

Open Reduction and Internal Fixation of Scapula Fractures in a Geriatric Series

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Abstract

The purpose of this small descriptive series was to report patient and injury characteristics, as well as, surgical and functional outcomes in patients aged 70 years or older, with operative scapular fracture. A retrospective review of 214 scapula fractures identified 6 consecutive geriatric patients aged 70 years or older and formed the basis for this study. Outcomes reported include surgical complications; disabilities of the arm, shoulder, and hand (DASH); range of motion (ROM); and strength assessment at the 6-month postoperative interval and final follow-up. All patients were community ambulators and 5 of the 6 patients routinely performed recreational activities that required shoulder strength and/or motion. Outcomes were attained on all patients at greater than 1 year with a mean of 23.2 months. There were no surgical complications and all fractures united. The mean ROM expressed as a percentage of contralateral ROM ranged from 82% to 100% at both 6-month and final follow-up. The mean strength expressed as a percentage of contralateral strength ranged from 63% to 82% at the 6-month follow-up and 94% to 100% at the final follow-up. The mean DASH score was 12.3 at final follow-up. Our conclusion is that operative treatment for displaced scapula fractures appears to be safe and can yield good functional results in patients aged 70 years and older.

Keywords

geriatric trauma, scapula fractures, orthopaedics

Introduction

Geriatric orthopaedic injuries resulting from low-energy accidents, such as hip fractures and fractures of the distal radius, have been well studied. However, there is a paucity of literature regarding high-energy orthopaedic injury in the elderly population^{1,2} and no literature to our knowledge specific to the treatment of scapula fractures in the geriatric segment. The purpose of this study is to report on the diagnosis, decision making, and operative treatment of 6 patients aged 70 or older who presented with a scapula fracture. The clinical results including functional outcome are reported.

Today's geriatric population in the United States surpasses that of other age-groups and comprises the fastest growing cohort of the population. In 2009, The US Census Bureau reported that 12.9% of Americans were aged 65 years or older. The elderly population is expected to double by 2030 from the 2000 census and progress to reach 20.1% of the total US population by 2050.^{3,4} A subset of this population participate in physical activities formerly perceived as being exclusive to youth. This subset may benefit from surgical intervention following traumatic injury in order to help preserve their functional capacity for future years and decades of life. The understanding of operative technique, indications, and outcomes of scapula fractures is a fast evolving topic over the past decade as well. Most of the clinical investigations on the scapula focus on a

younger demographic, and therefore, high-energy mechanisms are highlighted as a common theme in these patients.⁵⁻¹⁴ Much of the indications for surgery were born out of such series with an assumption that young trauma victims have a high functional demand and expectation and makeup an important part of the labor force.

The geriatric patient, however, is more susceptible at the time of surgery due to complications from comorbidities, limited physiologic reserve as well as weakened bone structure from osteoporosis. These additional factors must influence the decision to operate, particularly in a bone that has a high rate of union.^{7,13,15,16} It is with this context that we present the decision making and results around a small operative cohort of elderly patients with scapula fractures.

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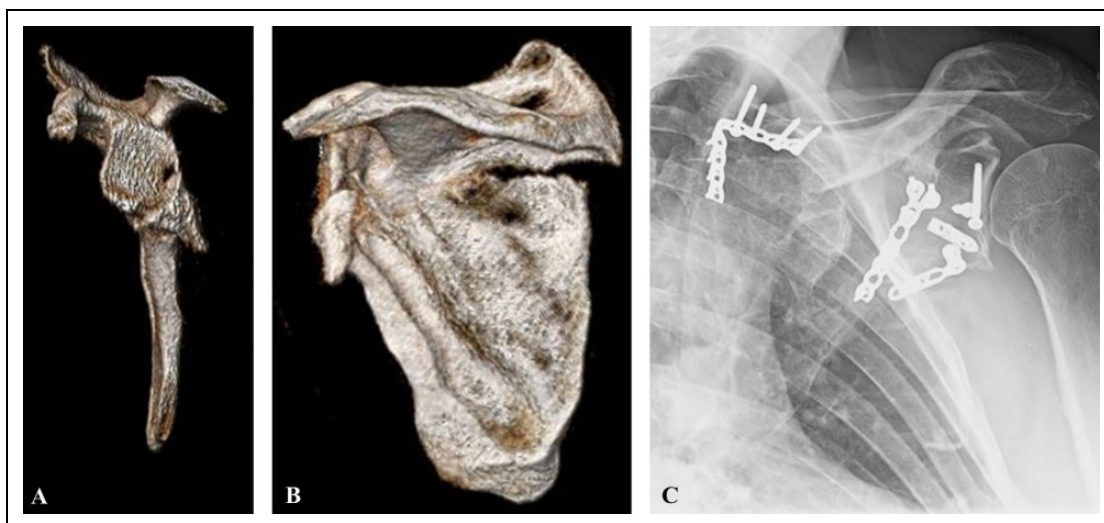


