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Original Research Article

Fractures of the Scapula: Results and Functional Outcomes of Operative Treatment

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Abstract

Introduction: Scapula fractures are uncommon and usually caused due to high-energy trauma. Although most scapular fractures do not require surgery; highly displaced and malunited fractures of the scapula can lead to pain and poor functional outcome. Some recent studies have demonstrated that operative treatment can lead to superior functional recovery and improved outcomes. The indications for surgical treatment of scapular fractures, however, remain controversial. The aim of this study was to describe the surgical technique and report patient-based functional outcomes and complications following open reduction and internal fixation in patients with scapular fractures.

Material and Methods: The study comprised of 12 patients admitted in our hospital between January 2019 to December 2021 with scapula fracture meeting the inclusion criteria. After pre-operative X-ray and CT scan of scapula with 3D reconstruction Fractures were classified according to the revised (AO/OTA) classification system, after which surgery was carried out on these patients. An extensile or modified Judet approach was used depending on fracture configuration. The fracture was fixed using various combination of 3.5 locking and non-locking plates and lag screws. Patients were followed up for minimum of 12 months. Functional outcomes were measured using UCLA shoulder rating scores.

Results: Mean age of patients was 33 years (range 25-45 years). Mode of injury was road traffic accident in 8 cases, fall in 3 cases and sports injury in 1 case. All patients underwent surgery for scapula fracture. Postoperative radiographs demonstrated restoration of anatomic alignment, length, and translation. All fractures maintained fixation and reduction. No implant failures or loosening or infection was noted. All fractures united clinically and radiologically at 6 months follow-up. The mean shoulder range of motion at the time of final follow-up was 155^{O} (range, 90^{O} to 178^{O}) of forward flexion, 104^{O} (range 80^{O} to 122^{O}) of abduction, and 50^{O} (range 40^{O} to 70^{O}) of external rotation. The outcome was measured using the UCLA Shoulder rating scale. The mean score in our group was 32 (ranging between 20-35). 9 patients have excellent outcome, 2 had good results and 1 had poor results in our study.

Conclusion: We thus conclude that open reduction and internal fixation of displaced scapular fractures is a reliable, effective and safe treatment option, which leads to good to excellent functional outcomes and reliable union rate.

Keywords: Scapula Fractures, Trauma, Shoulder Surgery, Internal Fixation.

Introduction

Fractures of the scapula are uncommon and account for 0.5% to 1.0% of all fractures. [1,2] They are caused usually due to high-energy trauma and frequently have other concomitant injuries involving the pulmonary system, cervical spine, or cranial region. [3-5] Since scapula is covered by muscles and has a rich vascular supply, scapular fractures usually heal well. Also, the large arc of scapular–thoracic and glenohumeral joints compensates for most deformities. Due to these factors, most scapular fractures do not require surgery to achieve a satisfactory outcome. [6,7]

However, highly displaced and malunited fractures of the scapula can alter shoulder girdle function due to malalignment, arthrosis, dysfunction of the rotator cuff, scapulothoracic dyskinesis, and impingement type pain. [8-13] Some recent studies have demonstrated that operative treatment for scapular fractures lead to superior functional recovery and improved outcomes. [14-16]

No universally accepted parameters can be found in the existing literature, although some authors have suggested criteria based on displacement in CT scan and X ray to indicate surgical management. [16] The indications for surgical treatment of scapular fractures, however, remain controversial.

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

Material and Methods

The study comprised of 12 patients admitted in our hospital between January 2019 to December 2021 with scapula fracture on whom surgery was carried out .

Inclusion criteria included age equal to or older than 20 years, X-ray and/or CT diagnosed scapular fracture with or without glenoid fracture, and who met operative indications as per existing literature: [16]

1. Medial/lateral displacement (M/L) ≥20mm,
2. M/L ≥15mm if angular deformity $\geq 30^0$,
3. Angular deformity $\geq 45^0$,
4. Double lesion of superior shoulder suspensory complex (SSSC), with displacement ≥10mm in both lesions,
5. Glenopolar angle (GPA) ≤ 220, and
6. Open fractures.

Patients with polytrauma, hemodynamically unstable patients, patients with traumatic brain injury, cervical spinal cord injury and brachial plexus injury were excluded from the study.

All patients underwent pre-operative X-ray examination (true AP, Y scapular view) and CT scan of scapula with 3D reconstruction for assessment of fracture morphology and degree of displacement. Fractures were classified according to the revised (AO/OTA) classification system.[17,18] Patients were followed up until radiological union. Functional outcomes were measured using UCLA shoulder rating scores. [19-21]

Surgical technique

The surgery was carried out under general anaesthesia with patient lateral decubitus, “sloppy forward” position. The entire forequarter is prepped and draped, and the operative extremity was placed at 90 degrees over a foam wedge. An extensile or modified Judet approach was used depending on fracture configuration. The fracture was fixed using various combination of 3.5 locking and non-

locking plates. Glenoid fractures were fixed by lag screws.

