Biomedicine International

Biomedicine International (2011) 2: 16-21

ORIGINAL ARTICLE

Traumatic Shoulder Girdle Injury: Relation to the Mechanism of Trauma, and the Age and Sex of Patients

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ABSTRACT

Fractures and dislocations are common manifestations of shoulder girdle injuries (SGI) and are routinely diagnosed using radiography. SGI were investigated in relation to age and sex, and trauma. Furthermore, the number of diagnostic errors arising from evaluating SGI without the use of imaging tools was investigated. Two consultant radiologists retrospectively analyzed 572 shoulder radiographs from 293 patients for evidence of fractures and dislocations. The age and sex of patients, radiographic indications, etiology, clinical diagnoses, and cadres of the requesting physicians and the reporting radiologist were also recorded. Eighty-seven shoulder fractures were diagnosed and 44.4% were accounted for by road traffic injuries (RTI). Scapular fractures occurred predominantly in males aged 20-39 years (P = 0.031) after high-energy trauma, and the majority were associated with other shoulder girdle and extra-shoulder fractures. Falls and RTI accounted for 50% and 61.5% of fractures in patients less than 20 years of age and aged between 20-39 years, respectively (P=0.001). Clinical evaluation of SGI without using imaging tools resulted in 52 of 72 patients (72.2%) being diagnosed incorrectly. Falls are a common cause of SGI in females aged less than 10 years, and scapular fractures are more common than previously thought. This study demonstrates that radiography is invaluable for the evaluation and diagnosis of SGI. *Biomed. Int. 2011; 2: 16-21. ©2010 Biomedicine International, Inc.*

Key Words: dislocation, fractures, plain radiographs, shoulder girdle, trauma.

INTRODUCTION

The shoulder girdle (pectoral girdle) is composed of three bones (clavicle, scapula and proximal humerus) and two joints (acromioclavicular joint and glenohumeral joint), binds the upper extremities to the thorax, and is commonly involved in traumatic injuries (fractures and dislocation) throughout life [1-4]. Injury to any of the component bones can distort normal anatomy and affect the function of the entire extremity [4-9].

Appropriate management of an injured shoulder requires clinical and imaging evaluation. Imaging methods used to investigate shoulder girdle injuries (SGI) include plain radiography, contrast radiography (arthrography), computed tomography and magnetic resonance imaging. Conventional, computed and magnetic resonance angiography can be required for suspected vascular injuries [4-9]. Normally, plain radiography is used to evaluate SGI as it is the most readily accessible and affordable type of radiography throughout the world [10]. Using at least two radiographic views, an anteroposterior and an anterior oblique view, plain radiography has an 88% success rate in diagnosing SGI [1-4, 9]. Several other radiographic projections have complementary roles in detecting SGI [1, 2, 9].

Improved access to imaging tools is one of the World Health Organization's (WHO) top global healthcare priorities, but approximately two-thirds of the world's population does not have adequate access to imaging technology [10]. Therefore, evaluation and diagnosis of SGI depends on clinical acumen in such cases. This retrospective study examined incidences of SGI in relation to the mechanism of trauma, and sex and age of the patients, and projected the percentage of diagnostic errors that could occur when evaluating SGI without imaging technology.

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Submitted June 12, 2010; accepted n revised form November 11, 2010.

Advance Access Publication May 15, 2011 (see www.bmijournal.org)

MATERIALS AND METHODS

Two consultant radiologists retrospectively analyzed 572 shoulder radiographs from 293 patients taken between 2000 and 2008 for evidence of fractures and dislocations in order to calculate the incidence of SGI in relation to the trauma mechanism, and the age and sex of the patients. A further aim of this study was to determine the rate of bedside clinical diagnostic errors when evaluating SGI without imaging tools. The age and sex of patients, radiographic indications, etiology, clinical diagnoses, and cadres of the requesting physicians and the reporting radiologists, were documented and correlated with the radiographic findings. Their significance was determined using chi-square tests.

Only radiographs from patient(s) evaluated for trauma were used. Radiographic diagnoses were compared to the pre-radiograph clinical assessment and diagnoses made at the emergency unit. In addition, the presence of shoulder dislocation, the types of dislocations and the affected side were documented. The findings from this study, together with previous radiologist reports routinely embedded in the film jackets in our centre, were compared to identify inter-observer variations. The cadres of the requesting officers and the radiologist reports were documented. The pre-disposing etiology and radiographic manifestations of trauma including dislocations and fractures were correlated with patient age groups and sex of the patients using cross tabulation analysis. Data were analyzed using SPSS 11.0 for windows.