Figure 1. Three-dimensional computed tomography (CT) oriented in the (A) scapula Y view and (B) posterior–anterior (PA) view showing the highly displaced fracture sustained by patient #1. Eight millimeters of intra-articular step off and 3 cm of displacement at the lateral border were measured. C, Postoperative anterior–posterior (AP) view shows the fixation strategy employed by the senior author.

Patients and Methods

This is a retrospective study of an operative database consisting of patients treated for scapula fractures. Between 2002 and 2012, the senior author (PAC) operated on 214 scapula fractures (54% were referred from outside institutions) with the following surgical indications: articular step-off or gap >4 mm, ≥ 20 mm medial/lateral (M/L) displacement (lateral border offset), $\geq 45^\circ$ of angular deformity on a scapular-Y X-ray, the combination of angulation $\geq 30^\circ$ plus M/L displacement ≥ 15 mm, double disruptions of the superior shoulder suspensory complex both displaced ≥ 10 mm, glenopolar angle $\leq 22^\circ$, and open fractures.^{7,13,17–20}

All patients, 70 years of age or older, who met the above-mentioned operative criteria, who reported a high functional demand preoperatively and functional expectation postoperatively, were enrolled. We analyzed medical records to report patient demographics, which surgical indications were met, and any record of specific activity and lifestyle demands of the patient. In addition, fracture patterns and details of the operation are reported including blood loss, operating room (OR) time, implants utilized, and hospital length of stay. Fracture types were recorded as were any associated orthopaedic and nonorthopaedic lesions.

Additionally, postoperative function as measured by range of motion (ROM), strength, and functional outcome was documented. The ROM was measured with a 14-in handheld goniometer,²¹ and the strength was measured with a handheld dynamometer²² (MicroFET 2; Hoggan Health Industries, Draper, Utah), and both measurements were compared to the contralateral extremity as an internal control. The functional outcome was assessed with a disabilities of the arm, shoulder, and hand (DASH) tool²³ and 36-item Short Form Health Survey version 1 (SF-36V1)²⁴ and SF-36V2.²⁵ The patients were scheduled for follow-up at approximately 2, 6, 12, and 24 weeks after surgery as well as at 12-month postoperatively.

This study was approved by the Hospital Institutional Review Board and reviewed by our hospital Clinical Scientific Review Committee.

Results

Our review identified 6 patients who met study inclusion. Of the 6 cases, 5 were referred to the senior author (PAC) for consideration of surgery. There were 3 males and 3 females included in the study with a mean age of 78.3 (range = 73–90) years. All 6 cases were community ambulators. Of the 6 cases, 5 considered themselves highly active, 1 because of the enjoyment of gardening, 2 patients exercised on a regular basis, while 1 was an avid golfer who played multiple times per week (Figure 1), and another who enjoyed downhill skiing and wilderness portaging.

With regard to comorbidities, 3 of the patients had none, while 1 had psoriatic arthritis. One patient (#3) underwent an ipsilateral total shoulder replacement 10 years prior to her scapula injury and another patient (#6) had undergone a contralateral total shoulder replacement previously, as well. Three patients had a previous diagnosis of osteoporosis. There were 2 who had documented low serum vitamin D levels, including patient #3. Table 1 provides demographics and comorbidities for each patient.