A curved 'boomerang' incision starting from posterolateral lip of the acromion, and extending medial along the spine of the scapula, with right angle turn at the medial border of the scapula was made (classic approach). In some cases, modified straight incision starting from posterolateral lip of the acromion, extended in line with the tip of scapula, parallel, and lateral, to the medial scapular border was used.

Superficial dissection was carried out through skin and fat. The posterior deltoid muscle belly was identified and exposed. Deltoid muscle was sharply dissected off the scapular spine and base of acromion and retracted muscle distally and laterally to reveal the underlying infraspinatus and teres minor muscles. Teres minor was retracted inferiorly taking care to avoid injury to posterior branch of axillary nerve and infraspinatus retracted superiorly taking care to avoid injury to suprascapular nerve and artery. Lateral column and glenoid fossa exposure was done after identifying underlying posterior glenoid capsule deep to musculature and incising posterior capsule in line with muscular interval (Figure 1).

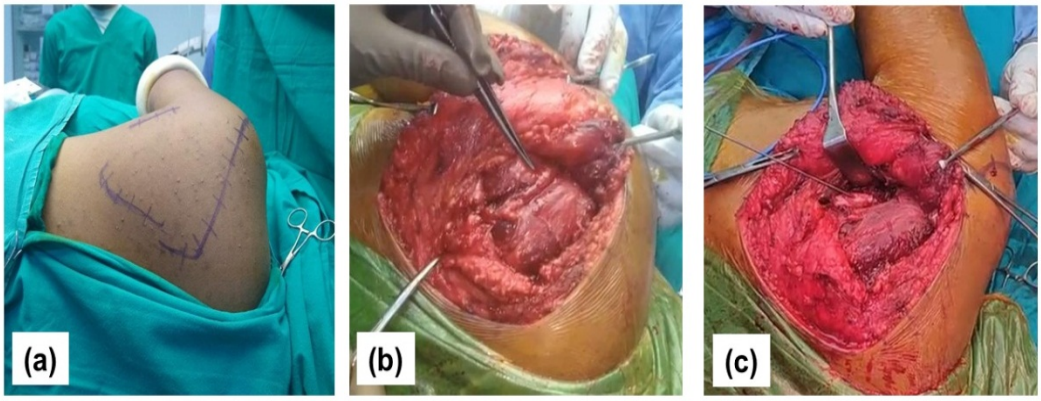

Figure 1: Intraoperative images showing position and surface marking (a); incision (b); and exposure (c).

Medial and inferior aspect of scapular body exposure was gained by dissecting the infraspinatus along off the medial border of scapula and retracting it superiorly and laterally thus maintaining its suprascapular neurvascular pedicle.

In highly communited or multi part fractures, lateral exposure was extended by tagging and cutting the infraspinatus tendon insertion approx. 1-2 cm lateral to its insertion on greater tuberosity and retracting medially. Medial exposure was extended by dissection of infraspinatus off the medial border of scapula and carried superiorly upto the scapular spine.

After gaining proper exposure and understanding fracture configuration, reduction was carried out using various instruments such as shoulder hook, Cobb elevator, pointed bone tenaculums, and Schanz pins. Generally, fixation involved 3.5-mm reconstruction, dynamic compression plates or locking plates for the spine and lateral border. 3.5-mm lag screw was be used for acromion process and glenoid fixation. Wound closure was done with absorbable suture in a layered manner.

Postoperatively, shoulder immobilization was used for support initially and gradually removed as tolerated. Physical therapy was started within 1–2 weeks postoperatively for passive ROM only. Active full ROM and strengthening began at 6 weeks postoperatively and was continued up to achievement of patient or therapist goals. OPD follow-up was at 2, 6, and 12 weeks and 1 year, more frequent follow-up was scheduled in case if any

symptoms or complaints were present. Radiographs were obtained at the 2-, 6-, and 12-week intervals. Patients were allowed to return to light work at 6 weeks and heavy work after 12 weeks.

Results

We saw 80 cases of scapula fractures during the course of our study, out of which 12 met operative indications and fulfilled the inclusion criteria. The majority of patients were males (10 males, 2 females). The patient age range was between 25-45 years, mean age was 33 years. All the fractures resulted from high-energy blunt trauma. Injury mechanism was road traffic accident in 8 cases, fall in 3 cases, and sports accident in 1 case. The most common associated injuries were rib fractures (n = 8) and ipsilateral clavicle fractures (n =4). (Table 1) The fractures were classified by AO/OTA classification. Preoperative radiographic criteria determined operative indications and approach. All patients underwent preoperative 3-dimensional reconstruction CT scan.

