e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(3); 1582-1586

Original Research Article

Comparative Study of Plating and Conservative Management of Scapula Fracture

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Received: 25-12-2023 / Revised: 23-01-2024 / Accepted: 26-02-2024
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Conflict of interest: Nil

Abstract:

Background: The appropriate course of action for displaced scapular fractures has been a subject of debate and inconsistency among surgeons. The complexity of the anatomy, approaches, and fracture patterns has deterred surgical intervention for these relatively rare fractures. It remains uncertain whether outcomes such as return to work, pain levels, or complications vary between nonoperative and operative treatment approaches for these fractures. Thus, we aimed to compare the rates of union, range of motion, ability to return to work, pain levels, and occurrence of complications between patients who underwent operative versus nonoperative treatment for scapular body and neck fractures.

Patients and Methods: We examined a consecutive series of 36 patients presenting with scapular fractures at a tertiary referral center over a two-year period (2021 to 2023) in an unblinded study. Of these patients, 18 received open reduction internal fixation, matched by age, occupation, and gender with 18 patients treated non-operatively. The distribution of AO/OTA fracture types was similar between the two groups. On average, the operative group exhibited greater displacement, shortening, and angulation compared to the nonoperative group. Patients were followed until healing or discharge from care (average follow-up duration, 1.5 years; range, 14–32 months), with assessments including complications, return to work status, and radiographic healing.

Results: All fractures achieved union, and no significant differences were observed in return-to-work rates, pain levels, or incidence of complications between the two treatment groups.

Conclusions: Our findings indicate that operative treatment of displaced scapular fractures yields comparable outcomes in terms of healing, return to work, pain management, and complication rates when compared to nonoperative treatment. We recommend against surgical intervention for scapular neck or body fractures with displacement less than 20 mm.

Introduction

Scapular fractures are relatively rare, accounting for approximately 1% of all fractures and 3% to 5% of upper extremity fractures. [1,2] This low occurrence is attributed to the scapula's mobility and anatomical protection. However, when fractures occur, particularly those that are substantially displaced, they can significantly impact shoulder function, leading to issues such as malalignment, arthrosis, rotator cuff dysfunction, scapulothoracic dyskinesis, and impingement-type pain. [3-6,19]

Historically, nonoperative treatments with early range of motion (ROM) have been successful in promoting predictable healing, facilitating a return to daily activities, and reducing pain due to the scapula's extensive muscular attachments and enveloping tissues, which aid in early and complete healing. However, challenges arise in cases requiring surgical intervention due to factors such as limited bone stock, complex anatomy, and difficult surgical access.

The decision to pursue operative treatment for scapular fractures remains contentious, with no universally accepted guidelines in the literature. Displaced fractures of the scapular body and glenoid neck, with or without intra-articular involvement, may be addressed surgically using a modified Judet approach and stabilized with mini-fragment fixation. [7] Nevertheless, it remains unclear whether there are differences in outcomes such as return to work, pain levels, or complications between nonoperative and operative approaches. To address this gap, we conducted a comparative analysis focusing on matched pairs of patients treated either nonoperatively or operatively, examining factors including union

rates, ROM, return to work, pain levels, and complications.

Methods

We listed 36 consecutive patients who presented to a tertiary referral centre with a scapular fracture in an unblinded study over a period of two years (2021 to 2023).

Criteria for inclusion were as follows: patients aged 18 years or older, diagnosed with scapular or glenoid fractures through radiographic and/or CT imaging, and treated with open reduction and internal fixation. Indications for operative intervention included criteria such as medial displacement exceeding 20 mm, shortening greater than 20 mm, angular deformity surpassing 45°, intra-articular step-off exceeding 3 mm, or presence of double shoulder suspensory injuries (DSSI) including clavicle, coracoid, acromion, or intra-articular displaced glenoid fractures.[8-10] Contraindications for surgery encompassed associated injuries such as severe traumatic brain injury with elevated intracranial pressures, unstable cervical spine injuries preventing lateral decubitus positioning, or severe burns impeding surgical access.

The exclusion criteria encompassed cases with associated neurovascular injuries, prior operations or fractures around the shoulder, open fractures, bilateral floating shoulder, rib fractures necessitating interventions like chest drainage or stabilization, presentation exceeding 48 hours post-injury, and patients unfit for shoulder surgical treatment within 24 hours of presentation.

Subsequently, 18 patients constituted the operative cohort. To ensure comparability, 18 patients were selected from the subsequent admissions who were managed nonoperatively. Matching was done for age, occupation, and gender. The remaining nonoperative patients (12) who were unmatched were excluded from the analysis.

The typical distortion of the upper body fragment or glenoid component often involves shortening, shifting inward, and bending towards the middle border or body.

To address fracture fragments, 2.5-mm Schantz pins with terminal threads were utilized, inserted at the back of the glenoid neck and the side border, sometimes along with a small external fixator to maintain alignment. For fractures solely affecting the glenoid neck or scapula, a plate was positioned evenly on both sides of the fracture line along the side border to ensure stable fixation.