The original mechanism of injury was from a motor vehicle accident for 2 of the cases. Two were sustained in falls—one off of a 4 meter roof and the other while downhill skiing, and 1 was the result of a snowmobile collision. The last was an iatrogenic injury that occurred during the course of an operation to perform a total shoulder arthroplasty (Figure 2). Of the 6 fractures, 5 were intra-articular, 3 of which also extended into the scapula body. The remaining fracture was a symptomatic nonunion of the acromion.

After lengthy discussion with each patient regarding the patient's baseline function, and their expectation of function after treatment, as well as a critical assessment of surgical risk,

Table 1. Patient Demographics and Comorbidities.^a

Patient number	Age	Gender	Activity levels	Comorbidities	Additional injuries	Bone quality	Vit D	ASA
1	75	M	Avid golfer	None	Rib fractures Splenic laceration Pneumothorax	Unknown	16.6 (deficient)	1
2	75	M	Store owner Regular exercise	Psoriatic arthritis	Rib fractures Pneumothorax	Osteoporosis	n/a	2
3	76	F	Bus driver Gardening	Ipsilateral shoulder replacement	Tibial plateau Metacarpal Fx Pubic ramus fx	Osteoporosis	23.2 (insufficient)	3
4	73	M	Downhill skiing and wilderness portaging	None	None	Unknown	n/a	2
5	80	F	Exercise	None	TBI Pelvic ring	Unknown	n/a	3
6	90+	F	Independent ambulator	Contralateral shoulder replacement	None	Osteoporosis	n/a	2

Abbreviations: Vit D, laboratory analysis of vitamin D 25-hydroxy; TBI, traumatic brain injury; ASA, American Society of Anesthesiologists physical status classification system; M, male; F, female; n/a, not applicable; fx, fracture.

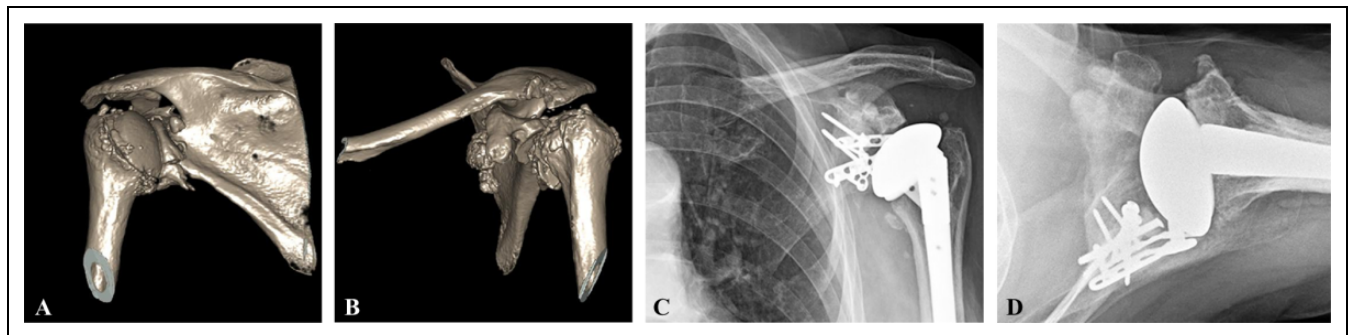


Figure 2. A and B, Three-dimensional computed tomography (CT) of patient #6 who sustained a comminuted intra-articular fracture during a total shoulder replacement procedure. Postoperative (C) anterior–posterior (AP) and (d) axillary X-rays show reconstruction of glenoid with no evidence of subluxation of the humeral prosthesis.

the collective decision was made to operate on each of the patients. Operative indications, surgical approach, blood loss, and operative time are provided in Table 2.