Table 1: Demographic Characteristics

	Category	Number
Gender	Male	10
	Female	2
Side	Right	9
	Left	3
Mode Of Injury	RTA	8
	Fall	3
	Sports related	1
Fracture Morphology (AO-OTA Classification)	Extra articular, Complex body fractures (14 B2)	6
	Body + articular segment without glenoid fossa involvement (14 F0.3)	3
	Body + Glenoid fossa involvement (14 F1.2,3)	3
Associated Injuries	Ribs and Ipsilateral clavicle	1
	Ribs only	7
	Ipsilateral clavicle only	3

Postoperative radiographs demonstrated restoration of anatomic alignment, length, and translation. All fractures maintained fixation and reduction. No implant failures or loosening was noted. In terms of the surgery, no infections, hematomas, dehiscence, postoperative flap numbness or hyperesthesia were noted. All fractures united clinically and radiologically at 6 months follow-up **(Figure 2)**.

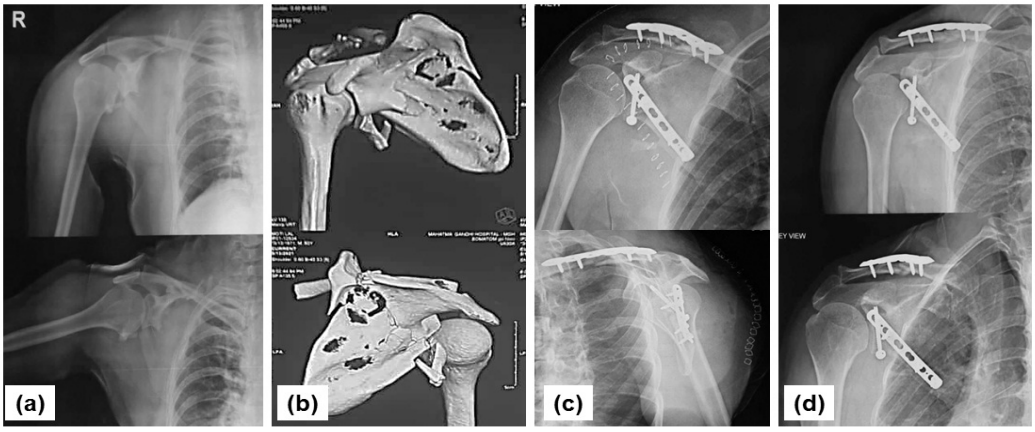

Figure 2: Preoperative X-ray (a); Preoperative CT Scan (b); Postoperative X-ray (c) and Follow-up X-ray (d).

Patients were followed up for at least 12 months after the surgery and outcomes measured at final followup. The ROM of the injured shoulder was measured **(Figure 3).**

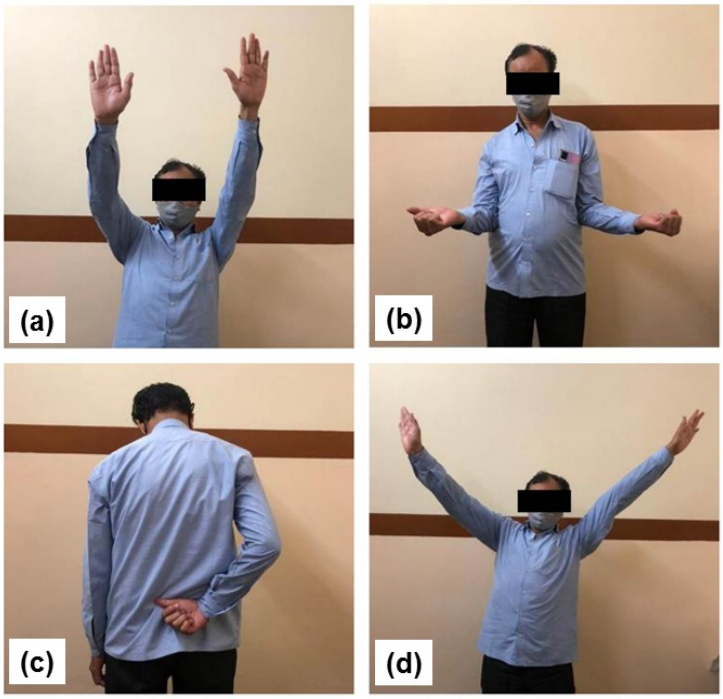

Figure 3: Clinical pictures at follow-up showing range of motion

The mean shoulder range of motion at the time of final follow-up was 155^{O} (range, 90^{O} to 178^{O}) of forward flexion, 104^{O} (range, 80^{O} to 122^{O}) of abduction, and 50^{O} (range, 40^{O} to 70^{O}) of external rotation.

