Original research article

Retrospective observational assessment of the outcome of surgical fixation in considerably displaced floating shoulder

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Abstract

Aim: to determine the functional outcome of surgical fixation in significantly displaced floating shoulder injury.

Materials and Methods: This retrospective observational study was carried out in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, for 15 months. 20 significantly displaced floating shoulders (scapular neck medialization >10mm and GPA <30˚) were selected. The minimally displaced floating shoulder, intrarticular fractures of shoulder joint and the patients having any associated life threatening injury were excluded. Standard X-ray shoulder AP and Lateral views both pre and post operative were obtained. Pre operative CT scan with 3D reconstruction was obtained in most of the cases. Clavicular fracture and scapular fracture were classified according to Allman and Goss classification respectively. The clinico- radiological assesment was done at every subsequent 4 weeks of interval with X-ray shoulder AP/Lateral view and Oxford Shoulder Score till 9 months.

Results: Out of 20,15 had sustained injury due to motor vehicle accident while 5 had history of fall from height. There were 14 males and 6 females. Mean age was 37.4 years. The mean delay in surgery from the day of accident was 6.1 days. Mean stay in the hospital postoperatively was 7.7 days. 12 had type I Allman clavicle fracture, 5 had type IIA and 3 had type IIB. Only type II Goss scapular neck fracture with medial displacement >10mm and GPA <30◦ were included. Most of the patient had no major complications postoperatively. The mean time for radiological union of clavicle and scapula was found out to be 14.1 weeks and 8.9 weeks respectively. The mean Oxford shoulder score was 46.4 in 15 patients, 37.1in 3 patients and 27.3in 2 at the end of at least 9 months follow up.

Conclusion: The surgical fixation of all the floating shoulders, especially significantly displaced, allows for early rehabilitation and better functional outcome.

Keywords: surgical fixation, floating shoulders, clavicle and scapula

Introduction

In 1993, Goss[1] first defined the bone-ligament cyclic structure composed of the coracoid, coracoclavicular ligament, distal end of the clavicle, acromioclavicular joint, acromion, and superior part of the glenoid cavity, as the superior shoulder suspensory complex (SSSC) that connected the upper limbs with the axial skeleton. When the SSSC was injured, the stability of shoulder suspension would sustain serious damage; the local muscle tension and weight of

the affected limb would make the distal end of the fractured limb generate rotation and displacement forward, downward, and inward. This 3- dimensional displacement would change the start-end relationships and the structural length of the acromion and the muscles around the glenohumeral joint, resulting in a dynamic power imbalance of the shoulder joint. If not treated properly in the early injury period, this could lead to malunion, a drooping shoulder deformity, shoulder pain and weakness, subacromial impingement syndrome, traumatic arthritis, and even delayed nerve and vascular damage and other complications.[2] In 1975, Ganz and Noesberger[3] defined a scapular neck fracture associated with an ipsilateral clavicular shaft fracture as a floating shoulder injury (FSI), which was now considered a type of SSSC injury.[4] There was still no consensus about a gold standard of treatment. Edwards et al.[5] thought that this could be treated conservatively, especially in those with small displacements (less than 5 mm), to avoid the risk of surgical complications. Other authors[6,7] thought that when FSI occurred, regardless of the initial displacement, open reduction and internal fixation should be performed, to avoid limitation of shoulder function. Van Noort et al.[8] thought that FSI was not always stable, and that if the scapula did not exhibit downward rotation and displacement, conservative treatment could achieve good results. Anavian et al.[9] suggested that for complex fractures of the glenoid cavity accompanied by displacement, whether the scapular neck or body was involved or not, surgical treatment would have good effects. Egol et al.[10] reported that surgery could not be used for routine treatment, and that each patient must undergo individualized therapy. In light of these conflicting reports, the author retrospectively studied and compared shoulder function using three treatment methods (nonsurgical, surgery with only clavicular fixation, and surgery with combined clavicular and scapular fixation), in order to determine optimal treatment for FSI.

Materials and Methods

This retrospective observational study was carried out in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, for 15 months. after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

20 significantly displaced floating shoulders (scapular neck medialization >10mm and GPA <30˚) were selected. The minimally displaced floating shoulder, intrarticular fractures of shoulder joint and the patients having any associated life threatening injury were excluded. Standard X-ray shoulder AP and Lateral views both pre and post operative were obtained. Pre operative CT scan with 3D reconstruction was obtained in most of the cases. It helped in better understanding of fracture pattern, displacement of the scapular neck and for the preoperative planning. Clavicular fracture and scapular fracture were classified according to Allman and Goss classification respectively.