RESULTS

Trauma resulted in 72 of the 293 patients having to undergo shoulder radiographs. The group of 72 patients comprised 44 (61.1%) males and 28 (38.9%) females within the age range of 0-65 years; each patient underwent anteroposterior and lateral oblique shoulder radiographs, but four patients had an added trans-scapular (scapular-Y) view. The symptoms leading to radiographic requests were pain and limitation of movement in 60 (83.3%) patients, suspected fractures in eight individuals (11.1%) and a suspected dislocation in four people (5.6%). A consultant or senior registrar carried out the initial radiographic reporting, and requesting officers were registrars or more senior medics. Two cases of scapular fractures were missed at initial reporting, one by a senior registrar and the other by a consultant.

There were 87 shoulder girdle fractures and their bony distributions are illustrated in sample radiographs (Table 1, Fig. 2a-k & Fig 3a & b). In 24 of the 72 patients (31.9%) SGI was associated with dislocation (Table 2, Fig. 2g-j & 3a), and in three patients it was associated with proximal humeral epiphyseal fracture separation (Fig. 2j). Where fracture shoulder dislocations occurred, glenohumeral dislocations (Fig.2g-k) were evident in 19 patients (13 posterior, 4 anterior subglenoid and 2 anterior subcoracoid dislocations), acromioclavicular dislocations in three patients, coracoclavicular separation in two individuals and sternoclavicular dislocation in one patient. Ten of 14 patients presenting with scapular fractures in this study had other associated shoulder girdle fractures, and five had concomitant non-shoulder girdle frac-

Table 1. shoulder girdle fractures related to age group

		SHOULDER GIRDLE FRACTURES				Total
		Clavicular Fracture	Scapular Fracture	Humeral Head Fracture	Combine/Multiple Fractures	
Age Group (Years)	Below10	14		6		20
	10-19	3		1		4
	20-29	6	6	3	2	17
	30-39	2	2	5		9
	40-49	1		4		5
	50-59	3		2	1	6
	Above 59			3		3
	Unsure	2	1	4	1	8
Total		31	9	28	4	72

Table 2. FRACTURES COMPLICATED BY DISLOCATION RELATED TO AGE

		TYPES OF DISLOCATION				
		Anterior Sub-coracoid	Anterior Sub-glenoid	Posterior	No Dislocation	Total
Age Group	Below 10 Yrs			4	16	20
	10-19 Yrs			2	2	4
	20-29 Yrs	1		3	13	17
	30-39 Yrs		1	1	7	9
	40-49 Yrs		1	1	3	5
	50-59 Yrs			1	15	6
	Above 59 Yrs		1	1	1	3
	Unsure	1	1		6	8
Total		2	4	13	53	72

