



COMPARATIVE STUDY TO EVALUATE THE FUNCTIONAL OUTCOME BETWEEN INTRAMEDULLARY NAILING AND PLATE FIXATION OF MIDSHAFT CLAVICLE FRACTURES

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ABSTRACT

Aims and Objectives : To assess functional outcome in mid-shaft clavicle fractures undergoing fixation by plate osteosynthesis and intramedullary nail fixation. **Methodology:** A total of 30 patients were randomized into 2 groups (Plating group and Nailing group) on an alternate basis. All required data was collected during the stay in the hospital, pre-operative radiograph and blood investigations were done, post-operative protocols were followed with clinical assessment done using Constant Shoulder score and DASH scoring. **Results:** In my study, 15 cases were treated with plate osteosynthesis and 15 cases treated with intramedullary TENS nailing. All fractures united at an average of 10-12 weeks. There were 14 excellent and 1 good outcome in plating group, nailing group had 12 excellent and 3 good functional outcomes. 5 patients showed complications, one plating patient with infection, 4 plating patients and 2 nailing patients with hardware irritation. All complications were addressed accordingly. **Conclusion:** Both plate osteosynthesis and intramedullary TENS nail fixation of mid-shaft clavicle fractures offer excellent functional outcome without any significant differences and intramedullary fixation can be considered as an equally effective method of fixation of mid-shaft clavicle fractures.

KEYWORDS : Intramedullary TENS fixation, plate osteosynthesis, Constant shoulder score, DASH score.

INTRODUCTION

Clavicle fractures are common injuries in young, active people, particularly those who participate in activities or sports that involve high-speed falls (bicycling, motorcycles) or violent collisions (football, hockey). 80-85% of these fractures occur in the middle one-third of the clavicle, with 73% being displaced fractures of the clavicle midshaft. It is more common in guys. The most prevalent cause for injury is a direct hit to the shoulder or a fall on the lateral shoulder.¹

A variety of procedures for primary fixation of displaced clavicle fractures have yielded good results, with high union rates and minimal complication rates. Several surgical therapies are presented, including K wire fixation, Austin Moore pins, Knowles pins, Rockwood pin, intramedullary screw fixation, TENS, and plate and screw fixation.

However, management has recently switched to surgical intervention, particularly Open Reduction and Internal Fixation utilizing plate fixation, or Intramedullary fixation, and increasing incidences of fixation are now being reported.^{2,3}

Because there are numerous fixation techniques, we want to evaluate the functional outcome of intramedullary TENS fixation to ORIF with plate osteosynthesis. If TENS fixation had equivalent or better results than ORIF, the additional benefits of TENS include a smaller scar, less blood loss, and a shorter operational time, making TENS fixation a promising alternative to plate osteosynthesis.

Objectives of the Study

To evaluate the functional outcome of Open reduction and Plate Osteosynthesis and Intramedullary Nail Fixation surgery. To compare the functional outcome between Open reduction and Plate Osteosynthesis and Intramedullary Nail Fixation surgery.

MATERIALS AND METHODS

The Prospective randomized control study was conducted in the Department of Orthopedics, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore from January 2021 to May 2022. The study was conducted on

patients of either sex with middle one-third clavicle fracture undergoing Open reduction with plate osteosynthesis and Intramedullary nail fixation to the clavicle. A total of 30 patients who meet the following criteria were included in the study. Patients were randomized by allocating them to 2 groups (Group 1 - Plating group and Group 2 - Nailing group) on an alternate basis.

Inclusion Criteria: All skeletally mature patients of both male and female gender giving informed consent for participation in this study, Unstable, displaced, non-comminuted/simple comminuted fractures of middle one-third clavicle, Clavicle fracture associated with other injuries, Fractures within the last 4 weeks, Shortening of over 15 mm or >2cm, If fracture fragments are tenting or compromising skin, Bilateral clavicle fracture.

Exclusion criteria: Severely comminuted/segmental fractures, Open fractures, Fractures older than 4 weeks, Congenital anomaly or bone diseases, Any medical contraindication for surgery, Patient refusal, Clinically important neuro-muscular upper limb disability.

General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on the shoulder, Road traffic accident, direct injury to shoulder and fall on outstretched hand. Enquiry was made to note site of pain and swelling over the affected clavicle. Past medical illness and family history were also recorded.

