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Original research article

Study on surgical management of ipsilateral clavicle and scapular fractures (floating shoulder injury)

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Abstract

Aim: To study on surgical management of ipsilateral clavicle and scapular fractures (floating shoulder injury).

Methodology: The study protocol was approved by an Ethical Committee for research studies of NRI Medical College. Patients of floating shoulder injury with gross displacement at fracture site of both clavicle and scapula attending the emergency department of NRI Medical College, Mangalagiri.

Results: In our present study, we included patients in age range between 20-60 years with a mean age of 38.7 years with majority of the patients in range of 31-40 years (35%) In our present study males were predominant (75%) than females (25%) In our study Right sided injuries were more (60%) compared to left (40%). In our study majority of the injuries were due to high energy RTA (85%) followed by fall from height (15%). In our study ipsilateral side multiple rib fractures (40%) were the most common associated injury followed by head injury (15%) and C-spine fractures (5%). Among the 20 cases, Type C3 (Scapular neck displaced & unstable) was more common (60%) followed by C2 (Scapular neck un-displaced & unstable) (25%) and B3 (Scapular neck displaced & stable) (15%). The average duration for fixation of both clavicle and scapula in our study was 131.17 mins while for fixation of clavicle alone was 66.67 mins In our present study 17 cases (85%) were operated for both clavicle and scapula with LCP & RECON plates and 3 cases (15%) were operated for only clavicle with LCP. In our present study, the average blood loss in those patients who got operated for both clavicle and scapula is around 90ml while those operated for clavicle alone it was around 35ml. In our present study the mean time period (in weeks) for the union was 12.6 weeks for both clavicle and scapula when operated with clavicle fixation alone and 14.7 weeks respectively for both clavicle & scapula when operated with fixation of both clavicle & scapula. In our study the functional outcome of all patients was analyzed using HERSCOVICI SCORE. The mean HERSCOVICI SCORE in our study was 13.3 (EXCELLENT) in clavicle fixation alone group and 11.35 (EXCELLENT) in both scapula & clavicle fixation group.

Conclusion: We concluded that successful indirect reduction of the displaced fracture of the glenoid neck can be achieved with surgical fixation of the clavicle alone using LCP. However, open reduction and internal fixation of the scapula with RECON plating must be performed if significant displacement of scapula is present which ultimately resulted in good functional outcome.

Keywords: Scapular fractures, HERSCOVICI SCORE, Ipsilateral clavicle, pain

Introduction

The term "floating shoulder" injury (FSI) is used to describe ipsilateral midshaft clavicular and scapular body/neck fractures with double disruptions of the superior suspensory shoulder complex (SSSC). These injuries cause the glenoid to lose its bony connection. Around 0.10% of trauma victims get floating shoulder injuries. Ganz and Noesberger [1] provided the initial description of it in 1975. In order to further clarify their terminology, Goss [2] defined it as a "double rupture of the superior shoulder suspensory complex". The upper extremity is suspended from the superior shoulder suspensory complex, a bone and soft tissue ring attached to the trunk by superior and inferior bony structures. The distal clavicle, acromioclavicular joint, glenoid process, coracoid process, coracoclavicular ligament, and acromian process. When the SSSC was damaged, the stability of shoulder suspension would suffer severe harm; the weight of the affected limb and the local muscle tension would cause the fractured

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limb's distal end to rotate and move forward, downward, and inward. A dynamic power imbalance of the shoulder joint would emerge from this three-dimensional displacement, which would alter the start-end connections and structural length of the acromion and the muscles surrounding the glenohumeral joint. This could result in traumatic arthritis, subacromial impingement syndrome, drooping shoulder deformity, malunion, shoulder pain and weakness, delayed nerve and vascular damage, and other consequences if it is not effectively treated during the first injury period. Each fracture, when treated separately, is typically only minimally displaced and does not require surgery. In combination, each disruption might, however, render the others unstable. For instance, a glenoid neck fracture may cause the site of a clavicular fracture to shift more than it would otherwise, and vice versa. If the clavicular-acromioclavicular joint-acromial strut, coracoacromial ligament, or C-4 connection are further damaged, the resulting instability will be worse. Due to the loss of the rotator cuff's typical lever arm with glenoid displacement, Ada and Miller's [3] research observed a high prevalence of rotator cuff dysfunction in individuals with displaced clavicular and scapular fractures. According to Williams *et al*. [4] coracoacromial and acromioclavicular capsular ligaments must also be torn in order for ipsilateral fractures of the scapular neck and clavicular shaft to result in a floating shoulder. Van Noort *et al*. [5] believed that FSI was not always stable and that conservative treatment could produce satisfactory results if the scapula did not show downward rotation and displacement. According to Egol *et al*. [6] findings, each patient needs to receive tailored therapy, and surgery cannot be utilised as a standard form of treatment for all patients.

