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ORIGINAL RESEARCH

Surgical management of lateral third of clavicle fracture: A prospective study

[1]Virendra K Bhasme, [2]Adiveppa A Hosangadi, [3]Vinod K Makannavar, [4]Gangadhar S

[1, 2]Associate Professor, MBBS MS (ORTHO) Department of Orthopaedics, Karnataka Medical College and Research Centre , Hubli, Karnataka, India
[3]Assistant Professor, MBBS MS (ORTHO), Department of Orthopaedics,Karnataka Medical College and Research Centre , Hubli, Karnataka, India
[4]Junior Resident, MBBS MS (ORTHO) Department of Orthopaedics,Karnataka Medical College and Research Centre , Hubli, Karnataka, India

Corresponding Author
Gangadhar S
Junior Resident, MBBS MS (ORTHO) Department of Orthopaedics,Karnataka Medical College and Research Centre , Hubli, Karnataka, India

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ABSTRACT

Background: Lateral clavicle fractures are a common injury among young athletes. This study aims to evaluate the effectiveness of open reduction and internal fixation (ORIF) in treating these fractures, using either lateral anatomical locking plates or hook plates. The study was essentially a prospective study aimed at studying the role of fixation using these plates and not a comparison between the plates

Materials and Methods: Over a 24-month period, a prospective clinical study was conducted on 25 patients diagnosed with lateral clavicle fractures. These patients were treated under the Orthopaedics Department at Karnataka Medical College and Research Centre, Hubballi. Each patient received either a lateral anatomical locking plate or a hook plate for fracture stabilization. The functional outcomes were assessed using the Constant Shoulder Score.

Results: The study found that most participants were men, with road traffic accidents being the leading cause of injury. The average age of the patients was 34.24 years. Approximately 10% of the patients had additional injuries. Over 35% experienced delayed complications, primarily presenting as shoulder pain. The average time for fracture healing was 13.36 weeks. The Constant Murley Score had an average value of 86.00, with a standard deviation of ±4.24. A significant correlation was observed between the score and the time taken for fracture healing.

Conclusion: Young male adults were predominantly affected by fractures, with road traffic accidents being the primary cause. The majority of patients achieved good to excellent outcomes, with faster fracture healing following open reduction and internal fixation using plates. Complications were minimal and easily managed.

Key words: Lateral clavicle fracture , Anatomical locking plate , Hook plate

INTRODUCTION

Clavicle fractures are a frequent occurrence, affecting about 29 out of every 100,000 people annually[1]. These fractures account for 2.6–4% of all fractures in adults[1] and are particularly common among younger, active individuals, especially those involved in sports or activities with high risk of high-speed impacts or falls [1].

Lateral end fractures represent approximately 21-28% of all clavicle fractures[2] and are more commonly observed in older adults, typically as a result of simple falls[2]. The presentation of these fractures can vary widely, with displacement seen in 10-52% of cases[2]. In such situations, the intact acromioclavicular joint usually holds the small lateral fragment in place, while the distal end of the medial fragment may be pulled upward and backward [2].

Lateral clavicle fractures are among the more unstable types and necessitate timely intervention[3]. Conservative methods for achieving closed reduction can be particularly difficult with these fractures[3]. When displaced distal clavicle fractures are treated non-operatively, there is a significant risk of complications, including delayed union and non-union[3], with non-union occurring in 22%–33% of cases and delayed union in 45%–66% [3]. Given these elevated risks, open reduction and internal fixation are generally recommended as the preferred surgical treatment for displaced lateral end fractures[3].

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Over the years, a variety of surgical techniques have been introduced, each with varying degrees of effectiveness [4]. Some of the surgical options for treating lateral end clavicle fractures include Kirschner wires, coracoclavicular screw fixation, hook plate fixation, and lateral clavicle locking plate fixation [5]. Despite the availability of these techniques, there is no universally accepted gold standard[4], which has led to ongoing debates about the most effective approach for managing unstable lateral clavicle fractures [4]. Among the current surgical options, the clavicle hook plate and lateral anatomical plate are well-regarded [6]. While these plates generally result in high union rates and low complication rates, there are still concerns about their long-term effects, particularly in relation to the acromioclavicular joint [6].