Outcomes were attained in all patients at greater than 1 year with an average follow-up of 23.2 months (range = 13.5–33.1). In 5 of the 6 patients, quantitative functional measures were obtained at both 6- and 12-month or greater intervals. The mean ROM for forward flexion, abduction, and external rotation expressed as a percentage of contralateral ROM was 95%, 95%, and 82% at the 6-month follow-up and 100%, 96%, and 88% at the final follow-up. The strength for forward flexion, abduction, and external rotation expressed as a percentage of contralateral strength was 73%, 82%, and 63% at the 6-month follow-up and 100%, 100%, and 94% at the final follow-up. Patient number 6 was unable to report to her clinician for a follow-up examination. An in-depth interview via telephone at 23 months following surgical intervention revealed that the patient was able to perform all activities of daily living. The patient also reported occasional shoulder pain

in her ipsilateral arm but mentioned that the pain was not severe enough to merit pain medication. The patient was able to flex her arm at least 90° and was able to lift light-weight objects above her shoulder. Patient number 6 also denied any additional surgeries for the affected limb.

The mean DASH score at 6 months was 8.6 (range = 0–32.5) and 12.3 (range = 0–50.8) at final follow-up. Patient number 3 was unique in that she had previously undergone a total shoulder replacement and presented with an ipsilateral periprosthetic, intra-articular fracture following a motor vehicle collision. Excluding this patient resulted in a mean DASH score of 2.7 at both 6-month and final follow-up. Mean SF-36V1²⁴ and SF-36V2²⁵ scores were within normal limits for all parameters. Mean SF-36V1 scores for the 6-month follow-up were 88 and 89.2 for the physical and the mental health components, respectively. Mean SF-36V2 scores at final follow-up were 49.2 and 47.6 for the physical and mental health components, respectively. Table 3 provides each patient's functional outcomes. To date, there

Table 2. Fracture and Surgical Characteristics.

Patient number	Mechanism	Fracture type	Operative indication	Blood loss, mL	Op time, minutes	Surgical approach	Length of stay
1	Snowmobile collision	Articular and body	8 mm intra-articular step 3 cm M/L displacement	200	290	Minimally invasive posterior	1 day post-op 6 days total
2	Fall from height	Articular and body	2.7 cm M/L displacement 6 mm intra-articular gap	250	170	Posterior interval	2 days post-op 2 days total
3	MVC	Periprosthetic fracture (articular)	4 mm intra-articular step off	650 ^a	413 ^a	Extensile posterior	5 days post-op 13 Days total
4	Skiing	Articular	4 mm intra-articular step off	200	166	Straight posterior	3 days post-op 3 days total
5	MVC	Acromion	Symptomatic nonunion	50	132	Straight posterior	1 days post-op 1 days total
6	Iatrogenic during total shoulder replacement	Articular	1 cm intra-articular step and gap	300	205	Staged: 1. Straight posterior 2. Deltpectoral	2 days post-op 7 days total

Abbreviations: MVC, motor vehicle collision; M/L, medial-lateral; Op, operative; ORIF, open reduction and internal fixation.

^aORIF of tibial plateau was also performed and contributed to blood loss and op time.

Table 3. Six-month and Final Patient Outcomes.

6-Month follow-up

Patient number	DASH	ROM ^a (injured/contralateral)			Strength ^b (injured/contralateral)		
		FF	ABD	ER	FF	ABD	ER
1	0	123/126	87/93	65/68	13/15	14/13	14/17
2	4.2	155/150	114/114	68/85	11/18	10/10	15/24
3	32.5	100/134	100/120	65/83	8/13	10/14	10/17
4	0	118/116	88/83	36/62	12/14	9/10	6/17
5	6.5	140/140	90/95	65/65	12/15	4/7	17/21
6	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c
Mean	8.64	127/133	96/101	60/73	11/15	9/11	12/19
Percent		95	95	82	73	82	63

Final follow-up

Patient number	Follow-up, months	Return to ADL	DASH	ROM ^a (injured/contralateral)			Strength ^b (injured/contralateral)		
				FF	ABD	ER	FF	ABD	ER
1	33.1	Y	0	133/133	98/102	55/55	21/20	18/18	23/20
2	13.5	Y	0.8	162/162	92/92	46/53	20/19	15/12	19/22
3 ^d	27.8	Y	50.8	112/136	72/85	42/52	9/7	8/6	14/11
4	23.0	Y	3.3	149/125	100/94	42/59	14/14	12/11	14/18
5	18.9	Y	6.5	140/140	90/95	65/65	12/15	4/7	17/21
6	23.0	Y	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c	n/a ^c
Mean	23.2	6/6	12.3	139/139	90/94	49/56	15/15	11/11	17/18
Percent	100	100		100	96	88	100	100	94

Abbreviations: ADL, activities of daily living; DASH, disabilities of the arm, shoulder, and hand; ROM, range of motion; FF, forward flexion; ABD, abduction; ER, external rotation; n/a, not applicable.