Aim

Our aim of the study is to evaluate the role of surgical management and also to study the functional outcome in surgical management of floating shoulder injury.

Aim: Study on surgical management of ipsilateral clavicle and scapular fractures (floating shoulder injury).

Objectives

- To evaluate the role of surgical management in floating shoulder injury.
- To evaluate the results in management of floating shoulder injury.
- To follow up the patients operated upon and note functional outcome and complications.

Materials & Methods

Study area: NRI Medical College, Mangalagiri.

The study protocol was approved by an Ethical Committee for research studies of NRI Medical College.

Study population: Patients of floating shoulder injury with gross displacement at fracture site of both clavicle and scapula attending the emergency department of NRI Medical College, Mangalagiri.

Study design: Prospective study.

Study period: The study was conducted from 2021 to 2022.

Sample size: 20 patients.

Inclusion criteria

1. Gross displacement of a clavicular fracture by ≥ 5 mm & that of a scapular neck fracture ≥ 10 mm.
2. Obvious scapular body fracture displacement.
3. A fracture of the exterior edge of the body of scapula with penetration into the glenohumeral Joint.
4. Scapular neck fracture combined with glenoid cavity fracture.
5. Coracoid fracture accompanied by coracoacromial or coracoclavicular ligament injury, with separation and displacement, or compression of blood vessels and nerves.
6. Shoulder fracture subsidence>5 mm, affecting the function of the rotator cuff and the motion of the inferior acromial joint.
7. Scapular spine fracture>5 mm in CT Scan.
8. GPA (34) (gleno polar angle) <20°.

Exclusion criteria

1. Delayed presented cases
2. Patients medically unfit for surgery
3. Patients who have not given informed consent.

Methodology: A total of 20 patients with ipsilateral clavicle and scapular fractures were chosen and

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sampling based on the inclusion and exclusion criteria and included in the study. After stabilization and admission of the patient detailed examination of the patients was carried out. Then standard Antero-Posterior view of injured shoulder with clavicle and scapular Y views of radiographs were taken, and the fracture configuration was noted. Patients were managed with intravenous fluids, whole blood transfusions if required & then limb immobilized in J-SLAB along with arm sling pouch to maintain the length & alignment of the fractures initially. Associated injuries like rib fractures with haemothorax and head injuries was treated by concerned specialists. 3D CT was taken when needed to know the exact alignment of the fragments. These fractures were classified according to displacement and instability.

Preoperative assessment: All routine basic investigations, including complete blood picture, Blood Grouping, and typing and Viral markers, were done if patients are aged more than 50 years; both cardiologist and pulmonologist opinion obtained to know the cardiac and pulmonary state of the patient to withstand the surgical procedure. Informed & written consent obtained from all patients. Haemoglobin levels and also the amount of blood to be lost during surgery are considered, and blood transfusion is planned for the patients. Test doses of antibiotics and xylocaine were given. Parts preparation along with bladder and bowel preparations were done.

Operative technique

Under general anaesthesia & strict aseptic conditions, patient in supine position initially, scrubbing and draping of injured upper limb done including shoulder upto neck region. In cases of both clavicle and scapula fixation, initially clavicle was fixed and later scapula. The clavicle approached through standard anterior approach. After subcutaneous dissection, fracture ends are freshened and fixed with adequate length of pre-contoured clavicle plate. After wound wash closure was done.