Consequently, it is important to assess the effectiveness of locally adapted lateral anatomical plates and hook plates, while also considering whether the surrounding soft tissue structures of the acromioclavicular joint require repair [7]. By combining radiological evaluations with clinical outcome assessments, we can gain a deeper understanding of how well these interventions work and their overall impact on patient recovery [7].

Materials and Methods

This research study was approved by the ethical committee and institutional review board before the commencement of study. The study was conducted on the patients with lateral clavicle fractures admitted under the department of Orthopaedics, atKarnataka Medical College and Research Centre , Hubballi. It was conducted between July 2022 to July 2024 for a period of 2 years. It was a prospective type of clinical study

Inclusion Criteria: All displaced lateral third fractures of clavicle with or without acromioclavicular disruption, Failure to maintain reduction with conservative methods, Lateral third fractures without neurovascular deficit, Lateral third fractures with soft tissue interposition

Exclusion Criteria: Age group less than 16 years, High anaesthetic risk, Any medical contraindication for surgery, Fractures of mid shaft of clavicle.

After taking proper history and thorough examination x-rays were taken including Zanca view. Routine blood investigations, ECG, chest x-ray etc. were done.Physician fitness for surgery was routinely taken.Pre-operative evaluation was carried out and patients were kept fasting for six hours before surgery. Informed written consent for surgery taken. Patient preparation carried out, instructions from the anaesthetic and physician were followed, iv antibiotic was administered 30 minutes before surgery to all patients after test dose, usually 1gm ceftriaxone intravenously.

Patient was operated either in general anaesthesia or regional (supraclavicular) nerve block.Patients were operated either in supine or beach chair position with proper padding of bony prominences.

Head secured to appropriate head rest, patient put to beach chair position by elevating the head end by 45 to 60°. This will help reduce the fracture by gravity and ligamentotaxis. A small bag is placed in inter-scapular region which aids in fracture reduction. Upper limb is draped and should be movable. Advantage of beach chair position is reduce venous pressure and thereby decrease bleeding, allows the blood to drain away from the operative field during surgery.

The operative limb, from the base of the neck to the hand, was thoroughly scrubbed, painted, and draped in a sterile manner, ensuring that it remained freely movable. An oblique skin incision of appropriate size was made, centered superiorly over the fracture site. Careful dissection to the level of the bone taking care not to injure any vessels or

The fracture ends were identified and cleared of any debris and hematoma. A free fragment if present was preserved and, if possible, reduced to the proximal or distal clavicle using a lag screw. The fracture ends were then reduced using reduction forceps and temporarily stabilized with either a K-wire or lag screw.

The choice of implant was decided based on the amount of bone stock available in the lateral fragment. If the bone stock was good and fragment was large pre-contoured lateral anatomical locking plate was used. If the bone stock was not sufficient and fragment was small then clavicle hook plate was used. After assessing the size of the distal fragment, a suitable plate of the appropriate length was chosen and carefully positioned on the top surface of the clavicle (Figure 1).

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Fig 1: (a) Lateral anatomical locking plate (b) Clavicular hook plate (c) (d) Instruments and implants

To safeguard against injury to the nearby nerves and blood vessels, the underside of the clavicle was exposed, allowing for the placement of a protective instrument during drilling or tapping. The acromioclavicular (AC) joint was pinpointed using a K-wire, with its position confirmed by a C-arm, ensuring that screws were not inadvertently placed in the joint, especially when using a lateral plate with extension. The joint also served as a guide to help properly position the hook of the plate beneath the acromion. (Figure 2)

Fig 2: Intraoperative pictures of (a) Lateral anatomical locking plate (b) Clavicular hook plate

The torn ligaments were not repaired during the procedure. Any tissue that was in the way was carefully removed. The AC joint itself was not opened; instead, its location was marked with a needle and verified through fluoroscopy. In case of hook plate fixation the soft tissue behind the AC joint was then prepped for the insertion of the plate's hook. Initially, a 15 mm hook was gently guided under the acromion. The shaft of the plate was aligned on the top surface of the clavicle and checked for proper positioning. Care was taken not to apply too much force to lower the plate onto the bone. If the plate didn't fit easily, an 18 mm hook was used instead. In cases where significant resistance was encountered, the alignment was rechecked and adjusted as needed. The section of the plate that sits on the clavicle was slightly bent to ensure it was centered properly on the bone, with careful attention to avoid bending the tip or hook of the plate.