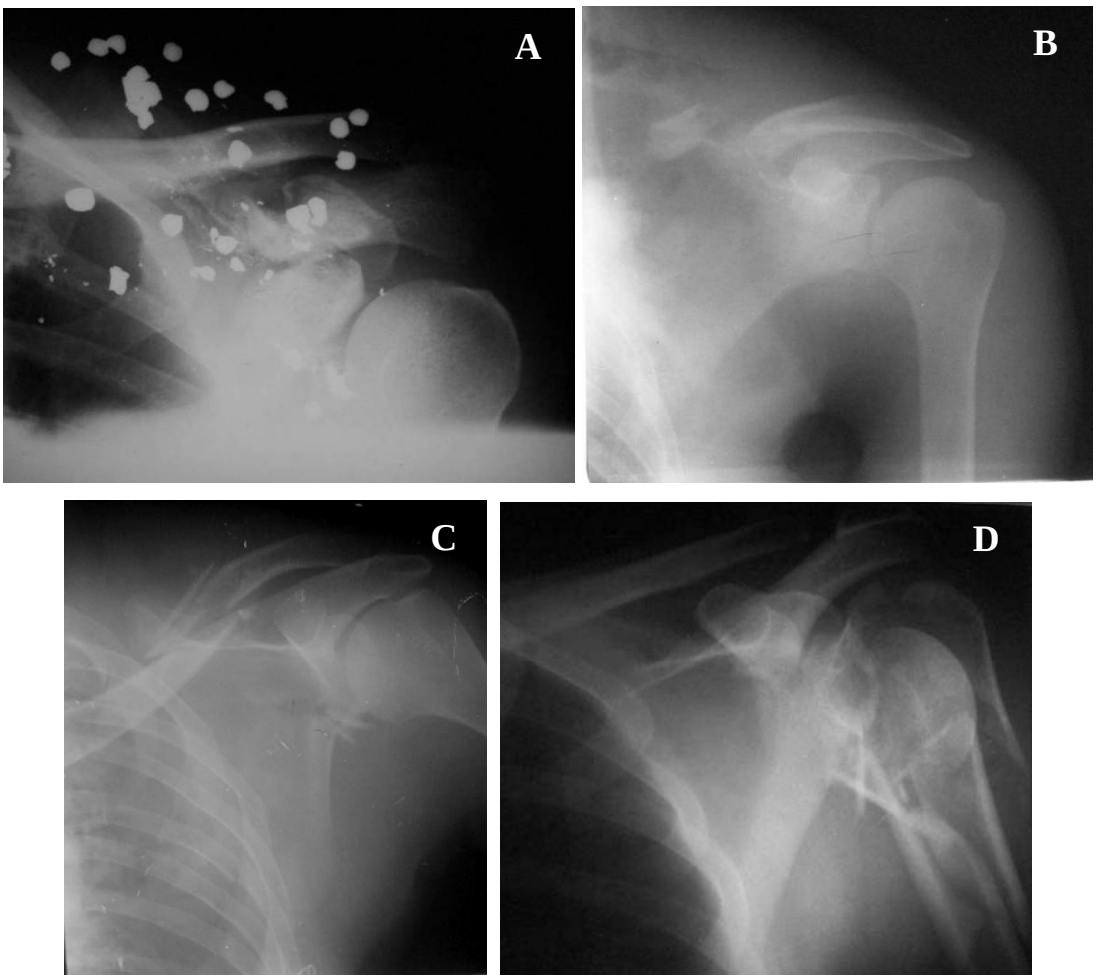

Fig. 2 A-C. Radiographs demonstrating various forms of shoulder girdle injuries resulting from trauma. (A-C) Scapulothoracic dissociation from a gunshot, motorcycle crash and car crash, respectively, with (C) demonstrating additional multiple ribs fractures, (D) Comminuted fracture of the humeral and scapular head and neck,

tures. Thirty-five of the 87 shoulder girdle fractures in this study were clavicular, with two cases of comminuted clavicular fractures and acromioclavicular joint ruptures (Fig. 2b & 3b). Humeral fractures were clinically suspected but not their associated SGI.

In 32 of the 72 subjects whose SGI was induced by trauma, the etiology of SGI (Table 3) was road traffic injuries. Six of the scapular fractures occurred in a motorcyclist that had collided with stationary objects (Fig. 2b & 3b), two followed a building collapse, one from an attack with a machete (Fig. 2f) and one from a gunshot (Fig. 2a); the remainder occurred in motor car accidents. Falls and RTI together accounted for 50% and 61.5% of SGI (fractures) in patients under 20 years of age and in the group aged 20-39 years, respectively (P=0.001). Analysis of SGI in relation to sex (Table 4a) demonstrated that the scapular fractures illustrated in Figures 2a-g occurred in males within the age group of 20-39 years (P = 0.031), and the occurrence of clavicular and scapular fractures was similar in this age group. In patients aged more than 39 years, fractures predominantly involved the clavicle and humerus (Table 4b; P = 0.031). There were no observable differences in terms of the sex of

Table 3. Aetiology of Shoulder Girdle Fractures Correlated to Patient Age Group

		Aetiology					
		Fall	**Road Traffic Injury**	**Gun Shot**	**Unknown**	**Other Trauma**	**Total**
AGE GROUP (Years)	**Below 10**	10	2		4	4	20
	10-19	2				2	4
	20-29	2	11		2		17
	30-39	1	5	2	1		9
	40-49		4	2			5
	50-59		4	1		2	6
	Above 59					3	3
	Unsure		6		1	1	8
Total		15	32	5	8	12	72