Clavicle was fixed with anatomical 3.5mm clavicle plate through standard direct approach in supine position. Scapular fixation was done with 2.7mm anatomical plate for scapula viz. lateral plate for lateral column and/or boomerang plate for body fixation (wherever required) through Judet approach in lateral position. The whole fixation was done as a single stage procedure.

In Judet closure, trapezius released at the medial angular margin of the incision has to be securely restored. Post- operatively the arm was kept in shoulder immobilizer for two weeks till suture removal. This was followed by gentle pendulam exercise in shoulder arm pouch for next fortnight. Full ROM exercises were started after 4 weeks. The clinico-radiological assesment was done at every subsequent 4 weeks of interval with X-ray shoulder AP/Lateral view andOxford Shoulder Score till 9 months.

Results

Out of 2,015 had sustained injury due to motor vehicle accident while 5 had history of fall from height. There were 14 males and 6 females. Mean age was 37.4 years. The mean delay in surgery from the day of accident was 6.1 days. Mean stay in the hospital postoperatively was 7.7 days.

12 had type I Allman clavicle fracture, 5 had type IIA and 3 had type IIB. Only type II Goss scapular neck fracture with medial displacement >10mm and GPA <30◦ were included. Most of the patient had no major complications postoperatively. The mean time for radiological union of clavicle and scapula was found out to be 14.1 weeks and 8.9 weeks respectively. The mean Oxford shoulder score was 46.4 in 15 patients, 37.1in 3 patients and 27.3in 2 at the end of at least 9 months follow up.

2 had concomitant acromion fracture which was managed with plate and screw simultaneously while fixing clavicle. Suprascapular nerve was injured in 2 patient preoperatively. 6 patients had open clavicle fracture one (Gustillo-Andersons Type II), and two (Gustillo- Andersons Type I). 2 developed infection postoperatively at the clavicle fracture operated site. It was managed with debridement and antibiotics initially and eventually implant removal at 3 months postoperatively. This clavicle fracture went for delayed union at the end of 1 year with no further treatment.

Table 1: Demographic profile of the patients

Gender	**Number of patients**	**Percentage**
Male	14	70
Female	6	30
Age		
Below 30	6	30
30-40	10	50
Above 40	4	20
RTA	15	75
Fall from height	5	25
Meanage in years	37.4years	
Delay in surgery	6.1 days	
Mean stay in the hospital postoperatively	7.7 days	

Table 2: Fracture Classification, radiological Union and functional outcome

S.NO.	**Fracture Classification**		**Radiological Union**		**Functional outcome**
	Clavicle (Allman)	**Scapula (Goss)**	**Clavicle (Weeks)**	**Scapula (Weeks)**	**(OSS)**
	Type I	Type II	15	10	49
	Type I	Type II	14	9	43
	Type I	Type II	13	10	45
	Type IIB	Type II	13	8	47
	Type I	Type II	14	9	36
	Type IIA	Type II	13	8	43
	Type I	Type II	14	7	48
	Type IIA	Type II	16	11	27
	Type I	Type II	17	10	37
.	Type IIA	Type II	11	12	46
.	Type I	Type II	12	8	49
.	Type I	Type II	14	9	43

.	Type I	Type II	14	12	45
.	Type IIB	Type II	13	10	47
.	Type I	Type II	12	9	36
.	Type IIA	Type II	14	7	43
.	Type I	Type II	14	8	48
.	Type IIA	Type II	15	7	27
.	Type I	Type II	13	13	37
.	Type IIB	Type II	16	7	46
	Mean		**14.1**	**8.9**	