The outcome was measured using the UCLA Shoulder rating scale. The mean score in our group was 32 (ranging between 20-35). 9 patients have excellent outcome, 2 had good results and 1 had poor results in our study. **(Table 2)**

Table 2: Shoulder function and outcome score on follow-up

S. N.	AO Type	Follow-up (Months)	ROM at Follow-up			Score (UCLA Shoulder rating scale)
			Flexion	Abduction	External rotation	
1	14 F1.3	12	94	104	46	28
2	14 B2	14	172	106	58	34
3	14 B2	12	166	120	60	34
4	14 F0.3	12	156	112	50	35
5	14 F1.2	14	90	80	40	20
6	14 B2	13	168	102	64	32
7	14 B2	12	174	98	60	35
8	14 F1.2	13	148	100	44	28
9	14 B2	12	170	102	58	34
10	14 F0.3	14	178	122	70	35
11	14 F0.3	16	174	104	64	34
12	14 B2	12	170	98	58	35
Mean		13	155	104	56	32

Discussion

In the past, conservative treatment was used predominantly and is still considered acceptable, but it often leads to poor functional outcome and altered shoulder girdle function in displaced fractures due to malalignment, dysfunction of the rotator cuff, arthrosis, impingement and scapulothoracic dyskinesis.[22] Displaced scapular neck fractures alter the working length of the muscles thereby reducing the force of the rotator cuff muscles and altering the normal lever arm due to displaced glenoid.[10] Recently, surgical treatment of scapular fractures shown to provide good and predictable outcome. [15,23] Indications for surgery, however, still remain controversial. Conclusion of studies evaluating the results of surgical and conservative treatment of scapular fractures are difficult to interpret because of infrequently reported radiographic fracture characteristics such as displacement and angular deformity. [6,15,24]

In our study, the mean range of motion (ROM) in the injured shoulder were 105^0 of abduction, 156^0 of forward flexion, and 60^0 of external rotation. These values were comparable to what were reported previous studies. Herrera et al. reported abduction 106^0; forward flexion of 152^0 and external rotation 61^0 in their study. [25] Aisinih et al, reported the mean range of motion (ROM) in the injured shoulder to be 114^0 of abduction, 157^0 of forward flexion, and 42^0 of external rotation. They attributed limitation of external rotation in their study to extended exposure of surgical fixation using the buttress plate.[26] Schroder et al. reported the average range of motion of the operatively treated and contralateral shoulders respectively, 154^0 and 159^0 of forward flexion, 106^0 and 108^0 of abduction, and 66^0 and 70^0 of external rotation [15].

Only a few studies have so far analyzed functional outcomes using UCLA scores following internal fixation of scapular fractures. Lou et al. reported the mean UCLA score to be 33.5 ± 1.6 (range 31–36) points. According to the UCLA score system, two patients achieved excellent results and one patients had good results in their study. [27] Hui Quin et al. reported mean UCLA score as 33±1.7 points (range, 30-35 points), resulting in an excellent outcome in 5 patients and a good outcome in 4 out of 9 patients in their study of surgical treatment of glenoid fractures. [28] Heim KA, et al. in their study found that overall, the average total UCLA score was 29.1 ± 1.90 (mean ± SEM) out of 35 points for combined pain, function, active forward flexion, strength of forward flexion, and satisfaction. Two patients had excellent results, six had good results, two had fair results, and one patient had a poor result. [29] Khallaf et al. [30] reported the results of 14 displaced scapular neck fractures treated surgically and evaluated at 6–30 months by the UCLA shoulder scale. They found 86% excellent and 14% good results after surgery. Li et al. noted 86% good to excellent results in 14 patients after operative treatment of displaced scapular neck fractures. [31] The mean score in our group was 32 (ranging between 20-35). 8 patients have excellent outcome, 3 had good results and two had poor results in our study. [32]

Our study has limitations. The sample size is small and consists of only patients treated operatively. Patients who were treated conservatively were not included. So, a comparison of the functional outcomes between patients treated operatively and conservatively could not be made. The surgical approach was mixed (classic and modified Judet) and we do not have enough data to compare between the two surgical approaches. Like many previous studies our follow-up was limited. The functional outcome score we used, the UCLA shoulder scoring system, is also not as sensitive as other scoring systems such as the Constant Score, so the

real limitations in function may not have been detected.

Conclusion

We thus conclude that open reduction and internal fixation of displaced scapular fractures is a reliable, effective and safe treatment option, which leads to good to excellent functional outcomes and reliable union rate.

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