have been described in patients with scapula fractures.^[15–17,20,21] Obrebsky et al.^[16] described a modified Judet approach between teres minor and infraspinatus instead of elevating the whole posterior muscle flap and posterior deltoid fibers from the scapula. However,

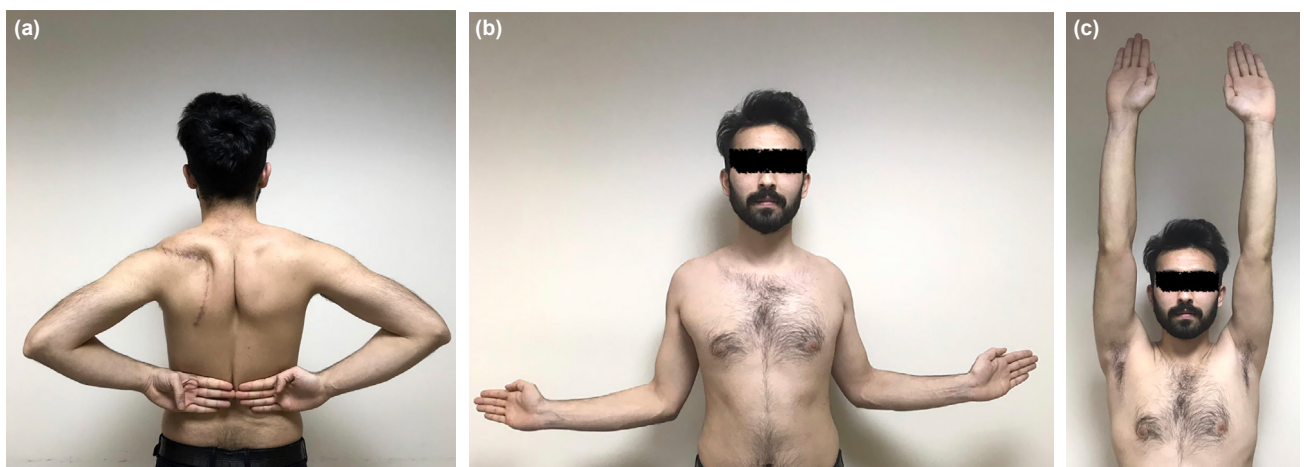


Figure 4. Twenty-five-year-old male patient with suprascapular nerve injury. (a–c) Post-operative infraspinatus atrophy is obvious with any external rotation deficiency.

scapula fractures occur in the setting of high-energy trauma, approximately 90% of patients have a concomitant injury and lengthening of the preoperative preparation period to stabilize the vital parameters of patients may lead to a delay in definitive fracture management as well.^[22] Therefore, such limited approaches characterized by poor visualization and manipulation of fracture pattern may cause a new fracture line, adversity in current fracture reduction, or even neurovascular injury cause by thin scapular structure and the tight insertion of the muscles in delayed fracture patterns. In our study, the average length of time from admission to operative stabilization was 8.45 days (range 5–13).

In patients with scapular fractures, suprascapular nerve injury secondary to trauma may be misdiagnosed in the pre-operative examination. Bi et al.^[23] have reported that the nerve had been impinged between fracture fragments or even ruptured in patients. Therefore, during surgical dissection in fractures extending to the supraglenoid notch, physical examination, and dissection of the nerve is quite important. The complications of suprascapular nerve injury in the supraglenoid notch may cause loss of external rotation strength and infraspinatus atrophy. In our experience, after the post-operative 6th month, it is obvious. However, there is not enough data about the incidence and clinical follow-up of these type of patients in the literature yet. Based on the experience acquired during the management of our patients, it is essential either to do a preoperative examination of the suprascapular nerve, if it is possible, or to control the anatomical continuity of the nerve intraoperatively. In our series, five fracture patterns of patients were extending toward the supraglenoid notch and two of them have nerve injuries. Despite our statement of infraspinatus atrophy in both two patients, their daily routine were not affected adversely and the DASH/Constant scores were 6.7/94 and 2.5/98 in these patients, respectively. Hence, any further surgical attempts were not planned.

There were some limitations in our study. First, the preparation of study in three different centers and operations by three different surgeons lead to disturbance of homogeneity. However, in all centers, surgeries have been managed by at least 10 years of experienced shoulder-specified surgeons. Second, the results were affected by a limited number of patients without a control group. Due to the high success rates of conservative treatment in selected patients, study groups were planned in different three centers to study similar fracture patterns that have limited surgical indications.

Conclusion

This study suggests that scapula body fractures extending the glenoid fossa (Ideberg Type 4 and Type 5) can be safely fixed through the Extensile Judet approach and had satisfactory clinical results. Furthermore, visualization of concomitant suprascapular nerve injury is beneficial in cases with occult neurologic situations which may be misdiagnosed through

limited approaches. Randomized controlled trials with specific fracture-patterned patients are required to provide more reliable data regarding indications for surgical approaches.

Ethics Committee Approval: This study was approved by the University of Health Sciences Ümraniye Training and Research Hospital Clinical Research Ethics Committee (Date: 11.02.2021, Decision No: 8.10.1.TKH.4.34.H.GP.0.01/33).

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Conflict of Interest: None declared.

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ORIJİNAL ÇALIŞMA - ÖZ

Glenoid fossaya uzanan skapula cisim kırıklarının cerrahi tedavisi: Cerrahi teknik ve erken dönem sonuçlar

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AMAÇ: Bu çalışmanın amacı, açık redüksiyon ve internal fiksasyon yapılan skapula kırıklı hastalarda cerrahi tekniği tanımlamak ve fonksiyonel sonuçları değerlendirmektir.

GEREÇ VE YÖNTEM: Bu çalışmada, Mart 2014 Eylül 2019 tarihleri arasında üç farklı merkezde, Ideberg tip dört ve beş skapula kırıklı, Judet yaklaşımıyla ameliyat edilen 10 hasta geriye dönük değerlendirildi. En az iki yıllık takiplerin sonucunda, tüm hastaların DASH ve Constant skorları değerlendirildi.

BULGULAR: Hastaların üçünde sol ve yedisinde sağ tarafta kırık bulunmaktaydı ve ortalama yaşları 35.1±9.75'idi. Ortalama Constant ve DASH skorları sırasıyla 87.9±13.68 ve 5.57±5.21'idi. İki hastada, yaklaşık supraglenoid çentikten 2 cm'lik mesafede, supraskapular sinirde travmatik tam kat yaralanma tespit edildi ve epinöral tekniklerle tamir edildi. İki yıllık takipler sonucunda hastalarda infraspinatus kas atrofisi gelişti.

TARTIŞMA: Sonuç olarak, bu çalışma glenoid eklem yüzüne uzanan deplase skapula kırıklı hastaların cerrahi tedavisinde Judet yaklaşımının tatminkar sonuçlarıyla güvenli bir tercih olduğunu desteklemektedir. Ek olarak, iki hastada rastlanan ve cerrahi sırasında tamiri yapılan travmatik supraskapular sinir hasarının daha kısıtlı veya modifiye yaklaşımlarla tanı konmasının zor olacağı kanaatindeyiz.

Anahtar sözcükler: Judet; skapula kırığı; supraskapular sinir.

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