General condition of the patients was examined for pallor, pulse rate and blood pressure. Respiratory and cardiovascular system were examined for any abnormalities. Local examination was done in the following steps:

On inspection the following points were noted. Patients with fractured clavicle often support the flexed elbow of the injured side with the other hand. Abnormal swelling was present in the middle third for middle third clavicle fracture and in the lateral third for lateral third clavicle fracture. The condition of the skin over the clavicle was noted for any abrasion, laceration and contusion.

On palpation the following points were noted: Palpation of the entire length of the affected clavicle for tenderness in the middle third or in the lateral third fracture. The fractured clavicle was also palpated for any abnormal mobility and crepitus.

Movements: The movements of the affected side shoulder were restricted due to pain.

The distal neurovascular status of the affected upper limb was examined and the associated injuries were noted. Plain radiograph of clavicle with shoulder in anteroposterior view was taken to assess the site of fracture and the fracture type (displacement and comminution). The fracture was classified according to Robinson's classification. The affected upper limb was immobilized in an arm pouch.

Routine investigation like Hb%, Total count, Differential count, ESR, Blood urea, Sugar, Serum creatinine and ECG were done. HBsAg, HCV and HIV test were done before surgery on all patients. All patients were operated as early as possible once the general condition of the patients was stable and the patients were fit for surgery as assessed by the physician.

Preoperative Preparation of Patients:

Patients were kept fasting for 6 hours before surgery. A written informed consent for surgery was taken. The neck, chest, axilla shoulders and arm were prepared. Tranquilizers were given as advised by the anesthetist. A systemic antibiotic usually Inj. Cefoperazone + Sulbactam 1.5gm intravenously were administered 30 minutes before surgery to all patients. All patients were operated under general anaesthesia.

Procedure Group 1 –

Patients were placed in supine position on OT table after General Anesthesia. Scrubbing, painting and draping was done. The insertion point made approximately 1 cm lateral to the sternoclavicular joint. A one-centimeter vertical skin incision made, and a hole is made in the anterior cortex with the help of awl. A TEN inserted (diameter of nail depending on the width of the medullary canal) in the medullary canal of the clavicle with T-handle. With oscillating movements, the nail advanced until it reaches the fracture site. If closed reduction was unsuccessful, an additional skin incision was made at the level of the fracture site for open reduction of the fragments. Although the clavicle is S shaped, the tip of the TENS is curved which helps to pass the elastic nail into distal fragment. The nail is next driven across the fracture site into the medullary canal of the lateral fragment until resistance is felt by the surgeon. The protruding end of the nail is cut off and bent as close to the bone as possible. Using the impactor, the bent end of the nail is impacted, and the skin is closed over the bent end of the nail. The procedure was performed under fluoroscopic guidance.

Procedure Group 2 –

Patients were placed supine/ beach chair position after giving general Anesthesia on OT table, a sand bag was placed between the medial border of the scapula and the spine. Incision was made transversely just under the fracture site, supra clavicular nerves identified and spared wherever possible. After reduction of fractures, an appropriate size of locking plate was fixed on the antero-superior surface of the bone by appropriate size screws. In oblique or complex fractures, inter fragmentary lag screws were used to achieve compression. The fascia and skin were closed in layers. The procedure was performed under fluoroscopic guidance.

Post-operative Protocol:

Protocol was same for both groups. Postoperatively, patients were given a sling, but were encouraged for early shoulder mobilization as tolerated. Pendular exercises for the shoulder were started from the second day. And all the patients were

discharged on the second postoperative day. After 7 days, active range of movement exercises were started, however, overhead shoulder abduction was allowed only after 2 weeks. The sling was discarded at around 2 weeks, thereafter activities of daily living were started, but those requiring lifting heavy objects were delayed until radiological and clinical union was achieved.

All patients were reviewed in the outpatient department at 3 weeks, 6 weeks, 3 months and 6 months after surgery. At each visit, patients were assessed clinically and radiologically. Constant Shoulder score and DASH scores were assessed at 6 weeks, 3 months 6 months, average of these scores were used for comparison of functional outcome.

