The Use of Surgery in Displaced Scapular Neck Fractures

F. Khallaf A. Mikami M. Al-Akkad

Department of Orthopedics, Al-Jahra Hospital, Kuwait

Key Words

Scapular neck fractures · Open reduction · Internal fixation

Abstract

Objectives: To evaluate the use of surgical management in displaced scapular neck fractures. **Subjects and Methods:** 14 adult male patients (average age 34 years, range 19–44) with displaced scapular neck fractures were treated by open reduction and internal fixation in Al-Jahra Hospital, Kuwait from April 2000 to January 2004. Patients' clinical and radiological results were analyzed retrospectively. **Results:** The average follow-up was 20 months (range 6–30 months). Anatomical or near-anatomical reduction of the fracture with excellent clinical function was obtained in 12 patients (86%) and with good functional outcome in 2 patients (14%). One patient with associated head injury developed heterotopic ossification connected to the lateral border of the scapula. **Conclusion:** The results of this report show that open reduction and internal fixation of grossly displaced scapular neck fractures are the treatment of choice for these injuries to restore the normal biomechanics of both glenohumeral and scapulothoracic joints and allow favorable clinical outcome.

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Introduction

Displaced fractures of the neck of the scapula are relatively rare injuries, accounting for 10–55% of all scapular fractures, which in turn comprise only 3–5% of shoulder girdle injuries and less than 1% of all fractures [1, 2]. This is most likely because of the thick protective muscular envelope, the recoil of the underlying chest wall on impact, the highly mobile shoulder girdle, and the bony suspensory mechanism where the clavicle and its articulations represent the common sites of failure. These fractures exclusively occur in high-energy trauma as in road traffic accidents and falling from height. They are typically associated with multiple traumatic injuries, which mostly take the priority and draw the attention away from the treatment of scapular fractures [3, 4]. Traditionally, most displaced scapular neck fractures have been treated conservatively and several studies have reported poor outcome especially in significantly displaced injuries [2, 5, 6]. Surgical management of displaced scapular neck fractures has been accepted with promising outcome [7, 8]. The purpose of this retrospective study of the largest reported group of surgically treated displaced scapular neck fractures in the literature to our knowledge was to assess the results and complications of open reduction and internal fixation through the Judet dorsal approach.

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Dr. F.G.M. Khallaf
Orthopedic Department, Al-Jahra Hospital
PO Box 21416
13075 Safat (Kuwait)
Tel. +965 455 9189, Fax +965 489 9617, E-Mail fkhalaf2000@yahoo.com

Table 1. The associated injuries with displaced scapular neck fractures in the 14 patients

Type of injuries	Patients
Rib fractures	5
Rib fractures with pneumothorax	2
Ipsilateral clavicle fracture	1
Ipsilateral acromio-clavicular dislocation	2
Ipsilateral humerus fracture	2
Ipsilateral forearm fracture	1
Ipsilateral trochanteric fracture	1
Contralateral fracture of the tibia and fibula	2
Head injury	1
Splenic tear	1
Unstable fracture of the pelvis with ipsilateral vertical shear	1
Fracture of the iliac bone	1
Fracture of the contralateral superior and inferior pubic rami	1
Mild wedge fracture of the dorsal spine	1
Pulmonary contusion	3

Subjects and Methods

Between October 2000 and January 2004, 19 patients with scapular neck fractures were treated in the Department of Orthopedics, Jahra Hospital, Kuwait. In 4 patients, the scapular neck fractures were undisplaced and treated conservatively, and they were excluded from the study. One patient with a grossly displaced scapular neck fracture refused surgery and was also excluded from the study. Fourteen patients were operated upon for displaced scapular neck fractures and were followed up clinically and radiologically. The 14 patients were adult males, with an average age of 34 years (range 19–44 years). The cause of injury was involvement in road traffic accidents. All the patients except 2 had other injuries including head, chest, abdomen, spine, pelvis and extremities (table 1).

Preoperative Assessment

A general multisystem screening physical examination was conducted for every patient followed by detailed upper extremity neurovascular evaluation. Unfortunately, the general condition, the pain and the swelling compromised the shoulder girdle neurological motor assessment in most patients. The first priority in the management of the patients was directed to the life-threatening head, chest or abdominal injuries. After stabilization and performing life-saving procedures, the musculoskeletal injuries were then investigated. The most helpful roentgenographic studies included a true lateral scapular view along with axillary and antero-posterior views of the shoulder which would reveal most glenoid neck, body and acromion fractures.