Anterior approach to clavicle

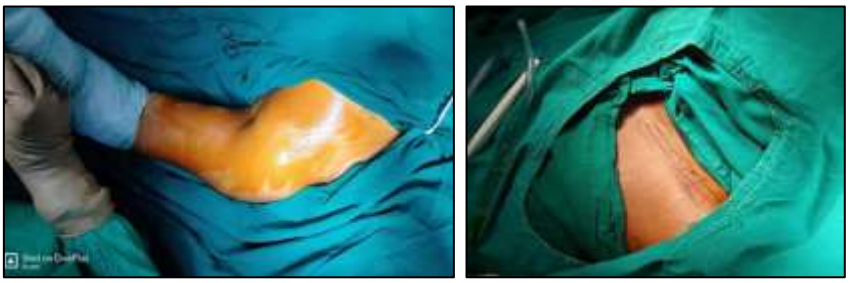

Fig 1: Patient Positioning and Incision Marking

Fig 2: Fracture Reduction

Fig 3: Plate Fixation & Skin Closure

Initial fixation of clavicle aids in indirect reduction of scapula fracture [38] (glenoid neck fracture usually). If reduction was satisfactory, scapula was treated conservatively. In cases of gross displacement of scapula fractures, scapular fixation is also done.

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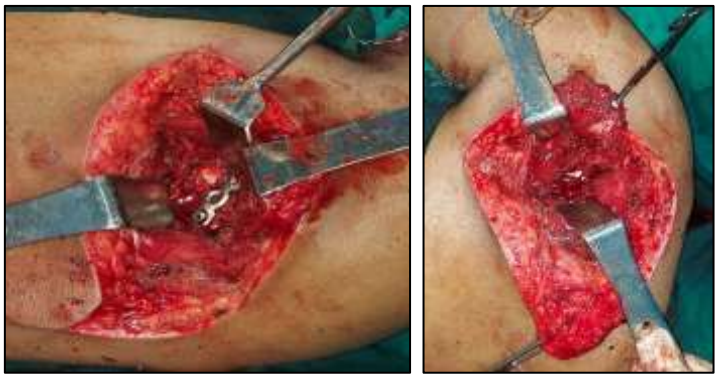

Fig 4: Fracture Reduction and Plate Fixation

Fig 5: Wound Closure

Post-operative protocol

- After surgical intervention postoperatively shoulder girdle is immobilized for 3-4 weeks, patients were given a sling for comfort and physical therapy was initiated.
- Analgesics & antibiotics were administered.
- Active wrist finger and elbow movements were encouraged from day 1 itself
- Active/passive shoulder movements were halted till 4 weeks
- After 4 weeks, the focus was placed on regaining full active ROM, with strengthening using 3- to 5-pound weights, therapy bands, and proprioceptive exercises.

Postoperative follow up after 6 weeks, 3, 6, 12, 18, and 24 months by radiographs were analysed to determine the presence of nonunion or malunion or associated fixation failure including broken hardware or screw pull-out etc.
The functional outcome of all patients was analyzed using HERSCOVICI (7) SCORE:
It has subjective (pain, lifestyle) and objective components (range of motion, muscle strength)

Results

The age groups included in the study from 20 years to 60 years, with a mean age of 38.7 years. Incidence of fracture was observed maximum between 30-40 years of age.

Table 1: Age Distribution

Age	Number of cases	Percentage
20-30 Years	5	25%
31-40 Years	7	35%
41-50 Years	4	20%
51-60 Years	4	20%

Among the 20 cases, males were predominant than females. Males were 15 (75%), and females were 5(25%).

Table 2: Sex Distribution

Sex	No. of Cases	Percentage
Male	15	75%

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Female	5	25%

Right side injuries were more compared to left in our study.

Table 3: Side of Injury

Side	Male	Female	Total
Right	8	4	12
Left	7	1	8
Total	15	5	20

Among 20 cases, 17 cases were due to road traffic accidents, and 3 were cases due to fall from height.

Table 4: Mode of injury

Mode of Injury	No. of Cases	Percentage
RTA	17	85%
Fall From Height	3	15%

Associated injuries: Floating shoulder injury usually results from a high energy trauma so it is usually associated with other injuries. In our study ipsilateral side multiple rib fractures were the most common associated injury followed by head injury and C-spine fractures.

Table 5: Associated Injuries

Associated Injury	No. of Patients	Percentage
RIB Fractures	8	40%
Head Injury	3	15%
C-Spine Fracture	1	5%
None	8	40%

Grade of Injury/Classification: Among the 20 cases, Type C3 (Scapular neck displaced & unstable) was more common followed by C2 (Scapular neck un-displaced & unstable) and B3 (Scapular neck displace & stable).

Table 6: Grade of Injury/Classification

Grade of Fracture	No. of Cases	Percentage
C3	12	60%
C2	5	25%
B3	3	15%

Duration of surgery: The average duration for fixation of both clavicle and scapula was 131.17 mins while for fixation of clavicle alone was 66.67 mins.