After surgery, patients who had general anaesthesia were asked nil per oral for 4 to 6 hours. They were given painkillers and antibiotics, and their operated arm was placed in a sling for support. X-rays were taken to make sure the fracture fragments were properly aligned. On the second day after surgery, the wound dressing was changed, and depending on how they were doing, patients were sent home with the arm sling. Simple arm exercises, like pendulum movements, were also started on the second day to help with gentle movement.

Two weeks later, patients came back for a check-up, where their stitches were removed. At this stage, they were encouraged to start active range of motion exercises, though they were still advised to avoid lifting their arm overhead.

Around four to six weeks after surgery, patients could begin more actively, though they were still advised to hold off on sports and exercises that involved resistance. They could start doing their daily activities again, but anything that involved heavy lifting was delayed until the fracture was fully healed.

At the six-week check-up, they were examined to see how well they were recovering, checking for any tenderness at the fracture site, and another X-ray taken to confirm the fracture was healing satisfactorily. If the healing process was good, patients were allowed to start doing resistance exercises to strengthen their arm. However, they were still advised to avoid contact sports or activities involving unpredictable movements for at least 12 weeks after surgery.

Patients had regular follow-ups at two weeks, six weeks, three months, and six months after surgery. During these visits, they were checked for any tenderness, instability, or deformities, and monitored shoulder movement. X-rays were taken at each visit to keep an eye on the union progress and to ensure the implant was in the right place. Rehabilitation exercises were adjusted based on how well the fracture was healing and how much time had passed since the surgery. Throughout the recovery process, the Constant Shoulder Scoring System was used to measure the shoulder's strength and function.

The Constant-Murley score (CMS) is a 100-points scale composed of a number of individual parameters. These parameters define the level of pain and the

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ability to carry out the normal daily activities of the patient. It was introduced to determine the functionality after the treatment of a shoulder injury. The test is divided into four subscales: pain (15 points), activities of daily living (20 points), strength (25 points) and range of motion: forward elevation, external rotation, abduction and internal rotation of the shoulder (40 points). The higher the score, the higher the quality of the function (Table 1).

Table 1: Constant shoulder murley score

Rating	Score
Excellent	86-100
Good	71-85
Fair	56-70
Poor	<56

Complications such as neurovascular injury, infection, non-union, malunion, implant migration, implant failure, soft tissue irritation, refracture and cosmetic outcomes were noted.

Implant removal was not done routinely in our study. It was done as per the need and will of the patient after fracture union. The number of days to return to normal activities after implant removal was noted.

Results

The mean age of the participants in the study was 34.24 years with a standard deviation of around ±10.72years. The minimum age and maximum age of the study participants were 19 years and 57 years, respectively. In the study, majority of the participants were males i.e., about 88.0%. Remaining 12.0% of them were females.

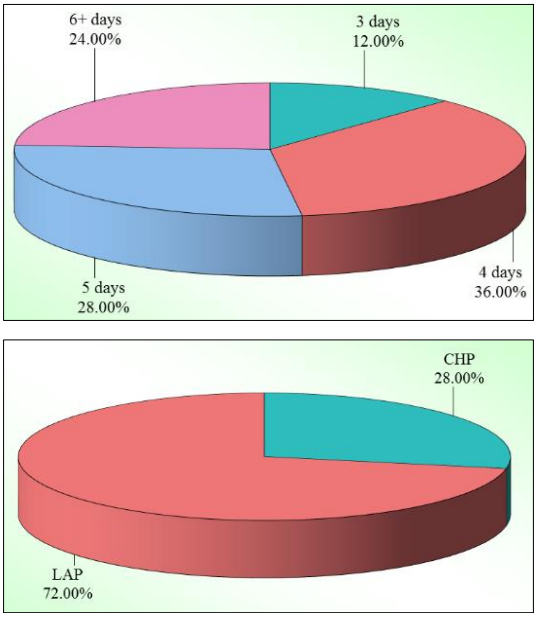
Majority of the participants in the study i.e., about 84.0% of them suffered injury due to road traffic accidents. The next common mode of injury was accidental slip and fall.

In the study, associated injuries were present in only 8.0% cases. It includes disruption of acromioclavicular joint, intertrochanteric fracture, and fracture of distal end of radius. However, in majority cases i.e., 92% had suffered fracture without association of any injuries. Majority of the study participants i.e., about 40.0% cases sustained fracture over right side. Remaining 60% cases presented with fracture over left side. None of the cases was bilateral.