^aThe values are given in degrees as the injured/noninjured shoulder.

^bThe values are given in pounds of force as the injured/noninjured shoulder.

^cPatient was not able to travel to clinic. A detailed phone interview revealed that the patient is able to perform all ADLs with minimal pain and does not use pain medications chronically.

^dAt final follow-up, patient 3 had a known rotator cuff tear on the uninjured side, limiting the range of motion and strength of the uninjured side.

have been no reported complications or secondary surgical procedures.

Discussion

Operative treatment of scapula fractures is only recently being accepted for certain displaced fractures in which the concern for deformity and dysfunction is heightened. Displaced scapula fractures more commonly occur in younger patients and most often from high-energy mechanisms. Furthermore, in this demographic, the expectation for optimal functional outcome is high. It stands to reason, therefore, that since operative indications have been developed out of this epidemiological context, the role for surgery in the geriatric patient remains unclear. First, there are few highly displaced fractures that occur in the elderly patients; second, their baseline function and functional expectation are less than that of younger patients; and finally, there are no current series or reports to our knowledge of scapula surgery in the elderly patients to guide surgeons.

Somewhat contradictory to the common misunderstanding that scapula fractures occur exclusively in a younger patient demographic is a finding by Court-Brown and Caesar who reported in an epidemiologic study a mean age of 52.1 years old for patients with scapula fractures. This age ranked 11th in frequency in a pool of 27 separate bones—ranking a higher mean age in prevalence than fractures of the ankle, clavicle, and tibia.⁹ What has not been discussed is whether the relative indications for surgery published in the literature are relevant to older patients who may have more modest physical demands. To the best of our knowledge, our report is the first case series of scapula fractures treated operatively in geriatric patients. In fact, only a single geriatric patient older than 70 years old was found in the literature in a series on open reduction and internal fixation for scapula fractures, which was previously reported by the senior author.⁷ However, it is becoming well acknowledged that severe scapula malunion leads to loss of motion, strength, endurance, and a patient's perception of dysfunction.^{10,15,26} In the current study, it was the senior author's belief that conditions were met for operative intervention in 6 patients older than 70 years of age, and we felt it was important to begin reporting the experience to aid in the decision making on patients who are certain to be encountered more commonly.

Our results demonstrate that surgery can be performed safely and with the expectation of a good outcome in properly selected patients. There were no complications of surgery or adverse events related to the patients' medical conditions, and all the patients were satisfied with their result, had functional shoulders, and would have chosen to have the operation if presented with the same situation again. The primary limitation of our study is that this small retrospective series is without a nonoperative comparative cohort, but the rarity of the condition makes such a comparison unlikely at this time. There are a number of variables, such as fracture pattern, history of a previous arthroplasty, or baseline function that are variables for which it would be difficult to control. Additionally, the senior author has a referral practice for this injury and it is unknown whether the surgical

results are generalizable. Although the fractures reported in this cohort are dissimilar and represent a spectrum of scapula challenges that might be encountered in the elderly patients, whatever the scapula fracture pattern and the approach it requires, the challenges of osteopenia and sarcopenia and comorbidities of the elderly patients can be overcome with a good surgery and rehab program. Indeed, we believe that the surgeon should not assume that such an operation should be avoided, just because it is a scapula, which has traditionally been treated nonoperatively, or just because it is in an elderly person, or both. A fracture of the scapula bone in which a frailer individual with less reserve and poorer bone stock, and one in whom would become severely dysfunctional if left alone, should be considered strongly for surgery if their baseline function warrants it.

In conclusion operative treatment for displaced scapula fractures appears to be safe and can yield good functional results in patients aged 70 years and older. Further critical investigation of this emerging population is warranted to confirm our study findings.

Declaration of Conflicting Interests

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