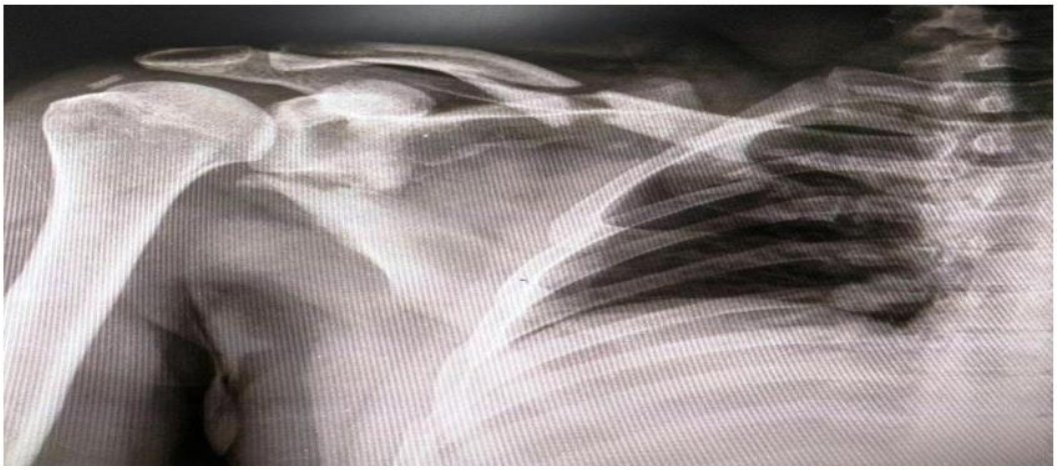

Fig. 1: Case 1: Pre-op X-ray (Clavicle Type I, Scapula Goss Type II GPA <30◦)

Fig. 2: Case 1: Pre-op 3-D CT Scan (Clavicle Type I, Scapula Goss Type II GPA <30◦)

Fig. 3: Case 1: Post-op X-ray AP view (2 plates in Scapula, GPArestored > 30°)

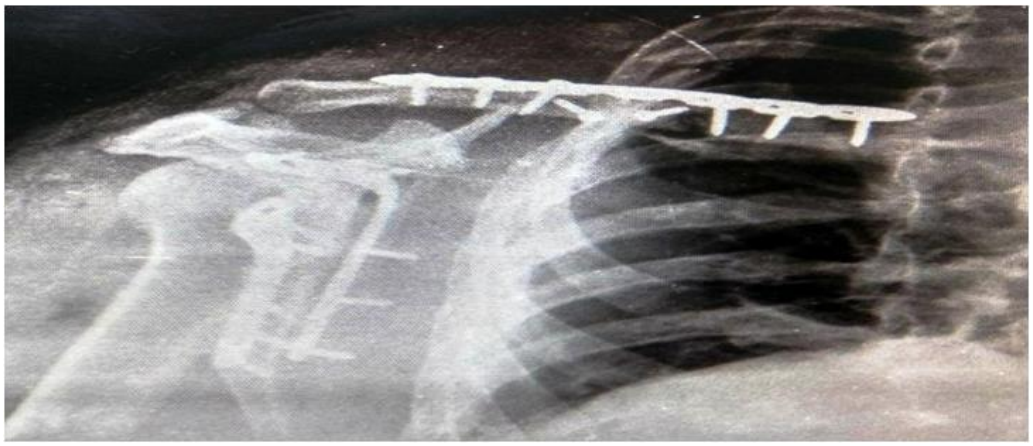

Fig. 4: Case 1: Post-op X-ray Lat view (2 plates in Scapula, clavicle fixed with plate)

Discussion

Scapula fracture constitutes 1% of all the fractures.11 Scapula neck fracture constitutes 18-33% of scapula fractures.[11] The floating shoulder is a rare complex high velocity injury constituting < 0.10% of all fractures,[12] and only 50% have double disruption of superior shoulder suspensory complex.[11] Half of them have concomitant injuries[13] such as hemothorax, pneumothorax, multiple ribs fracture, brachial plexus injury, cervical spine and extremities fracture which may lead to under-diagnosis of the condition.[13] Thus high index of suspicion is necessary while assessing injury of shoulder girdle.

There has been a variation in description of floating shoulder in past. It was first described by Ganz and Noesberger in 1975 as an ipsilateral fracture of clavicle and glenoid neck.[3] Herscovici et al. in 1992 described it as ipsilateral mid shaft fracture of clavicle and scapular neck fracture.[12] Hardegger in 1984 classified scapular neck fractures as anatomical and surgical neck fractures[14] Goss introduced 'double destruction' of superior shoulder suspensory complex[1] Williams et al. found in a cadaveric study that Glenoid becomes unstable when both the coracoacromian and acromioclavicular ligaments were divided.[15] Hence in floating shoulder, stability of the shoulder joint is at stake when either the bony integrity and/or the ligamentous continuity are lost.

