Injury, Int. J. Care Injured 46 (2015) 699–702

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

A comparison of actual and theoretical treatments of glenoid fractures

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ARTICLE INFO

Article history:
Accepted 24 January 2015

Keywords:
3D computed tomography
Glenoid fracture
Indications for surgery
Operative treatment
Radiographs

ABSTRACT

Background: There is no consensus on the operative treatment of glenoid fractures. The purpose of this study was to see whether there was a difference between how patients with a glenoid fracture would receive treatment according to theoretical operative indications based on the measurement of computed tomography (CT) scans and radiographs and the treatment they actually received in our institutions.
Methods: A total of 457 patients with a scapular fracture were treated in two level 1 trauma centres between January 2002 and August 2011. Ninety-eight patients with a glenoid fracture were retrospectively analyzed. Intra-articular gap, medial or lateral (M/L) displacement, angular deformity, and glenopolar angle (GPA) were measured on CT scans or radiographs to determine theoretical indications for operative treatment.
Results: Twenty-four patients (25%) actually had operative treatment, while 35 patients (36%) fulfilled at least one theoretical criterion to proceed with operative treatment with a medium correlation between theoretical indications for surgery and the actual operative treatment. All the patients with a theoretical indication for surgery had an intra-articular gap with a step-off of >4 mm. A bony Bankart lesion with shoulder dislocation and injury in sports was retained in the best multivariable model as indications for the actual surgery.
Conclusion: Theoretical guidelines for surgery on glenoid fractures may not have much influence on the current treatment.
Level of evidence: Therapeutic, level III.

Introduction

Scapular fractures are uncommon and usually managed nonoperatively [1,2]. However, operative treatment is increasingly advocated. One of the most common indications for surgery has always been a displaced glenoid fracture associated with glenohumeral instability, but other indications are debated [3,4].

A study by Cole et al. [5] described radiographic thresholds for operative treatment in patients with a fracture of the scapula including intra-articular gap with a step-off of ≥4 mm and 25% glenoid involvement, ≥20 mm medial or lateral (M/L) displacement, ≥45° of angular deformity, the combination of angulation of ≥30° plus M/L displacement of ≥15 mm, and a glenopolar angle (GPA) of ≤22°. These recommendations are debated. Some studies suggested that nonoperative treatment of even displaced scapular fractures results in satisfactory outcomes [6,7]. There may be less debate and variation for articular fractures.

The purpose of this study was to determine whether there was a difference between the theoretical treatment of glenoid fractures according to the radiographic guidelines described by Cole et al. [5] and the treatment they actually received in our institutions. Secondary analyses evaluated patient and radiographic factors associated with actual and theoretical operative treatments.

Materials and methods

Under Institutional Review Board (IRB) approval, 457 patients with a scapular fracture were retrospectively identified from a prospectively collected trauma database. They were treated between January 2002 and August 2011 at two level 1 trauma centres. The inclusion criteria that patients should be aged 18 or greater with a glenoid fracture were met by 98 patients.

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http://dx.doi.org/10.1016/j.injury.2015.01.037
0020–1383/

Seventy-seven percent of the patients with a glenoid fracture were men. The average age of the patients was 51 years (range 19–89 years). The most common cause of injury was a fall, followed by a motor vehicle collision as a passenger (34% and 31%, respectively). Fifty-eight percent of the patients had a fracture of the left scapula, 12% had a fracture associated with glenohumeral dislocation, and 75% had concomitant injuries. Ninety percent of the patients had radiographs of the shoulder and 89% had computed tomography (CT) of the thorax or scapula (Table 1).

Two investigators who were not involved in the patients' care reviewed the medical records for age, sex, race, employment before accident, mechanism of injury, radiographic examination, fracture side, concomitant shoulder dislocation, concomitant injuries, Injury Severity Score (ISS) [8], and the actual treatment (operative or nonoperative – the decision to proceed with either operative or nonoperative treatment was a shared decision between the surgeon and the patient). The fractures were classified on CT scans and, if no CT scans were available, on radiographs according to the Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association (AO/OTA) classification [9] by an orthopaedic trauma-trained surgeon (one of the two investigators).

Radiographic measurements were performed with Aquarius viewer (TeraRecon Inc., Foster City, CA, USA) on three-dimensional (3D) CT reconstructions, simulating anteroposterior (AP) and scapular-Y views. AP and Y radiographs were used when CTs were not available. Theoretical operative indications were classified according to the radiographic criteria by Cole et al. as follows: intra-articular gap with a step-off of $\geq$4 mm and 25% glenoid involvement, $\geq$20 mm M/L displacement (lateral border offset), $\geq$45° of angular deformity on a scapular-Y radiograph (angulation), the combination of angulation of $\geq$30° plus M/L displacement of $\geq$15 mm, and a GPA of $\leq$22° (Table 2) [5].