Computerized tomographic scan was performed in all of the 14 patients to assess the anterior angulation and the associated acromion, spine and body of the scapula. Magnetic resonance imaging was performed in the last 4 patients to assess the integrity of the brachial plexus. One of them with gross displacement of the

neck fracture and comminuted fracture of the scapular body that refused surgical intervention was the patient excluded from the study as previously mentioned.

The indications for the surgical management of open reduction and internal fixation of scapular neck fracture were medial displacement of the glenoid neck fragment by more than 1 cm and/or anterior angulation equal or greater than 40°. The average period between the date of injury and surgery was 7 days and the range was 3–14 days.

Surgical Procedure

A prophylactic antibiotic, a third-generation cephalosporin, was routinely injected intravenously with induction of anesthesia. The patient was placed prone and the involved forequarter was draped free. Using the Judget dorsal approach, skin incision was started at the palpable posterior border of the acromion, running parallel to the spine to the medial scapular border and then gently curving towards the inferior angle of the scapula. A subcutaneous flap was elevated then from medial to lateral until the posterior deltoid muscle belly was identified and delineated. The deltoid was released from its origin at the scapular spine with care to leave an adequate cuff to facilitate the later repair. Next, the deltoid was swung laterally, and the interval between the infraspinatus and teres minor was developed to provide ready visualization of the lateral scapular border and the inferior 2/3 of the neck. In 4 big and muscular patients (No. 2, 6, 11 and 14; table 2), the infraspinatus tendon was incised 2.5 cm medial to its insertion in the greater tuberosity along its superior and inferior borders to have adequate exposure to the scapular neck. After inserting a staying suture, the main muscle flap was retracted posteriorly and medially. The infraspinatus was elevated subperiosteally from the body to the extent needed but with care not to injure or avulse the suprascapular neurovascular pedicle from the retracted infraspinatus muscle belly.

In the first 2 patients, posterior arthrotomy was performed to identify the glenoid fossa and the orientation of the neck fragment. The associated scapular spine fractures were addressed along the spine subcutaneous border or at its base after mobilization of the infraspinatus. The crucial and most difficult point in this surgery was the restoration of the anatomical relation of the glenoid fossa fragment and the lateral border and usually the surface of reduction was a small area along the uppermost part of the lateral border. The difficulty of this reduction increased with delaying the surgery further (mostly due to the management of associated head, chest or abdominal injuries). In the patients No. 7, 9 and 13 who were operated after 2 weeks, we were obliged to use bone hooks to pull the neck and glenoid fossa fragment superiorly, laterally and posteriorly and the lateral border fragment inferiorly and medially to achieve the reduction. In this step, a lot of care was needed to avoid any injury to surrounding tissue and structures by the hook due to inadvertent movement.

Once the reduction of the fracture was achieved, it was fixed by applying a 6 or 7 holes small 3.5-mm reconstruction plate along the posterior aspect of the thick bone of the neck and lateral border with 2 or 3 screws in the neck glenoid fragment and 3 or 4 screws in the lateral border fragment as shown in figure 1a. In 8 patients, another 8-hole reconstruction plate was put oblique along the body to fix the lateral and medial fragments of the body. The bone near the neck, spine and inferior angle is relatively good for fixation as shown in figure 1b. The acromion fragment was

Fig. 1. Open reduction and internal fixation of scapular neck fractures with restoration of scapular morphology.

Table 2. The final follow-up clinical assessment of the 14 patients who had open reduction and internal fixation of displaced scapular neck fractures

Case No.	Sex	Age years	Injured side	Duration of follow-up years	Flexion degrees	Abduction degrees	External rotation degrees	Internal rotation	Clinical shoulder girdle muscle power
1	M	19	R	2.5	180	180	60	T6	5 ^a
2	M	36	R	2	150	150	40	T9	4 ^b
3	M	40	R	2	180	170	60	T8	5
4	M	44	R	1.75	175	170	40	T8	5
5	M	34	L	1	170	160	60	T8	5
6	M	34	L	1.75	180	170	70	T8	5
7	M	28	R	1.5	165	160	65	T8	4
8	M	34	L	1.5	160	140	80	T9	5
9	M	34	R	1.75	180	160	80	T6	5
10	M	39	R	1	150	150	45	T9	5
11	M	25	L	1.75	180	180	75	T6	5
12	M	31	L	1.25	160	160	60	T8	5
13	M	33	R	1.25	170	170	70	T6	5
14	M	43	L	0.5	175	160	50	T8	5

T = Thoracic vertebra.