Functional outcome was assessed by the Constant score which was used as primary indicator for the comparison between the two groups. DASH scores were also collected. Radiographic union was defined as evidence of bridging callus or obliteration of fracture lines. Clinical union was considered as absence of tenderness at the fracture site. Time to achieve union was recorded.

Complications such as neurovascular injury, wound infection, delayed union, malunion, implant migration, implant failure, soft tissue irritation, refracture after implant removal and cosmetic outcome with regards to visible deformity, scars and hardware prominence under the skin.

Constant Shoulder scores and grades obtained at 3 weeks, 3 months and 6 months were assessed and average score was used as primary indicator for the comparison of functional outcome between the two groups. DASH scores were also obtained at same interval.

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Normality of the continuous data was tested by Kolmogorov-Smirnov test and the Shapiro-Wilk test. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. Graphical representation of data: MS Excel and MS word were used to obtain various types of graphs such as bar diagram, Pie diagram. p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

RESULTS

Mean age of subjects in Plating Group was 29.93 ± 6.475 years and in Nailing Group was 32.20 ± 14.108 years. There was no significant difference in age distribution between two groups.

In the Plating Group, 86.7% were males and 13.3% were females. In Nailing Group, 73.3% were males and 26.7% were females. There was no significant difference in Gender distribution between two groups.

In both groups, mode of injury was RTA in 60% and Fall in 40% respectively. There was no significant difference in mode of injury between two groups. In Plating Group, 53.3% had FOOSH injury and 46.7% had direct injury. In Nailing Group, 66.7% had Foosh injury and 33.3% had direct injury. There was no significant difference in FOOSH/Direct Injury between two groups.

In the Plating Group, 60% had left side injury and 40% had

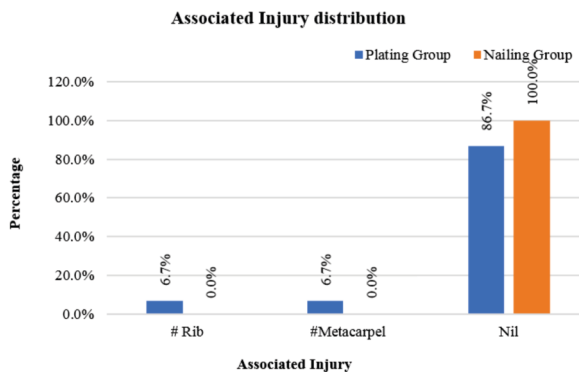
right side injury and in Nailing Group, 53.3% had left side injury and 46.7% had right side injury. There was no significant difference in side affected between two groups.

Table 1 : Robinson Classification Comparison Between two Groups

		Group			
		Plating Group		Nailing Group	
		Count	%	Count	%
Robinson Classification	2B1	13	86.7%	13	86.7%
	2B2	2	13.3%	2	13.3%
	Total	15	100.0%	15	100.0%

$\chi^2 = 0.000$, $df = 1$, $p = 1.000$ [Chi-square test]

In Plating Group, 13.3% had 2B2 grade and 86.7% had 2B1 grade. In Nailing Group, 13.3% had 2B2 grade and 86.7% had 2B1 grade. There was no significant difference in Robinson Classification between two groups. In the study Plating Group, 6.7% had Rib # and 6.7% had Metacarpel #. In Nailing Group, 0% associated injuries. There was no significant difference in Associated Injury between two groups.



Graph 1: Bar Diagram Showing Associated Injury Comparison Between Two Groups.

In Plating Group, 86.7% had LCP, 13.3% had Recon plate as implant and in Nailing Group, 100% had TENS implant. There was no significant difference in Implant use between two groups. Mean Duration of Stay in Plating Group was 5.07 ± 0.594 days and in Nailing Group was 5.00 ± 0.000 days. There was no significant difference in Duration of Stay between two groups. Mean time for Return to Work in Plating and Nailing Group was 13.33 ± 1.952 days. There was no difference in Return to Work between two groups.

Mean Time of Union in Plating Group was 9.07 ± 1.981 weeks and in Nailing Group was 10.00 ± 2.000 Weeks. There was no significant difference in Time of Union between two groups. Mean Maximum adjusted score (DASH) in Plating Group was 6.00 ± 11.832 and in Nailing Group was 10.00 ± 16.903 . There was no significant difference in Maximum adjusted score (DASH) score between two groups. Mean Constant Score (Normal side) in Plating Group was 97.20 ± 1.265 and in Nailing Group was 96.00 ± 1.852 .