In the study, nearly one third of cases i.e., about 28.0% presented with delayed complications. It includes mainly painful shoulder, and others such as acromion osteolysis and implant prominence. However, majority of them i.e., around 72.0% cases did not experience any sorts of complications even after 3 months. Moreover all the cases with complications were subjected into physiotherapy, and were provided special care, which helped in quick improvement from their condition.

The mean time to surgery in days from the time of admission in the study was 4.88 days with a standard deviation of around ±1.48 days (Figure 3a).

In 72% of the cases lateral anatomical plate was used and in 28% of the cases clavicle hook plate was used. (Figure 3b).



LAP- Lateral anatomical locking plate
CHP- Clavicle hook plate

Fig 3: (a) Time to surgery in day wise distribution of study participants (b) Implants used wise distribution of study participants

In the study, the final outcome was good in majority of the cases, i.e., about 84.0% cases. 8.0% of the cases yield excellent outcome, and on other hand, the fair outcome was also observed in only 8.0% cases (Figure 4).

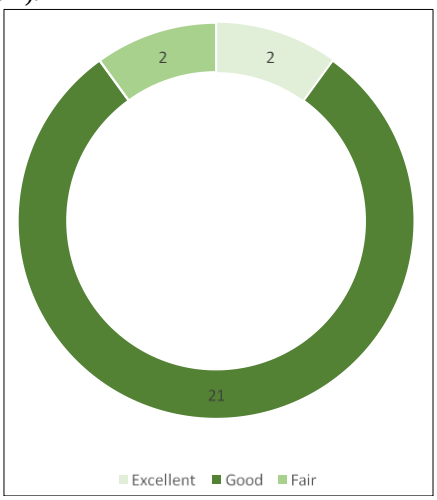


Fig 4:Functional outcome of fracture among the study participants

Discussion

In order to study the role of open reduction and internal fixation in lateral clavicle fractures using hook plates and lateral anatomical plates and to track the occurrence of complications, if any, the current prospective clinical study was carried out over the

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course of approximately two years on about 25 patients with lateral clavicle fractures who were admitted under the Department of Orthopaedics at karnataka medical college and research institute, Hubballi.

The majority of research participants were between the ages of 26 and 35. With a standard deviation of around ±10.72years, the mean age was 34.24years. In contrast, the majority of the volunteers in the earlier trials were significantly older. In the research conducted by Tiren D *et al*. [8], Renger *et al*. [9], Beirer *et al*. [10], Tambe AD *et al*. [5, 11], and Muramatsu *et al*. [12], the mean ages were, respectively, 38.02 years, 38.40 years, 40.74 years, 41.23 years, and 47.14 years.

Approximately more than 85.0% of the study's participants were men. The remaining 12 percent were women. All of the earlier research, including Meda PVK *et al*., Tambe AD *et al*., Muramatsu *et al*., and Renger *et al*., revealed this kind of male predominance. This suggests that because men participate in more activities that put them at risk for injury, they are more likely to suffer distal clavicle fractures.

The majority of research participants, or roughly 84.0%, were injured in automobile accidents. The accidental self-fall was the next most prevalent mode of injury. The results of the majority of the earlier investigations support this. Sports accidents were the second most frequent modality in the Renger *et al*. study, after traffic accidents. Road traffic accidents were the most common mode, followed by falls at home, in another study by Vaishya R, *et al*. [13].

According to the study, the proportion of associated injuries was assessed to be around 8.0%. It involves fractures of the distal end of the radius, intertrochanteric fractures, and dislocation of the acromioclavicular joint. Nonetheless, the majority of cases, or 80.0%, had fractures that were unrelated to any other injury. According to a study conducted by Vaishya R *et al*., fractures were frequently linked to traumas to the head, upper extremities, and ribs. Nonetheless, the majority of instances lacked the corresponding injuries.

The majority of study participants - roughly 60.0% of cases - sustained left side fractures. In the remaining 40.0% of instances, a right side fracture was visible. There were no bilateral cases. This is contrast to Zhang C. *et al*.'s study 23, where there was no bilaterality and a higher laterality towards the right side with a proportion of about 63.9% cases. However, in the study by Vaishya R *et al*., there was no bilaterality and 71.8% of the cases had a fracture on the left side.