^a Movement against gross resistance.

^b Movement against mild resistance.

fixed either by a lag interfragmentary 4-mm cancellous screw or by a small plate with 4 holes.

After fixation, the posterior arthrotomy of the glenohumeral joint was repaired with care and the incised infraspinatus tendon was sutured. The detached deltoid was repaired back to the cuff

of the muscle along its origin from the inferior aspect of the scapular spine. A hemovac drain was inserted before closure of the subcutaneous tissue and the skin. After surgery, the shoulder and the upper limb were protected in a triangular sling and postoperative X-ray of the shoulder and scapula was taken.

Fig. 2. Displaced scapular neck fractures with the 5-fragment pattern and directions of displacements.

Postoperative Management

As the pain decreased, typically within the first postoperative week, the shoulder was taken through range-of-motion exercises out of the sling with clearly defined limits including active-assisted and passive movements. Pendulum exercises and overhead pulleys were often used. By 3 weeks, the external support was discontinued. Active range-of-motion exercises and the use of the upper extremity were encouraged. With increased motion of the shoulder, the patient was allowed to begin strengthening exercises. By 6 weeks, most scapular neck fractures were healed. Isometric and progressive resistance exercises of the rotator cuff and the deltoid were essential.

Follow-Up

The patients were assessed clinically and radiologically every 3 weeks during the first 3 months after surgery and every 3 months through the period of the follow-up. The final assessment was done by an independent orthopedic surgeon who is not one of the authors. The patients were clinically assessed using the University of California, Los Angeles (UCLA) shoulder rating scale [9].

Fig. 3. The 5-fragment fracture pattern of most of the displaced scapular neck fractures.

Results

Pathoanatomical Results

Of the 14 patients, 1 had displaced distal clavicle fracture, another displaced fracture of the base of the coracoid process, 2 grade III acromioclavicular dislocation and 10 patients had displaced fracture of the base of the acromion process.

A certain pattern in the displaced scapular neck fractures was identified. The neck and glenoid fossa fragment was fractured by a vertically oblique fracture, which exited the upper part of the lateral border. It was displaced medially, inferiorly, and angulated anteriorly. The lateral border and the lateral part of the body were fractured from the rest of the body with a degree of communication and displaced a little laterally and superiorly due to muscle layer attachment.

The spine of the scapula was separated from the body and the neck by transverse fracture at the base of the spine, which exited to the medial border with little displacement. In the majority of patients (72%), the acromion was fractured and displaced at its base (junction with scapular spine) by an oblique transverse fracture. So in displaced scapular neck fractures associated with acromion fractures, there were usually 5 fragments with different degrees of displacement as shown in figures 2 and 3.

The crucial displacement was at the neck and glenoid fossa fragment. The other fragments, which included the lateral border, the body, the spine and the acromion were usually mildly displaced and had varying degrees of comminution, which was directly proportional with the severity of injury.

Radiological Results

Anatomical or near-anatomical reduction was achieved in all of the 14 patients. The reduction position obtained at the operation was maintained and fracture union was judged to have occurred at an average of 2 months (range 1.5–2.5 months) postoperatively. Follow-up radiographs showed no reduction collapse or displacement. There was no metal failure of backing out, breakage, migration of screws or plates. One patient (No. 4) who had associated head injury, fractured ribs and lung contusion and was operated 2 weeks after the accident, after stabilization of his general condition and weaning from mechanical ventilation, developed heterotopic ossification at approximately 9 weeks postoperatively. The ossification was in continuity with the lateral border of the scapula and this patient had the lowest range of shoulder movements in all directions with mild weakness of his shoulder girdle muscles. No other postoperative complication was observed.