Table 7: Duration of surgery

Duration for Clavicle & Scapula Fixation (In Mins)	No. of Cases	Percentage
90-120 Mins	4	23.5%
121-130 Mins	7	41.17%
131-140 Mins	6	35.29%

Table 8: Duration of Surgery for Clavicle Fixation Alone

Duration for Clavicle Fixation Alone (In Mins)	No. of Cases	Percentage
40-60 Mins	2	66.67%
60-80 Mins	1	33.33%

Choice of Definitive Fixation: Initial fixation of clavicle aids in indirect reduction of scapula fracture. If reduction was satisfactory, scapula was treated conservatively. In cases of gross displacement of scapula fractures, scapular fixation was also done.

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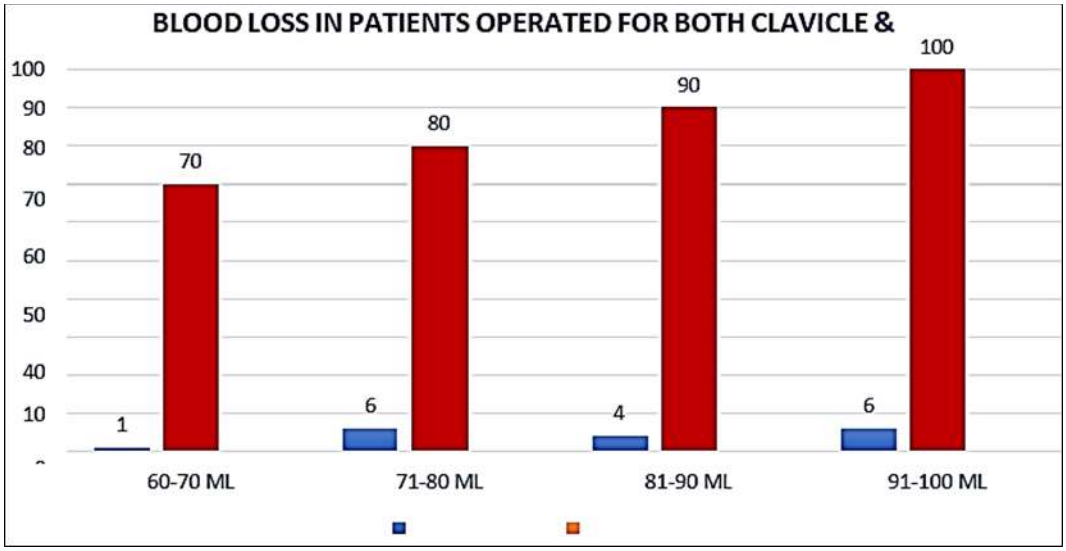
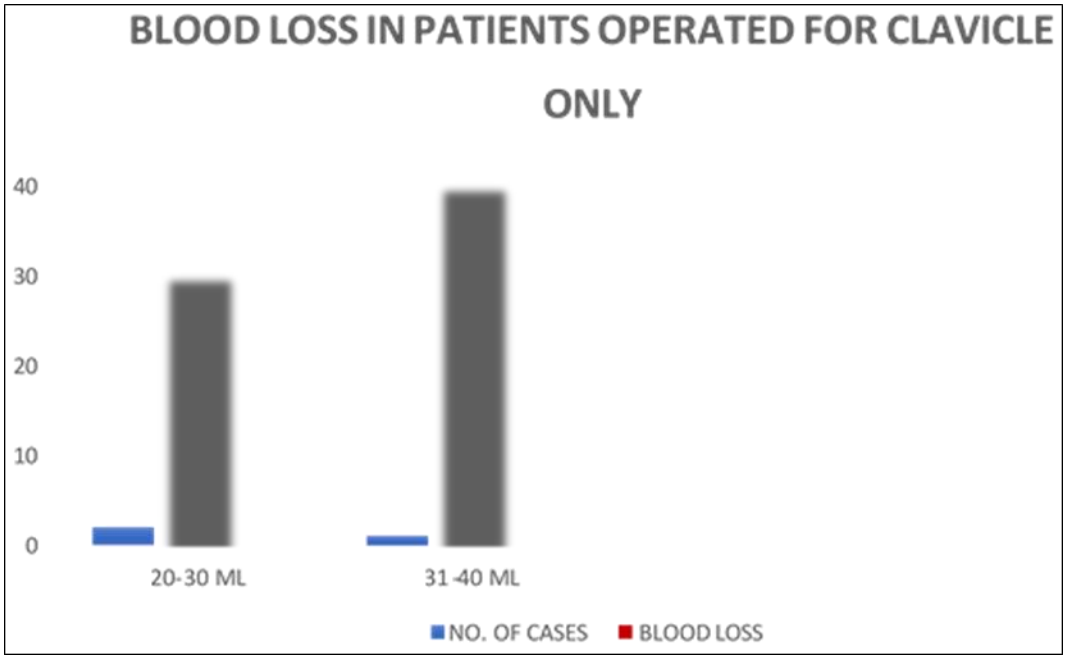
Table 9: Choice of Definitive Fixation