About 28.0% of patients, or nearly one-third of the total, had delayed complications at the time of the study. Along with other conditions like implant prominence and acromion osteolysis, the primary complaint is shoulder ache. But even after three months, the vast majority of them - roughly 72.0% of the cases - did not encounter any problems of any kind. Based on a review of the majority of prior studies, the majority of instances did not have any issues. The study conducted by Meda PVK *et al*. revealed that superficial infections accompanied by erythema and serous discharge were among the minor problems that were observed. A small number of studies, including Renger *et al*., have shown implant dislocation, whereas Tambe *et al*. and Vaishya R *et al*., have reported non-union in extremely few cases.

Among study participants, the average time for union of fracture was 13.36 weeks, with a standard deviation of approximately ±2.36 weeks. The union had minimum and maximum durations of 10 and 18 weeks, respectively.

Due to variations in the study samples and locations, this differs among studies. The study conducted by Meda PVK *et al*. [14] found that the mean duration for fracture union was 12.60 weeks, which was relatively shorter than the study conducted by Alhammam *et al*. [15], and Muramatsu *et al*., which was slightly longer. These findings suggest that the results of the current study was quite noteworthy.

According to the study, there was a statistically significant negative association between Constant shoulder Score and Fracture Union, indicating that the higher the Constant shoulder Score, the earlier the fracture union (Figure 5).

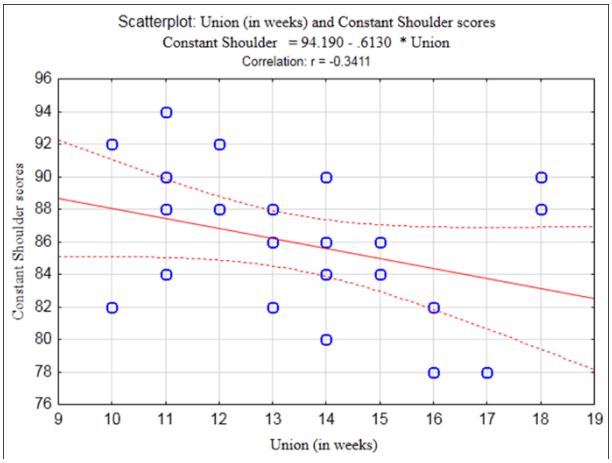

Fig 5:Scatter diagram showing correlation between Union (in weeks) and Constant scores

After analysing the Constant Score, the mean value was 86.00, with a standard deviation of around ±4.24. The readings ranged from 76 to 94 at the lowest and maximum, respectively. Since this is frequently utilised to assess how much the condition has improved, it has been examined in all prior investigations. As a result, though not as much as in the current study, the mean values ranged widely. In the cases of Beirer *et al*., Tambe AD *et al*., Lee YS *et al*., Alhammam *et al*., and Meda PVK *et al*. the corresponding scores were 85.6, 8.5, 90.1, 92.4, 94.2, and 97.3.

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Based on the assessment scores utilised in the study, the end result was examined, and it was found to be good in the majority of cases - roughly 84.0% of the cases. Only 8.0% of instances result in an exceptional outcome, and only 8.0% of cases also show a decent outcome. In light of the effectiveness of the intervention, this is really remarkable. This is similar to research conducted by Vaishya R *et al*., Renger *et al*., Muramatsu *et al*., Tiren D *et al*., and Alhammam *et al*., where the majority of the results were good to exceptional (Figure 6, 7).

Fig 6: (a) Pre op x ray (b) Post op x ray (c) Follow up x ray at 6 months (d) Follow up clinical pictures at 6 months