The means, standard deviations, ranges, and frequencies of the different demographic variables were calculated for the actual and the theoretical operative treatment groups. All parameters were sought in bivariate analysis. Variables with significant ($p < 0.05$) or near-significant ($p < 0.1$) relationships were evaluated in multivariable logistic regression using the backward conditional method to assess predictors of operative treatment and theoretical radiographic operative indications. The chi-square test was used to measure the association between the actual treatment (operative/nonoperative) and the theoretical radiographic operative indications (yes/no). Most commonly, the phi coefficient is used to measure the strength of the association. Cohen's criteria (1988) [10] described a coefficient of 0.10 for a small effect, 0.30 for a medium effect, and 0.50 for a large effect, with higher values indicating a stronger association between the two variables.

Results

Twenty-four patients (25%) actually had operative treatment, while 35 patients (36%) fulfilled at least one theoretical criterion to

Table 1
Demographic overview of 98 glenoid fractures.

Parameters		Total	Treated nonoperative	Treated operative	*p*-value	Recommendation nonoperative	Recommendation operative	*p*-Value
Age (y)	Mean (±SD)	51 (±19)	53 (±20)	47 (±18)	0.21	53 (±21)	48 (±14)	0.22
	Range	19–89	19–89	19–81		19–89	22–81	
Sex	Female	23 (24%)	16 (22%)	7 (29%)	0.45	16 (25%)	7 (20%)	0.55
	Male	75 (77%)	58 (78%)	17 (71%)		47 (75%)	28 (80%)	
Race	White	79 (81%)	59 (80%)	20 (83%)	0.45	49 (78%)	30 (86%)	0.66
	Black	6 (5.1%)	6 (8.1%)	0 (0.0%)		5 (7.9%)	1 (2.9%)	
	Asian	2 (2%)	1 (1.4%)	1 (4.2%)		1 (1.6%)	1 (2.9%)	
	Latin American	2 (2%)	2 (2.7%)	0 (0.0%)		2 (3.2%)	0 (0.0%)	
	Unknown	9 (9.2%)	6 (8.1%)	3 (13%)		6 (9.5%)	3 (3.1%)	
Employment	Working	44 (45%)	31 (55%)	13 (81%)	0.28	24 (38%)	20 (57%)	0.03
	Retired	10 (10%)	10 (18%)	0 (0.0%)		9 (14%)	1 (2.9%)	
	Unemployed	11 (11%)	9 (16%)	2 (13%)		8 (13%)	3 (8.6%)	
	Disabled	7 (7.1%)	6 (11%)	1 (6.3%)		2 (3.2%)	5 (14%)	
	Unknown	26 (27%)	18 (24%)	8 (33%)		20 (32%)	6 (17%)	
Mechanism of injury	MVC passenger	30 (31%)	26 (35%)	4 (17%)	0.038	17 (27%)	13 (37%)	0.091
	MVC pedestrian	3 (3.1%)	3 (4.1%)	0 (0.0%)		2 (3.2%)	1 (2.9%)	
	Work	11 (11%)	6 (8.1%)	5 (21%)		3 (4.8%)	8 (23%)	
	Sport	6 (6.1%)	2 (2.7%)	4 (17%)		4 (6.3%)	2 (5.7%)	
	Fall	33 (34%)	27 (37%)	6 (25%)		26 (41%)	7 (20%)	
	Direct blow	8 (8.2%)	6 (8.1%)	2 (8.3%)		6 (9.5%)	2 (5.7%)	
	Unknown/other	7 (7.1%)	4 (5.4%)	3 (13%)		5 (7.9%)	2 (5.7%)	
Radiographs	No	10 (10%)	8 (11%)	2 (8.3%)	0.73	8 (13%)	2 (5.7%)	0.27
	Yes	88 (90%)	66 (89%)	22 (92%)		55 (87%)	33 (94%)	
CT	No	11 (11%)	9 (12%)	2 (8.3%)	0.61	10 (16%)	1 (2.9%)	0.050
	Yes	87 (89%	65 (88%)	22 (92%)		53 (84%)	34 (97%)	
Side	Left	57 (58%)	42 (57%)	15 (63%)	0.62	34 (54%)	23 (66%)	0.26
	Right	41 (42%)	32 (43%)	9 (38%)		29 (46%)	12 (34%)	
Concomitant Shoulder Dislocation	No	86 (88%)	68 (92%)	18 (75%)	0.028	57 (91%)	29 (83%)	0.27
	Yes	12 (12%)	6 (8.1)	6 (25%)		6 (9.5%)	6 (17%)	
Concomitant Injuries	No	20 (20%)	12 (17%)	8 (35%)	0.17	11 (18%)	9 (26%)	0.29
	Yes	75 (77%)	60 (83%)	15 (65%)		49 (78%)	26 (74%)	
	Unknown	3 (3%)	2 (2.7%)	1 (4.2%)		3 (4.8%)	0 (0.0%)	
ISS	Mean (±SD)	13 (±10)	15 (±10)	9.6 (±8.8)	0.013	15 (±11)	11 (±8.8)	0.11
	Range	4–54	4–54	4–38		4–54	4–38	

CT, computed tomography; ISS, injury severity score; MVC, motor vehicle collision; SD, standard deviation; y, years.