Clinical Result

A summary of the follow-up clinical assessment of the 14 patients is given in table 2. None of the operated 14 patients reported that they had pain when using the upper extremity in the activities of daily living. Three patients (No. 4, 10 and 12) were uncomfortable sleeping on the operated shoulder. All of the patients were satisfied with the result of surgery at the most recent follow-up assessment. Clinically, active flexion averaged 170° and ranged from 150 to 180°. Abduction of the shoulder was slightly less than the flexion, averaging 163°, ranging from 150 to 180°. External rotation with the arm at the side ranged from 40 to 80°. Internal rotation with the arm at the side ranged from the ability of the thumb to touch the sixth thoracic vertebra to the ninth thoracic vertebra. With the arm in 90° of abduction, the external rotation ranged from 60 to 100° and the internal rotation ranged from 60 to 90°. The strength of the shoulder girdle muscles was normal (5/5) in flexion, extension, abduction, internal rotation, and external rotation in 12 patients after a muscle-strengthening physiotherapy rehabilitation program. Two patients (No. 2 and 7) had mild, generalized weakness (4/5) of the shoulder girdle in all of the tested direc-

tions, as evidenced by the fact that both the active and passive range of motions were equal but the patient could not maintain the position of the arm isometrically against firm resistance applied by the examiner.

Following the UCLA shoulder rating scale, 12 patients (86%) were rated excellent while the remaining 2 patients (14%) were rated good.

Discussion

The pathoanatomical results of the displaced scapular neck fractures in this study showed that these fractures were always associated with other disruptions in the superior shoulder suspensory complex (SSSC), which, as described by Goss in 1993 [10], is a soft-tissue and bony ring supported by superior and inferior bony struts. The ring includes: the glenoid cavity, the coracoid process, the coracoclavicular ligament, the distal part of the clavicle, the acromioclavicular joint and ligament, and the acromion process. The second most common disruption in the SSSC was the fracture of the acromion process.

The double disruption of the SSSC ring in the previous injuries resulted in an unstable construct and it was the most accurate description of a floating shoulder. The most common double disruption of the SSSC ring is the combined fractures of the clavicle and scapular neck which is why the term 'floating shoulder' usually refers to the ipsilateral fractures of the clavicle and scapular neck in the contemporary use [11]. In the present study, the most common combined injuries with displaced scapular neck fractures were the fractures of the acromion process (72%) and dislocation of the acromioclavicular joint (21%). Accordingly, the accuracy of the definition of floating shoulder is doubtful as indicated by Kumar and Satku [12].

The pathoanatomical analysis of the most common displaced scapular neck fractures in the current study revealed a pattern of fracture lines with 5 fragments (glenoid, lateral border, body, spine and acromion) (fig. 3). The glenoid fragment is always significantly translated medially and inferiorly and angulated anteriorly distorting the biomechanics of the glenohumeral and scapulothoracic joints. With displacement of the glenoid neck fragment, the normal lever arm of the rotator cuff is lost, decreasing the mechanical advantages of these muscles. Also, with anterior angulation of the glenoid neck fragment, there is an increase in the tilt of the face of the glenoid. Accordingly, the normal glenohumeral compressive force of the rotator cuff would be transformed to a

shear force. The translation and angulation of the glenoid neck fragment in the displaced scapular neck fractures results in rotator cuff dysfunction with patients' complaints of weakness and pain in the subacromial space especially at night on lying on the affected side.

Nonsurgical treatment of displaced scapular neck fractures has not yielded good results as exemplified by the study of Nordquist and Petersson [13] where 32% of the patients had poor function at 10–20 years of follow-up. As explained by Hardegger et al. [5], the displaced scapular neck fractures might cause a functional imbalance because the relationship of the glenohumeral joint with the acromion and nearby muscle origins is altered. Overall, there is an increasing tendency in the literature to suggest that surgery should be considered for fractures with translational displacement greater than or equal to 1 cm and/or angulatory displacement greater than or equal to 40° in either the transverse or coronal plane [1, 9, 12, 14–17], similar to the clinical outcome of the present study. The 14 patients did not have shoulder pain while using their upper extremities in the actions of daily living and exertional activities. Equally important is the fact that only one complication of heterotopic ossification with connection to the axillary border of the scapula occurred. Based on these results, we support the

evolving concept that open reduction and internal fixation of the displaced scapular neck fractures, guided by the understanding of the fracture pathoanatomy, is the treatment of choice to restore the normal biomechanics of glenohumeral and scapulothoracic joints allowing superior clinical outcome as has previously been advocated [6–8, 13, 17].

The main limitations of this study are the small number of patients and its being a retrospective analysis. A prospective and randomized study would be needed to substantiate the current findings, but such a study might be difficult because of the rarity of scapula fractures in general and displaced scapular neck fractures in particular.

Conclusion

The results of this report show that open reduction and internal fixation of grossly displaced scapular neck fractures is the treatment of choice for these injuries to restore the normal biomechanics of both glenohumeral and scapulothoracic joints and allow favorable clinical outcome.

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