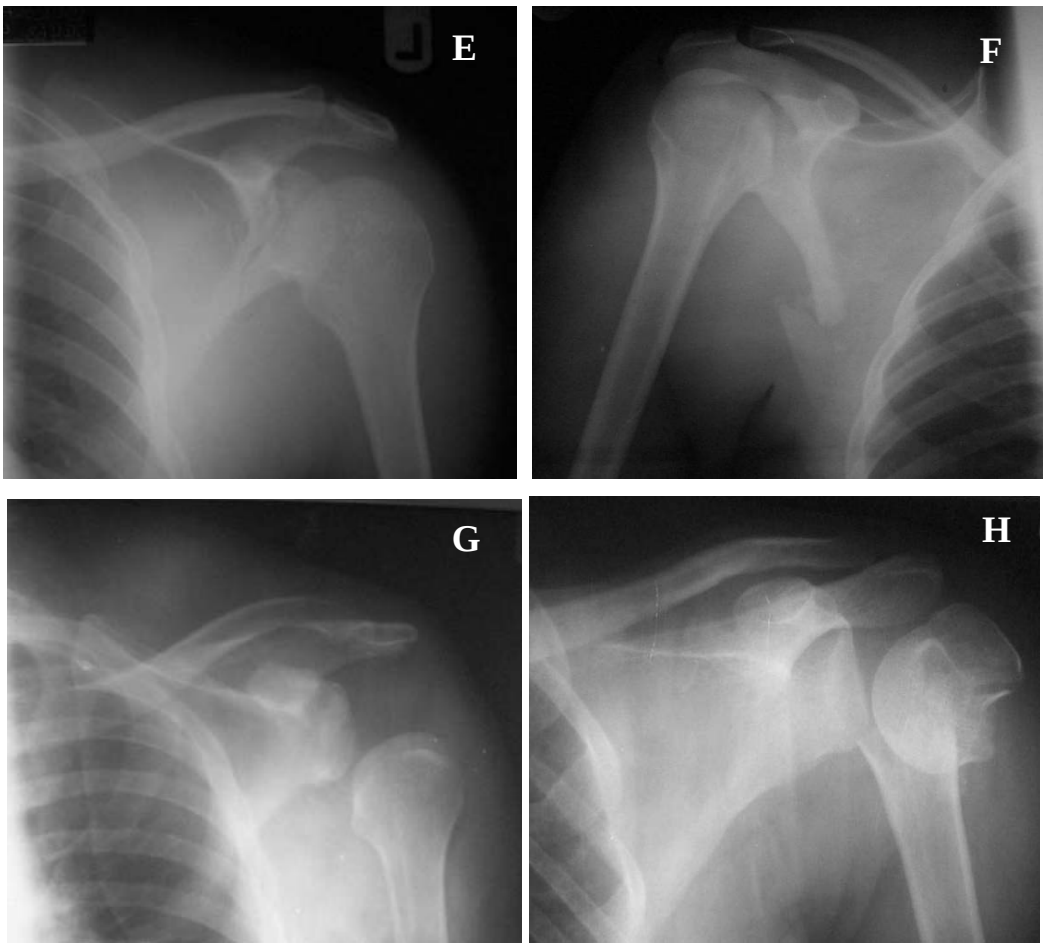

Fig. 2 E-H. (E) Isolated central glenoid fracture of the scapular, (F) Scapular body fracture from a machete injury, (G) Glenohumeral dissociation with chip fracture of the glenoid rim from a road traffic injury, (H) Humeral neck fracture with glenohumeral separation.

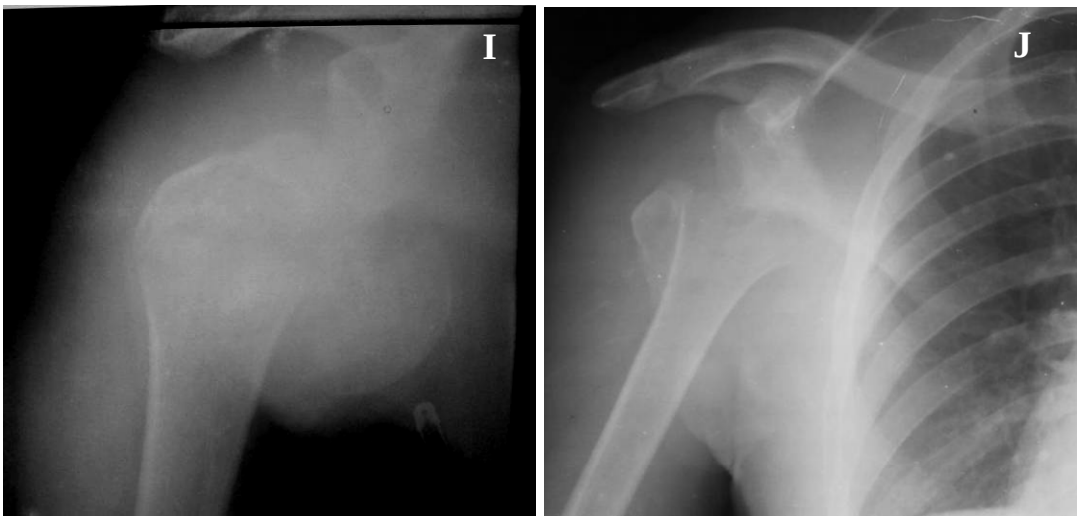

Fig. 2I-K. (I) Slipped right proximal humeral epiphysis with epiphyseal displacement into the axilla and (J) Communited humeral head and neck fractures.