In cases of glenoid fractures, screws were placed through the plate just beneath the glenoid lip. If medial fixation was necessary, the plate was positioned along the inner border, beneath the surface of the scapular spine. In instances where a clavicular fracture coincided with a simple scapular body or glenoid neck fracture, clavicular fixation was prioritized.

In the non-operative treatment group, patients were typically immobilized using a sling or immobilizer until pain subsided sufficiently to allow movement and function. In cases where lower extremity injuries were also present, patients were instructed to refrain from bearing weight on the affected limb until the fracture had visibly healed on radiographs and pain levels permitted. Range of motion exercises, strengthening routines, and rotator cuff rehabilitation commenced once pain levels permitted.

Both groups of patients underwent a rehabilitation protocol consisting of passive and active assisted exercises for four weeks following the removal of the bandage and sling. This phase was followed by unrestricted active exercises for an additional four weeks. The rehabilitation process was overseen by a single physiotherapist (OPS), who was not involved as an author in the study. Resistance and strengthening exercises commenced three months post-operatively, with all restrictions lifted at this stage.

Radiographs were taken at intervals of 2 weeks, 6 weeks, 12 weeks, and 6 months post-injury. Additional radiographs were conducted beyond the 6-month mark if clinical examination indicated persistent pain, asymmetrical range of motion, or mechanical symptoms.

Statistical analysis was done using SPSS v26 (IBM Corp., Armonk, New York). A p-value < 0.05 was considered significant.

Descriptive analyses were initially conducted for all variables pertinent to the research questions. To compare categorical variables such as return to work and complications between treatment groups, chi-square analysis was employed. For continuous variables such as fracture measurements, rates of union, and range of motion (ROM). T-tests were utilized to compare between treatment groups.

Results

Most of the study participants were males (n=32; 88.8%). The mean age was comparable in both the groups (41.8 years vs 42.2 years).

Five individuals in the operative group had a left sided injury (27.7%) while there were seven such cases in non-operative group (38.9%). In all, 23 patients (63.9%) were injured in a road traffic accident, 12 (33.3%) had a fall from height and one (2.8%) was a pedestrian. Fracture of surgical neck of scapula was the most common site of fracture (n=19; 52.7%), followed by body of scapula (n=15; 41.6%) and anatomical neck (n=1; 2.8%). (Table 1)

Table 1: Clinico-Demographic profile of study participants (N=36)

Demographic variables		Operative (n = 18)	Non-operative (n = 18)
Gender	Male	17 (94.5%)	15 (83.3%)
	Female	1 (5.5%)	3 (16.7%)
Age	Mean	41.8	42.2
	Range	(21–70)	(21–65)
Side of Injury	Right	13 (72.3%)	11 (61.1%)
	Left	5 (27.7%)	7 (38.9%)
Mechanism of injury	Road Traffic Accident	10 (55.6%)	13 (72.3%)
	Fall	7 (38.9%)	5 (27.7%)
	Pedestrian	1 (5.5%)	0
Goss classification of site of fracture	Body	7 (38.9%)	8 (44.5%)
	Anatomical neck	1 (5.5%)	0
	Surgical neck	9 (50%)	10 (55.5%)
	Acromion	0	0
	Coracoid	0	0

The preoperative displacement, shortening and angulation was comparable in both the study groups – displacement ($p<0.001$), shortening ($p<0.001$), angulation ($p<0.001$). (Table 2)

Table 2: Preoperative fracture parameters (N=36)

Measurement		Mean	Minimum	Maximum	p-value
Displacement (mm)	Operative (n = 18)	29.2	15	45	<0.001
	Nonoperative (n = 18)	18.4	10	35	
Shortening (mm)	Operative (n = 18)	36.3	15	50	<0.001
	Nonoperative (n = 18)	19.1	5	40	
Angulation (degrees)	Operative (n = 18)	25.9	0	100	<0.001
	Nonoperative (n = 18)	16.1	0	45	

All fractures successfully healed, and there were no discernible differences in return-to-work rates, pain levels, or complications between the two groups. The final recorded range of motion (ROM) was comparable in the two groups (Table 3).

Table 3: Range of motion in study participants (N=36)

ROM (degrees)		Mean	SD	Minimum	Maximum	T-value, p-value
Forward flexion	Operative (n = 18)	151.8	39.2	40	175	-0.423
	Nonoperative (n = 18)	142.1	37.1	70	180	0.529
Abduction	Operative (n = 18)	145.0	38.2	60	180	-0.898
	Nonoperative (n = 18)	123.2	41.3	75	180	0.281
External rotation	Operative (n = 18)	48.1	30.4	15	90	1.682
	Nonoperative (n = 18)	64.2	33.2	40	90	0.121
Internal rotation	Operative (n = 18)	55.2	31.7	15	90	2.318
	Nonoperative (n = 18)	73.2	18.2	60	95	0.047

Similar proportions of patients resumed their pre-injury jobs, with 16 out of 18 (88.8%) in the nonoperative group and the operative group. Changes in employment status or failure to return to work (two out of 18 in each group) were primarily due to associated injuries and polytrauma rather than the scapular injury itself.