Bestard et al. described Glenopolar Angle,[16] normal value ranges from 30-45°.[17] Kim et al. found that functional outcome score in patient with GPA >30° is better than those with GPA <30°.[18] Our results too have shown that >30° Glenopolar angle have shown better functional outcome. Goss also described that >10mm medial displacement and >40° angular displacement of glenoid as a measure of significant displacement.[19] Glenoid Offset described by DeFranco et al. showed poor outcome with the loss of >30mm glenoid offset.[20] Thus displacement plays a major role in functional outcome. So, we decided to study only significantly displaced floating shoulder injury.

Hardegger have shown that the injury in the floating shoulder destabilizes the shoulder joint. There is altered gleno-humeral joint relationship and loss of the normal lever arm of the rotator cuff muscles.[15] Ada and Miller have also described that resultant functional imbalance leads to weakness of all the movements especially abduction.[21] Hence biomechanical alterations affect functional outcome. The surgical fixation restores the normal anatomy. Most of the studies in past on conservative treatment in minimally displaced fractures, have shown good to excellent results viz Edward et al.,[22] Ramos et al.,[23] Van Noort et al.,[24] Labler et al.[25]Ramos et al. used Herscovici's score for the functional assessment of conservative management after intense physical therapy to conclude that mal-unions are well tolerated in minimally displaced fractures, in our study we have excluded these minimally displaced fractures. But in significantly displaced fractures, treated conservatively, had abduction

weakness and acromian impingement.[15] They also concluded that conservative treatment resulted in drooping of glenoid. Caudal dislocation of glenoid is indication of operative intervention.[24] Thus these studies indicate the need for surgical fixation in significantly displaced floating shoulder.

The study on fixation of only clavicle viz. Rickli et al.,[6] Hashiguchi et al.,[26] Low et al.[27] and Constant et al.[28] have advocated that fixation of clavicle indirectly reduces the scapular neck and restores almost normal anatomy. Low et al. in their study have shown excellent result using Rowe's score, after fixation of clavicle only, they believed that clavicle fixation reduces the scapular fracture indirectly with the help of intact ligaments, moreover they did not fixed scapula considering prolonged operative time as well as musculature trauma may lead to delay the rehabilitative process. In our study we assumed that significantly displaced scapular neck may not have intact ligament for indirect scapular reduction, so we preferred scapular fixation in same stage, we did not find that prolonged operative time or trauma to the scapular musculature had any bearing on the rehabilitative programme. Thus in cases where ligaments are intact, only clavicle fixation may reduce the scapular fracture, but where ligament intactness is questionable, as in significantly displaced scapular fracture, fixation gives better functional outcome. As the role of MRI to diagnose ligament injury in the acute phase is doubtful, we can indirectly relate the intactness of the ligaments on the measure of the displacements. The proponents of both clavicle and scapula fixation viz. Goss et al.,[1] Herscovici et al.,[12] Leung et al.,[29] Van Noort et al.[11] and Labler et al. showed good to excellent result in significantly displaced fractures when both the fractures were fixed surgically. Herdegger et al. recommended fixation in all anatomic neck scapular fracture.[15] Leung et al. expressed that post operative rehabilitation was started early in this group.[29] Results of our study are in unison withthis group of researcher.

Though there is debate over timing of fixation from the time of injury and sequence of fixation. We at our institute fix both the fractures in the same sitting within 10 days of injury as suggested by William et al.[30] We fix clavicle first as suggested by William et al. as it makes scapula fracture less mobile and hence reduction once achieved becomes stable.[34] They suggested the key step in scapular lateral border reduction is that it is achieved much easily by retracting body of the scapular body infero-medially instead of giving traction on the glenoid neck laterally.[30]

From the above studies we interpreted that the important prognostic factors for the management of floating shoulder depends on injury to ligaments stabilizing the shoulder joint (viz coracoclavicular, acromioclavicular and coracoacromian), degree of medial and caudal displacement of scapular neck fracture and glenopolar angle. Hence we have included only significantly displaced floating shoulder.

Conclusion

The present study concluded that the surgical fixation of all the floating shoulders, especially significantly displaced, allows for early rehabilitation and better functional outcome.

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