patients between the occurrence of clavicular and humeral fractures (Table 4a; P = 0.06). The sex of patients was not significant in terms of RTI contributing to shoulder girdle fractures (Table 4b). However, falls accounted for 11.4% SGI in males and 39.7% in females (P = 0.07). Gunshot related fractures (Fig. 2a) were present in male patients alone.

On clinical evaluation, diagnoses were not made, missed and under-diagnosed in 24, 16 and 12 patients, respectively (Table 5a & b; P = 0.000). Among 25 patients clinically diagnosed with fractured dislocation, 16 had radiographic evidence of fractures without dislocation. Of the 10 patients with clinical diagnoses of dislocation, six had radiographic evidence of fractured dislocation, and three of fractures

Table 4a. Correlation of Shoulder Girdle Fractures to Sex

		Shoulder Girdle Fractures				
		Clavicular Fractures	Scapular Fractures	Humeral Head Fractures	Combine/Multiple Fractures	Total
Sex	**Male**	16	9	16	3	44
	Female	15		12	1	28
Total		31	9	28	4	72

Table 4 b. Aetiology of Shoulder Girdle Fractures Correlated to Sex

		Aetiology					
		Fall	Road Traffic Injury	Gun Shot	Unknown	Other Trauma	Total
Sex	**Male**	16	20	5	6	8	44
	Female	10	12		2	4	28
Total		15	32	5	8	12	72

without dislocation (Table 5a & b). Therefore, 72.2% clinical judgment errors were made.

DISCUSSION

Normal radiographic anatomy of the shoulder girdle can be disrupted by trauma to any of the three component bones. The anatomical disruption can manifest itself as dislocations, fractures, fracture-dislocations and scapulothoracic dissociations (Figure 2 a-k). In this study, all humeral and clavicular fractures were clinically suspected prior to radiography, but the types of fractures and concomitant SGI were not precisely determined.

Relationships between the age and sex of patients, and the mechanism of trauma (Tables 1, 3, 4a and 4b), demonstrated that falls were the predominant cause of SGI in females aged less than 10 years. It is plausible that the type of footwear worn could account for the relative instability and increased falling in females. The prevalence of clavicular fractures in childhood and early adulthood, and the predominance of humeral head fractures in late adulthood in this study, support observations of age-related differences in activity, mobility and fragility that affect patterns of SGI [11, 12].

Scapular fractures are reported to constitute approximately 1% of all fractures and fewer than 5% of SGI [13, 14] but had an incidence of 16.5% (14 of 85 fractures) in this study. However, the incidence of scapular fractures could be higher than documented here as they commonly follow high impact injuries, and some patients could die before reaching hospital owing to multiple injuries. In Nigeria, common road accidents due to lax traffic regulations and controls, communal clashes/politically-motivated fighting and building collapses could contribute to such a high incidence. These assertions were made because, with the exception of one patient whose age was not documented, all scapular fractures occurred within the working prime age group of 20-39 years (Table 1; P=0.031). Furthermore, the aetio-mechanisms were high-energy trauma from road traffic injuries in 78.6% of patients (42.9% motorcycle crashes and 35.7% motorcar accidents), a building collapse in one patient, and gunshot and machete assaults in two patients. Only in two patients was a clinical diagnosis of scapular fracture made prior to radiography.