	No. of Cases	Implant Used
Both Clavicle & Scapula Fixation	17	Recon Plate-for Scapula Clavicle LCP-for Clavicle
Clavicle Fixation Alone	3	Clavicle LCP

Blood loss: The average blood loss in those patients who got operated for both clavicle and scapula is around 90ml while those operated for clavicle alone it was around 35ml.



Graph 1: Blood Loss in Patients Operated For Both Clavicle & Scapula



Union in weeks: Among the 17 patients who were operated for both clavicle & scapula with LCP+RECON plating the average time taken for union was 14.7 weeks while in the 3 patients who were operated for only clavicle fixation with LCP time taken was 12.6 weeks.

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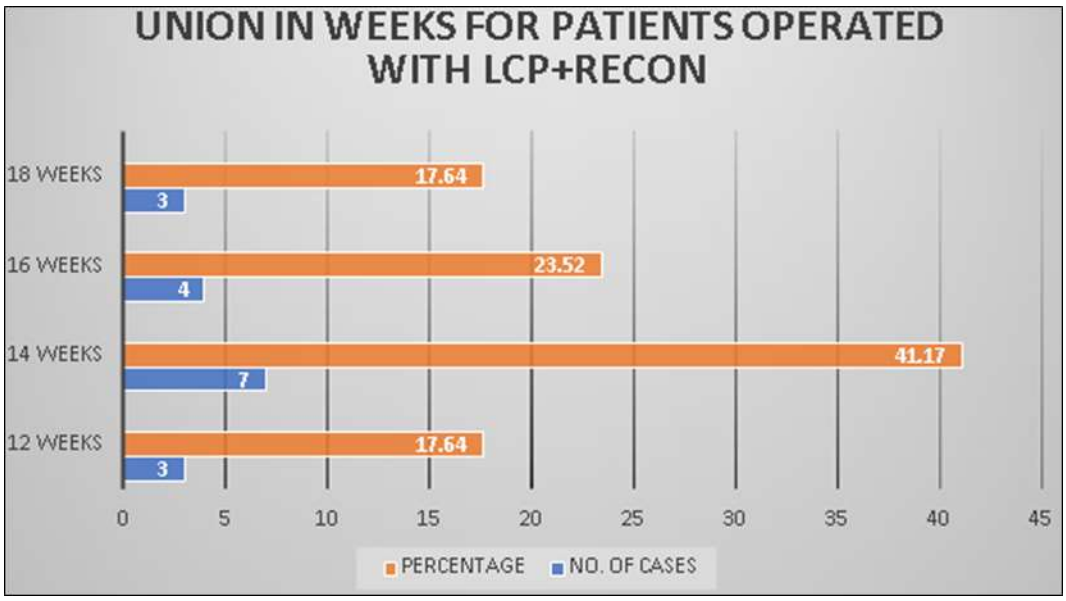