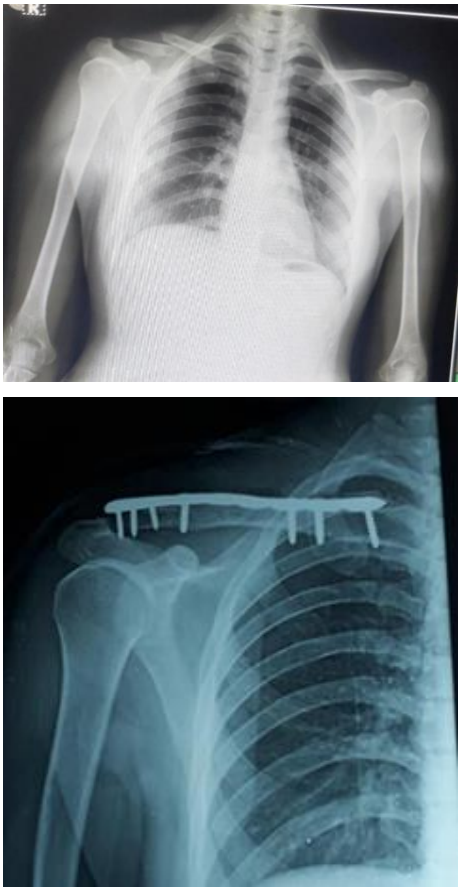

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Fig 7: (a) Pre op x ray (b) Post op x ray (c) Follow up x ray at 6 months (d) Follow up clinical pictures at 6 months

Conclusion

On observing the patients with lateral clavicle fractures in the study, following observations were made;

The fracture was more common in young adult males and the most common mode of injury was road traffic accidents. Open reduction and internal fixation using plates yielded good to excellent results in majority with the union of fracture in shorter duration. The complications were very few and very mild, and were easily managed, thereby quickening the recovery of the condition

Consent

Written informed consent were taken from the patients.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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None.

Author contributions

Author 1, 2, 3: Supervision, Validation.
Author 4: Writing - Original Draft Preparation.

References

1. Robinson CM, Cairns DA. Primary non-operative treatment of displaced lateral fractures of the clavicle. J Bone Joint Surg Am. 2004;86(4):778-782.
2. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. J Shoulder Elbow Surg. 2002;11(5):452-456.
3. Neer CS II. Fractures of the distal third of the clavicle. Clin Orthop Relat Res. 1968;58:43-50.

DOI: 10.69605/ijlbpr_13.9.2024.87

4. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. J Bone Joint Surg Br. 1997;79(4):537-539.
5. Tambe AD, Motkur P, Qamar A, Drew S, Turner SM. Fractures of the distal third of the clavicle treated by hook plating. Int Orthop. 2006;30(1):7-10.
6. Flinkkila T, Ristiniemi J, Hyvonen P, Hamalainen M. Surgical treatment of unstable fractures of the distal clavicle: A comparative study of Kirschner wire and clavicular hook plate fixation. Acta Orthop Scand. 2002;73(1):50-53.
7. Wang SJ, Wong CS. Extra-articular Knowles pin fixation for unstable distal clavicle fractures. J Trauma. 2008;64(6):1522-1527.
8. Tiren D, Hagg O, Forsberg L, Lindgren U. Hook plate fixation in acute displaced lateral clavicle fractures: A retrospective analysis. J Shoulder Elbow Surg. 2013;22(4):515-21.
9. Renger RJ, Roukema GR, Reurink G, Goslings JC, Schep NW. Hook plate fixation for Neer type II fractures of the distal clavicle: functional outcome and complications. J Shoulder Elbow Surg. 2009;18(5):847-53.
10. Beirer M, Schuh A, Lechner R, Haneveld H, Roch C, Stuby F, *et al*. The superior anterior clavicle plate for lateral clavicle fractures. Z Orthop Unfall. 2014;152(2):136-142.
11. Tambe AD, Motkur P, Qamar A, Drew SJ. Clavicle hook plate fixation for type II distal clavicle fractures. J Shoulder Elbow Surg. 2006;15(6):672-678.
12. Muramatsu K, Shigetomi M, Matsunaga T, Murata Y, Taguchi T. Use of the AO hook-plate for treatment of unstable fractures of the distal clavicle. Arch Orthop Trauma Surg. 2007;127(3):191-194.
13. Vaishya R, Vijay V, Khanna V. Outcome of distal end clavicle fractures treated with locking plates. Chin J Traumatol. 2017;20(1):45-48.
14. Meda PVK, Machani B, Sinopidis C, Braithwaite I, Brownson P, Frostick SP. Clavicular hook plate for lateral end fractures: A prospective study. Injury. 2006;37(6):277-283.
15. Alhamam NM, Nourredine Y, Fouad H. Hook-plate fixation for Neer type II distal clavicle fractures: clinical outcomes and complications. J Orthop Surg. (Hong Kong). 2017;25(2):2309499017717861.