Persistent pain was reported by one patient in each group. There were no treatment-related complications associated with scapular fracture management in either group, and no patients in the operative group reported incisional numbness, pain, or scarring.

Discussion

The orthopaedic literature offers limited advice on how to manage patients with a scapular fracture. There is a lack of consistency in the criteria used to evaluate treatment effectiveness, and evidence supports both conservative and surgical approaches.

Scapular fractures are infrequent occurrences, typically resulting from high-energy incidents and often accompanied by other injuries. [11-14,20] The scapula is surrounded by robust muscle tissue, facilitating rapid and reliable healing of fractures. [6]

Due to the absence of a definitive framework for determining whether surgery or non-surgical methods are preferable, we conducted a

comparative analysis. We examined matched pairs of patients who received either nonoperative or operative treatment, focusing on factors such as union rates, range of motion (ROM), return to work, and pain levels.

Due to the scapula's rich vascular network and muscular connections, it is expected that the rates of union would be high. [15] Surgical intervention may compromise the blood supply to soft tissues, but it does not seem to hinder the healing process compared to non-surgical methods. However, the timing of postoperative imaging can affect the reported healing time, and the commonly used intervals of 2, 6, and 12 weeks may not be adequate. Factors such as body fat or the presence of ribs can make it difficult to see the fracture healing process clearly.

Fractures treated non-surgically did not show any displacement or angulation over time, even with therapy. [16] While non-surgical fractures did not worsen in terms of displacement and translation over time, they did undergo remodeling. Despite using specific plates for fixation, there were no instances of failure or loosening.

The bone quality around the areas where screws were placed was good, although the screws had to be relatively short. However, the time required for union or healing did not hinder functional recovery in patients who underwent surgery. Nonetheless, some patients from both surgical and non-surgical groups experienced persistent pain despite radiographic evidence of fracture healing.

Results from a meta-analysis of case series revealed that nonoperative treatment was employed in 99% of isolated scapular body fractures and 83% of glenoid neck fractures. [17] Among these cases, nonoperative management yielded favorable outcomes, with 86% of scapular body fractures and 77% of glenoid neck fractures resulting in good or excellent results.

Another literature review found that 85% of scapular fractures, whether treated operatively or nonoperatively, achieved good to excellent outcomes over an average follow-up period of 4 years.6 In our patient population, close to 90% were able to return to work within 6 months following the injury. Final function and outcomes were primarily influenced by polytrauma unrelated to the scapular fracture.

Regarding non-surgical approaches, studies such as Edwards et al. [18] have shown promising outcomes for minimally displaced fractures. However, approximately a quarter of fractures in their study were displaced more than 5 mm, and non-surgical methods consistently resulted in weaknesses, shoulder depression, lateral bump, and crepitation. Consequently, when considering specific outcome measures, non-surgical management of displaced scapular neck and body fractures does not reliably lead to an early, pain-free return to pre-injury function. Conversely, operative treatment consistently leads to patients regaining pre-injury strength, range of motion (ROM), and function. Ada et al. found painless ROM and function and recommended surgery for fractures displaced over 9 mm and/or angulated more than 40°. Bauer et al. observed excellent outcomes and no complications with operative intervention, although their study only involved two scapular body or neck fractures, limiting its impact on treatment decisions. Hardegger et al [2] advocated for surgical fixation for fractures displaced more than 10 mm.

Our analysis of matched cohorts in both nonoperative and operative groups found statistical similarity across all demographics except for factors like fracture displacement, shortening, and angulation. We observed comparable scapular fracture patterns in both groups when classified using the Goss fracture classifications. [19]

The decision between nonoperative and operative treatment depended on factors such as surgeon and patient preferences, as well as the extent of fracture displacement and associated injuries. As validated musculoskeletal functional outcomes surveys for scapular fractures were not available at the time of treatment, it's possible that the final outcomes of operative treatment could have been similar within the same fracture group.

The research faced several constraints. Patients were monitored only until they achieved complete radiographic healing or returned to their baseline level of functioning, which typically occurred within an average of 1.5 years, rather than being observed over a longer-term period with intervals of 18 to 24 months.

Secondly, the decision for operative intervention depended on the surgeon and the specific fracture, rather than being determined through a randomized treatment approach. Lastly, the availability of comparable data to previous studies on scapular research was inconsistent, lacking clarity, and not fully comprehensive. Despite these limitations, the study's strengths lie in the uniformity of treatment across patients, who received consistent operative and nonoperative indications and protocols. Additionally, the utilization of a matched pair cohort analysis facilitated a comparison between the two treatment groups while mitigating the influence of confounding factors.

Conclusion

Surgical fixation effectively realigned and stabilized severely displaced scapular body and neck fractures. Both surgical and non-surgical

treatments for scapular fractures yielded high rates of healing, successful return to work, and few complications. Although surgical fixation achieved flawless restoration of anatomical function without complications, it's not advisable for scapular fractures with less than 20 mm displacement.

Further randomized prospective control studies, incorporating functional outcome data, are necessary to better determine when surgical fixation is warranted, necessitating cooperation and communication among researchers.

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