Mean Constant Score (Affected) in Plating Group was 93.87 ± 3.889 and in Nailing Group was 89.87 ± 4.172 . There was significant difference in Constant Score (Affected) between two groups. Mean Difference in Constant Score in Plating Group was 3.33 ± 3.754 and in Nailing Group was 6.13 ± 3.889 . There was no significant difference in Difference in Constant Score between two groups.

In Plating Group, 93.3% had excellent and 6.7% had good outcome and in Nailing Group, 80% had excellent and 20% had good outcome. There was no significant difference in Functional outcome between two groups

DISCUSSION

Advantages of plate fixation include good reduction, compression and rigid fixation. A multicenter, prospective clinical trial by Canadian Orthopaedic Trauma Society found that plate osteosynthesis had better functional outcome than conservative management in the treatment of displaced midshaft clavicle fractures- with decreased rate of non-union and symptomatic malunion.⁴

However it has its share of complications too, severe complications such as deep infection, non-union and implant failure were seen in 10%, lesser complications like superficial infection, keloid scar, implant loosening.⁵

Intramedullary fixation of clavicle fractures is an effective alternative fixation method. Advantages of intramedullary nailing from biomechanical point of view is that the tension side of clavicle changes with respect to rotation of the arm and the direction of loading⁶. Other potential advantages include smaller incision, load sharing properties and minimal periosteal stripping. The relative stability allows abundant callus formation during healing. Frequently encountered complications include skin irritation due to the prominent medial end of the nail and failure to control axial length.

The mean age of individuals in the Plating Group was 29.93 ± 6.475 years and in the Nailing Group was 32.20 ± 14.108 years, which is consistent with studies by Vishal sharma et al.⁷ Lee et al⁸, Narasaria et al.⁹, Saha et al¹⁰, and Silva et al¹¹.

The majority of the patients were male. In agreement with earlier research by Ishwar Bohra et al¹², Lee et al¹³, Narasaria et al⁹, Saha et al¹⁰, and Silva et al¹¹

According to Vajrangi et al¹⁴, fall was the more prevalent method of injury than RTA, but in our study, the mode of injury was RTA in 60% and Fall in 40%, which is consistent with the findings of Hemanth Kumar et al¹⁵ and Fuglesang et al¹⁶. In the Plating Group, 53.3% had a FOOSH (fall on outstretched hand) injury, whereas 46.7% sustained a direct injury. In the Nailing Group, 66.7% were injured due to FOOSH, whereas 33.3% were injured directly.

In both groups, the left side was more affected than the right side, consistent with the findings of Vajrangi et al¹⁴ and Hong et al¹⁷. In the Plating Group, 13.3% earned a 2B2 grade while 86.7% had a 2B1. In the Nailing Group, 13.3% had a 2B2 grade and 86.7% had a 2B1 grade, which is consistent with study by Philip A et al and Vajrangi et al¹⁴. The classification of fractures was not explicitly indicated in the remaining investigations. In the study plating group, one patient had Rib # and one had Metacarpel #. In Nailing Group, there were no connected injuries. The majority of research did not discuss or incorporate concomitant injuries.

According to Philip et al, the mean duration of stay was 4.13 ± 2.38 for the TENS group and 7.24 ± 4.10 with P value of 0.001, which was statistically significant. However, in our study, the mean duration of stay was 5.07 ± 0.594 days for the plating group and 5.00 ± 0.000 days for the nail group, which was not statistically significant. The mean time of union in the plating group was 9.07 ± 1.981 weeks and in the nailing group was 10.00 ± 2.000 weeks, which was consistent with Philip A et al's¹⁸ study - 10.17 ± 1.84 in the nailing group and 10.88 ± 2.44 in the plating group, which is consistent with Vajarangi et al's¹⁴ study. Silva et al's study found 16.8 ± 3.5 for the plating group and 15.9 ± 3.5 for the nailing group.