Graph 2: Union in Weeks for Patients Operated with LCP+RECON

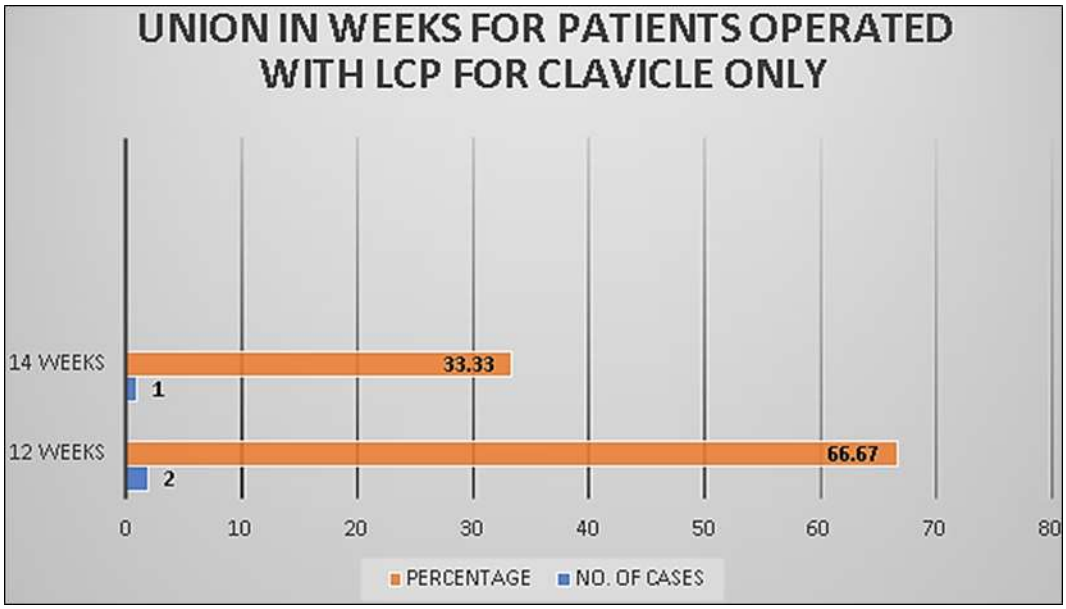

Table 10: Complications

Treatment	Complications	No. of Cases	Percentage
LCP+RECON	1. Persistant Shoulder Pain	4	23.52%
	2. Wound Gaping	3	17.64%
LCP	1. Persistant Shoulder Pain	1	33.33%

The functional outcome of all patients was analyzed using HERSCOVICI SCORE: It has subjective (pain, lifestyle) and objective components (range of motion, muscle strength).

Table 11: Functional Outcome

Functional Outcome	No. of Cases	Percentage
Excellent	12	60%
Good	6	30%
Fair	2	10%

Discussion

Isolated clavicular and scapular fractures that are stable and have little displacement heal without surgery. Complex fracture patterns are uncommon in "floating shoulder" injuries. This kind of double SSSC injury typically results from high-energy trauma and frequently has ipsilateral shoulder and chest damage along with it. Surgery should be the course of treatment if the patient can bear it. This will allow the SSSC to continue, the glenoid to stop rotating, the muscles surrounding the shoulder joint to lengthen

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and tighten, and the power balance and stability of the shoulder joint to return. The typical leverage functions of the rotator cuff in the upper extremity can be restored concurrently with adequate reduction and fixation, providing an anatomic and power base for the early training of the shoulder joint.
A prospective study was done among 20 patients with ipsilateral clavicle and scapular fractures managed surgically with LCP for clavicle alone in 3 patients through standard anterior approach & LCP+RECON plating for scapula in 17 patients with Judet (35)approach satisfying inclusion and exclusion criteria during the study period after obtaining informed consent in the department of orthopaedics.
In our present study, we included patients in age range between 20-60 years with a mean age of 38.7 years with majority of the patients in range of 31-40 years (35%).

Table 12: Comparision with other studies

S No.	Author of Study	Age Range	Mean Age
1.	Present study	20-60 years	38.7 years
2.	Glide *et al.* [7]	18-60 years	46 years
3.	Yadav *et al.* [8]	20-50 years	33.08 years
4.	Izadpanah *et al.* [9]	20-60 years	35.25 years

In our present study MALES were predominant (75%) than females (25%).

Table 13: Comparision of gender with previous studies

S. No.	Author of Study	Male/Female Ratio
1.	Present study	15:5
2.	Glide *et al.* [7]	10:3
3.	Yadav *et al.* [8]	20:5
4.	Izadpanah *et al.* [9]	13:3

In our study right sided injuries were more (60%) compared to left (40%).

Table 14: Comparison of mode of injury with other studies

S. No.	Author of Study	Right Side	Left Side
1.	Present study	60%	40%
2.	Yadav *et al.* [8]	72%	28%
3.	Labler *et al.* [10]	82.35%	17.6%

In our study majority of the injuries were due to high energy RTA (85%) followed by fall from height (15%).

S. No.	Author of Study	Mode of Injury	
		RTA	Fall from Height
1.	Present study	85%	15%
2.	Glide *et al.* [7]	100%	Nil
3.	Yadav *et al.* [8]	84%	16%

In our present study 17 cases (85%) were operated for both clavicle and scapula with LCP & RECON plates and 3 cases (15%) were operated for only clavicle with LCP.