Extra-shoulder injuries associated with SGI in this study can be grouped into thoracic extra-shoulder injuries and extra-thoracic extra-shoulder injuries. Patients presenting with scapular fractures had vari-

Table 5a. Correlation of Clinical and Radiographic Diagnoses

		Radiographic Diagnoses			
		Fracture without Dislocation	Fracture with Dislocation	Bony chips & Joint Effusion	Total
Clinical Diagnoses	**Fracture with dislocation**	16	9	16	25 (34.7%)
	Dislocation only	3	6	12	10 (13.9%)
	No Clinical diagnosis	17	7		25 (34.7%)
	Suspected fracture	6			7 (9.7)
	Multiple Injuries	4	1		5 (6.9%)
Total		46 (63.9%)	23 (31.9%)	3 (4.2%)	72 (100%)

Table 5b. Accuracy of Clinical Evaluation of Shoulder Girdle Fractures

		Clinical Diagnoses					
		Fracture with Dislocation	Dislocation	No Clinical Diagnoses	Suspected fracture	Multiple Injuries	Total
Clinicoradiographic Diagnoses	**Correct Clinical Diagnoses**	9			6	5	20
	Missed Clinical Diagnoses	15			1		16
	Clinical under diagnoses	2	10				12
	Radiographic Fracture but no clinical diagnoses			24			24
Total		26	10	24	7	5	72

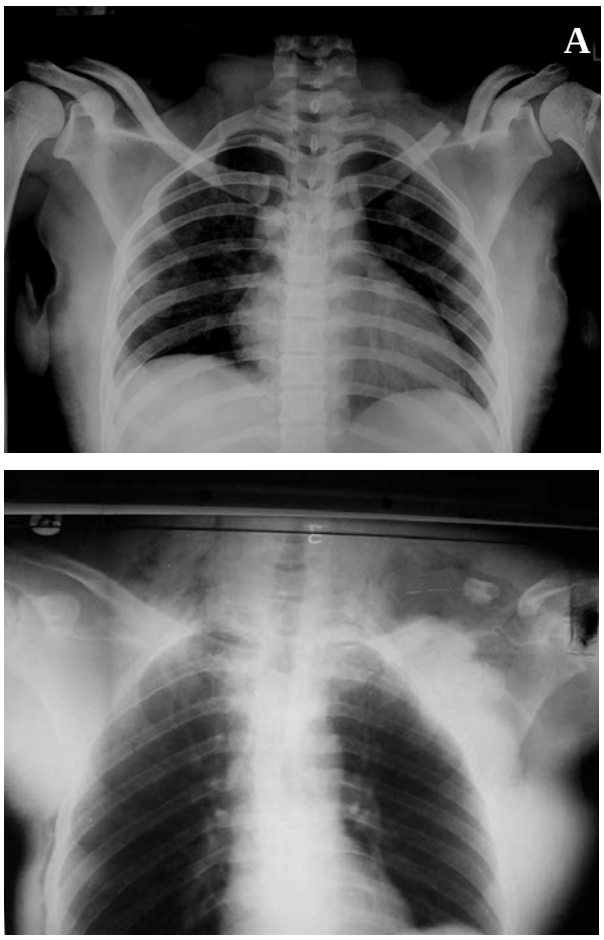

Fig. 3A&B. Frontal chest radiographs from patients with shoulder girdle injuries resulting from road traffic accidents. (A) The patient had a left clavicular fracture, bilateral shoulder dislocation and right humeral fracture. (B) Left scapulothoracic dissociation and extensive subcutaneous emphysema.

able thoracic and extra-thoracic injuries. Thoracic complications were observed and included subclavian vessel injury (Fig. 2a & b), hemopneumothorax (Fig. 3b), brachial plexus paresis (Fig. 2a, b, d & g), scapulohumeral dissociation (Fig. 2g) and scapulo-thoracic dissociation (Fig 2a-b & 3b). Extra-thoracic injuries included fractures of long bones and head injuries.

Pain, swelling and limitation of movement after trauma resulted in shoulder radiographs being requested. Humeral and clavicular fractures were diagnosed clinically, prior to imaging, but scapular fractures were not. The diagnostic yield of plain radiograph is high and demonstrates sufficient evidence of pathology (fractures and dislocation) without additional investigation (Fig. 2a-k & 3a-b), and led to changes in the clinical diagnoses of 52 out of 72 patients (72.2%) suffering from SGI due to trauma.

Extreme pain and swelling limit clinical evaluation in the acute and sub-acute phases of injuries, and this could contribute to the high rate of no diagnoses, missed diagnoses and under-diagnoses in this study. In addition, multiple bony and soft tissue injuries as presented in figures 2c & 2d could hinder clinical diagnostic accuracy. Moreover, the need to prevent further vascular or neuronal injury until the extent of initial injuries is ascertained can result in minimal clinical evaluation before a request for imaging is made. Such cases could account for instances of no clinical diagnosis being made prior to radiographic request.

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