In our study we experienced a small number of challenges, in Plating Group, 1 patient had infection, 4 patients had Hardware Irritation as complications and in Nailing Group, 2 patients had Hardware Irritation as complication. Various

investigations came across different complications such as implant bending in Silva et al study, transient neuropraxia in Meijden et al study¹⁹, wound dehiscence, implant failure and incisional numbness in Fugelsang et al²⁰ study.

The mean maximum adjusted score (DASH) in the Plating Group was 6.00 ± 11.832 and in the Nailing Group was 10.00 ± 16.903 , which was consistent with Silva et al - 9.9 ± 10.9 for the plating group and 8.5 ± 13.0 for the nailing group. However, some studies had different results, such as Meijden et al¹⁹ - 3 for the plating group and 5.6 for the nailing group, and Vajrangi et al¹⁴ - 12.315 ± 56.909 for the plating group and 11.45 ± 4.816 for the nailing group.

The Plating Group had a mean Constant Score (Normal side) of 97.20 ± 1.265 , while the Nailing Group had a mean of 96.00 ± 1.852 , indicating a substantial difference between the two groups. The mean Constant Score (Affected) was 93.87 ± 3.889 in the Plating Group and 89.87 ± 4.172 in the Nailing Group, indicating a significant difference between the two groups. The mean difference in Constant Score was 3.33 ± 3.754 in the Plating Group and 6.13 ± 3.889 in the Nailing Group. There was no significant difference between the two groups.

In the majority of the studies, only constant shoulder scores were measured and assessed, whereas in our study, we assessed Constant shoulder score grading, which was also done by Philip A et al. In agreement with Philip A et al study¹⁸, in the plating group, 93.3% had excellent and 6.7% had good outcome, and in the nailing group, 80% had excellent and 20% had good outcome, there was no significant difference in functional outcome between two groups, indicating that there is no sign.

CONCLUSION

The essential limitation of our investigation was that it was a small comparative study with a small number of patients conducted at a single center. Larger randomized controlled studies are required to better understand the outcomes and complications of plates and TENS in displaced midshaft clavicle fractures.

REFERENCES

1. Azar MD, Fredrick M, Beaty MD, Campbell's Operative. Orthopaedics, 14th edition, chapter 57;2021: 3031-3039. <https://www.asia.elsevierhealth.com/campbells-operative-orthopaedics-4-volume-set-9780323672177.html>
2. Yadav S, Phalak MO, Shevate I, Salunkhe R, Khandge A, Deshmukh A, Patel S, Patil GL. Comparative Study of Postoperative Outcomes of Clavicle Midshaft Fracture Treated by Nailing vs. Plating. Cureus. 2022 Mar 5;14(3):e22862. doi: 10.7759/cureus.22862. PMID: 35392444; PMCID: PMC8977932.
3. Chan G, Korac Z, Miletic M, Vidovic D, Phadnis J, Bakota B. Plate versus intramedullary fixation of two-part and multifragmentary displaced midshaft clavicle fractures - a long-term analysis. Injury. 2017 Nov;48 Suppl 5:S21-S26. doi: 10.1016/S0020-1383(17)30734-9. PMID: 29122117.
4. Canadian Orthopaedic Trauma Society. Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter, randomized clinical trial. J Bone Joint Surg Am. 2007 Jan;89(1):1-10. doi: 10.2106/JBJS.F.00020. PMID: 17200303.
5. Andersen K, Jensen PO, Lauritzen J. Treatment of clavicular fractures. Figure-of-eight bandage versus a simple sling. Acta Orthop Scand. 1987 Feb;58(1):71-4. doi: 10.3109/17453678709146346. PMID: 3554886.
6. Gupta P, Vishwakarma AK, Gupta DK, Agarwal S, Singh N. Comparative Evaluation of Results after Internal Fixation of Fracture Clavicle by Titanium Elastic Nailing System/Plate. Journal of Bone and Joint Diseases July-Sep 2017;32(2):10-16. DOI: 10.13107/bjbd.0971-7986
7. Sharma V, Patil P, Gaonkar N, Garud A, Choudhary S. A comparative study of stabilization of shaft clavicle fractures using intramedullary nailing vs plating. International Journal of Orthopaedics Sciences. 2019;5(2.1):06-13. <https://ijprt.org/index.php/pub/article/view/335>
8. Lee YS, Lin CC, Huang CR, Chen CN, Liao WY. Operative treatment of midclavicular fractures in 62 elderly patients: knowles pin versus plate. Orthopedics. 2007 Nov;30(11):959-64. doi: 10.3928/01477447-20071101-13. PMID: 18019991.
9. Narsaria N, Singh AK, Arun GR, Seth RR. Surgical fixation of displaced midshaft clavicle fractures: elastic intramedullary nailing versus precontoured plating. J Orthop Traumatol. 2014 Sep;15(3):165-71. doi: 10.1007/s10195-014-0298-7. Epub 2014 May 25. PMID: 24859367; PMCID: PMC4182648.
10. Saha P, Datta P, Ayan S, Garg AK, Bandyopadhyay U, Kundu S. Plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures: A comparative study. Indian J Orthop. 2014 Nov;48(6):587-93. doi: 10.4103/0019-5413.144227. PMID: 25404771; PMCID: PMC4232828.