Table 15: Comparing the Mode of Injury in Various Studies

S. No	Author of Study	Treatment method and no. of patients in the respective group & implant used		
		Non-operative	Clavicle fixation alone	Clavicle Fixation & Scapula
1.	Present study	None	3-LCP	17 Cases-LCP & RECON
2.	Glide *et al.* [7]	None	13	None
3.	Yadav *et al.* [8]	13 Cases	12 Cases-RECON	None
4.	Izadpanah *et al.* [9]	None	16 CASES- RECON & TENS	None

In our present study the mean time period (in weeks) for the union was 12.6 weeks for both clavicle and scapula when operated with clavicle fixation alone and 14.7 weeks respectively for both clavicle & scapula when operated with fixation of both clavicle & scapula.

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Table 16: Comparing treatment method and no. of patients in the respective group & implant used in various studies

S. No.	Author of Study	Union (In Weeks) of Clavicle & Scapula With Respective Treatment Methods		
		Non-Operative	Clavicle Fixation Alone	Clavicle & Scapula Fixation
1.	Present study	None	12.6 Weeks for both Clavicle & Scapula	14.7 Weeks for Both Clavicle & Scapula
2.	Yadav *et al.* [8]	Months (11 Weeks) for Clavicle Months (11.5 Weeks) for Scapula	2.5 Months (10.5 Weeks for Clavicle 2.9 Months (11.8 Weeks) for Scapula	None
3.	Hashiguchi and Ito *et al.* [11]	None	11.4 Weeks for Clavicle 16.8 Weeks for Scapula	None

In our study the functional outcome of all patients was analyzed using HERSCOVICI SCORE. The mean HERSCOVICI SCORE in our study was 13.3 (EXCELLENT) in clavicle fixation alone group and 11.35 (EXCELLENT) in both scapula & clavicle fixation group.

Table 17: Comparing union (in weeks) of Clavicle & Scapula with Respective Treatment Methods

S. No.	Author of Study	Outcome Measure	Mean Value of the Score in Respective Treatment Method		
			Non Operative	Clavicle Fixation Alone	Clavicle & scapula fixation
1.	Present study	Herscovic I Score	None	13.3 (Excellent)	11.35 (Excellent)
2.	Glide *et al.* [7]	Herscovic I Score	None	12.9 (Excellent)	None
3.	Yadav *et al.* [8]	Herscovic I Score	13 (Excellent)	14.9 (Excellent)	None
4.	Izadpanah *et al.* [9]	Constant Murley Score	None	78.2 In Plate Fixation Group (Good) 82.4 In Tens Group (Excellent)	None

In our study, in clavicle & scapula fixation group persistant shoulder pain (23.52%) followed by wound gaping (17.64%) were the 2 major complications. In clavicle fixation alone group persistant shoulder complication (33.33%) was the only complication.

Table 18: Comparing Functional Outcome in Various Studies

S. No	Author of study	Complication	No. of Patients
1.	Present study	Persistant Shoulder Pain Wound Gaping	4 Cases-In Clavicle & Scapula Fixation 1 Case-In Clavicle Fixation Only 3 Cases-In Clavicle & Scapula Fixation
2.	Glide *et al.* [7]	Non Union	1 Case-In Clavicle Fixation
3.	Yadav *et al.* [8]	Superficial Infection	2 Cases-In Clavicle Fixation

Table 19: COMPARING COMPLICATIONS IN VARIOUS STUDIES

Conclusion

The condition known as a "floating shoulder" injury is caused by two disruptions of the superior suspensory shoulder complex (SSSC), which cause ipsilateral mid shaft clavicular and scapular body/neck fractures. This might result in traumatic arthritis, subacromial impingement syndrome, drooping shoulders, malunion, shoulder discomfort and weakness, delayed nerve and vascular damage, and other consequences if it is not adequately treated.

A poor functional outcome from a floating shoulder injury caused by significant displacement at one or both fracture sites can be addressed with surgery.

In light of our research, we draw the conclusion that successful indirect reduction of the displaced fracture of the glenoid neck can be achieved with surgical fixation of the clavicle alone using LCP. However, open reduction and internal fixation of the scapula with RECON plating must be performed if significant displacement of scapula is present which ultimately resulted in good functional outcome.

Conflict of Interest: None.

Funding Support: Nil.

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