11. Silva AFB, Kojima KE, Joeris A, Silva SJ, Mattar R. Single, superiorly placed reconstruction plate compared with flexible intramedullary nailing for midshaft clavicular fractures: a prospective, randomized controlled trial. J Bone Joint Surg Am. 2015 Apr 15;97(8):620-6. doi: 10.2106/JBJS.N.00497. PMID: 25878305.
12. Bohra I, Saif Niyazi Md. Plate fixation versus elastic nailing for displaced clavicle fractures: A comparative study. Int J OrthopSci 2018;4(4):834-838. DOI: 10.22271/ortho.2018.v4.i4k.107. <https://doi.org/10.22271/ortho.2018.v4.i4k.107>
13. Smekal V, Irenberger A, Attal RE, Oberladstatter J, Krappinger D, Kralinger F. Elastic stable intramedullary nailing is best for mid-shaft clavicular fractures without comminution: results in 60 patients. Injury. 2011 Apr;42(4):324-9. doi: 10.1016/j.injury.2010.02.033. Epub 2010 Apr 14. PMID: 20394920.
14. Vajrangi A, Shetty SV, Shenoy RM. A Comparative Study Between Plate Fixation and Intramedullary Fixation for Displaced Mid-Shaft Clavicle Fractures in Adults. Malays Orthop J. 2022 Mar;16(1):40-45. doi: 10.5704/MOJ.2203.006. PMID: 35519522; PMCID: PMC9017922.
15. Kumar H, Banga R, Boparai R, Singh J. Flexible intramedullary nailing for fixation of displaced midshaft clavicle fractures. Journal of Medical Sciences. 2018;38(2):67. 10.4103/jmedsci.jmedsci_51_17
16. Kadakia AP, Rambani R, Qamar F, McCoy S, Koch L, Venkateswaran B. Titanium elastic stable intramedullary nailing of displaced midshaft clavicle fractures: A review of 38 cases. Int J Shoulder Surg. 2012 Jul;6(3):82-5. doi: 10.4103/0973-6042.102557. PMID: 23204762; PMCID: PMC3507328.
17. Hong, P, Liu, R., Rai, S. et al. Plating versus elastic stable intramedullary nailing for displaced pediatric midshaft clavicular fractures. J OrthopTraumatol 23, 42 (2022). <https://doi.org/10.1186/s10195-022-00659-2>
18. Philip A, Suranig SM, Lingaraj, Rengasamy K, Najimudeen S. Anatomical plating versus titanium elastic nailing for displaced midshaft clavicle fractures: a prospective comparative study. Int J Res Orthop 2021;7:278-84. <https://doi.org/10.18203/issn.2455-4510.IntJResOrthop20210621>
19. van der Meijden OA, Houwert RM, Hulsmans M, Wijdicks FJ, Dijkgraaf MG, Meylaerts SA, et al. Operative treatment of dislocated midshaft clavicular fractures: plate or intramedullary nail fixation? A randomized controlled trial. J Bone Joint Surg Am. 2015;97(8):613-9. doi: 10.2106/JBJS.N.00449
20. Duan X, Zhong G, Cen S, Huang F, Xiang Z. Plating versus intramedullary pin or conservative treatment for midshaft fracture of clavicle: A meta-analysis of randomized controlled trials. J Shoulder Elbow Surg. 2011;20:1008-15. doi: 10.1016/j.jse.2011.01.018.