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Utility of tens nail and planting for fracture of mid shaft clavicle fracture: A narrative review

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Abstract

Aim: To treat midshaft clavicle fractures using open reduction with internal fixation and titanium elastic nailing system. The purpose of this review article is to narrate various difficulty encountered in patients with midshaft clavicle fracture.

Method: An extensive search of all materials related to the topic was done for 25 years in Google Scholar and many more search engines. Overall, 20 articles focusing on the different aspects of mid shaft clavicle were identified and analyzed.

Conclusion: As majority of article shows that, treatment of patients with midshaft clavicle fractures with TENS patients had an excellent success, compared with plating. Thus, we concluded that TENS is therefore superior to plating for the treatment of clavicular fractures.

Keywords: Open reduction and internal fixation (ORIF), titanium elastic nailing system (TENS), midshaft clavicle fractures, functional outcome, disabilities of shoulder and hand (DASH)

Introduction

The most frequent bone injury is a clavicle fracture. The clavicle is involved in 2% to 5% of all adult fractures and 10% to 15% of paediatric fractures ^[1]

According to studies, 29 to 64 people out of 100,000 experience a clavicle fracture each year.

The majority of fractures are caused by a weak point in the middle of the clavicle. Choosing the right course of treatment remains difficult for orthopaedic surgeons despite the increasing frequency. Particularly, it is unclear if surgery yields superior results to nonsurgical treatment. In this case, a comparative randomised study was planned to examine the incidence of nonunion, shortening, functional outcome, cosmetic aspects, and complications between plating and the titanium elastic nail system (TENS) for clavicle fractures.

The study's goal is to evaluate the effectiveness of TENS therapy and surgical plating for displaced midshaft clavicle fractures. It also sought to assess the functional results of therapy with TENS and plating for displaced fractures of the middle part of the clavicle.

Although they only account for 2.6% to 4% of all adult fractures, they are highly significant since they impact the most productive segment of our population ^[1]. Up to 70% of those affected are male, and the majority are under the age of 45 ^[2, 3, 4].

Methodology

An extensive search of all materials related to the topic was carried out in the Google Scholar search engines. Relevant research articles focusing on "UTILITY OF TENS NAIL AND PLATING FOR FRACTURE OF MID SHAFT CLAVICLE FRACTURE - A NARRATIVE REVIEW" published in the period 1998 –2022 were included in the review. Keywords used in the search include Open reduction and internal fixation (ORIF), Titanium Elastic Nailing System (TENS), Midshaft clavicle fracture, Functional outcome, Disabilities of Shoulder and Hand (DASH). A total of 173 articles were available out of which after excluding articles with free available text the study was limited to twenty articles that were to be analyzed.

Review of Literature

Wijdicks *et al.* (2012) [6]. Performed a retrospective study that included a total of 90 patients with displaced midshaft clavicle fracture who were treated either with plate fixation (n=43) or TENS (n=47). Mean age of patients in two groups was 39.4 and 33.1 years, majority (73.3%) of patients were males, had involvement of left side (56.7%), had sports/road injury (63.3%), did not have 1718 neurovascular injury. Median duration of follow-up was 8 months in plating and 6 months in TENS group. Median time for removal of prosthesis was 11 months in plating and 5 months in TENS group, thus showing it to be significantly longer in plating as compared to TENS group. The authors reported "a total of seven implant failures occurred in six patients (14%) of the plate "Group A" and one implant failure (2.1%) in the TENS group, thus showing the difference to be borderline significant. Major revision surgery was performed in five cases in the plate group (11.6%) as compared to one case (2.1%) in the TENS "Group B" but this difference was not significant statistically. There were three refractures (7.0%) in the plate "Group A" After removal of the implant as compared to none0 in the TENS "Group B" But this difference was not significant statistically". A total of six minor revisions (13%) were reported in the TENS "Group A" As compared to none in the plate group, thus showing a significant difference between the two groups.

Narsaria *et al.* (2014) [7] reported a study that included 65 cases with displaced midshaft clavicle fractures who underwent surgical management either using precontoured plating (n=32) and antegrade TENS (n=33) respectively. Mean age of patients in plating and TENS group was 40.2 and 38.9 years. Majority of patients were males (76.9%) and had involvement of right side (58.5%). Mean time gap between injury and presentation was 7.2 and 6.9 days respectively in the two groups. Statistically, the two groups were similar for age, sex, side of involvement and time gap between injury and clinical presentation.

As compared to plating, TENS had significantly shorter operative time (40.2 min 1 vs 58.4 min), length of incision (4.5 cm vs 10.2 cm), hospital stay (1.4 days vs 2.8 days), blood loss (70 ml vs 130.8 ml). Union rate was 100% in plating as compared to 97.0% in TENS "Group B" But this difference was not significant. Mean time for union was 7.4 weeks in plating as compared to 6.1 weeks in TENS "Group B" But difference was not significant statistically. The two groups were comparable for complications like infection, implant failure and need for revision surgery. However, incidence of wound dehiscence, hypertrophic scar and refracture after implant removal was significantly higher in plating as compared to TENS group. The two groups were similar for functional scores too.

The authors found elastic nails to be "safe, minimally invasive surgical technique with a lower complication rate, faster return to daily activities, excellent cosmetic and comparable functional results, and can be used as an equally effective alternative to plate fixation in displaced midshaft clavicle fractures".

Saha *et al.* (2014) [8] assessed "the effectiveness of minimally invasive antegrade TEN and plating technique for the treatment of DMCF. A total of 80 unilateral displaced midclavicular fractures operated were included in study.

This prospective comparative study was approved by the local ethicalcommittee. Follow-ups were at 2nd and 6th weeks and subsequently at 3, 6, 12, 18 and 24 months postoperatively. Primary outcome was measured by the Constant score, union

rate and difference in clavicular length after fracture union.

Secondary outcome was measured by operative time, intraoperative blood loss, wound size, cosmetic results and complications. A total of 37 patients in the plate "Group A" And 34 patients in the TENS group completed the study. There was 20 no significant difference in Constant scores between the two groups. However, faster fracture union, lesser operative time, lesser blood loss, easier implant removal and fewer complications were noted in the TENS group. They were of the view that the use of minimally invasive antegrade TENS for fixation of displaced midshaft clavicle fractures is a better option in view of faster fracture union, lesser morbidity, better cosmetic results, easier implant removal and fewer complications; although for comminuted fractures plating remains the procedure of choice".

Wang *et al.* (2015) [9] carried out a retrospective case-control study that included a total of 55 midshaft clavicle fracture patients. Out of these 25 (45.5%) were operated using TENS and 30 (54.5%) were operated using plate fixation. "All patients were classified into four subgroups: simple fracture in the TENS group (ST; n = 13), simple fracture in the plate group (SP; n = 15), comminuted fracture in the TENS group (CT; n = 12), and comminuted fracture in the plate group (CP; n = 15). Wound size was significantly smaller in the TENS group.

The injured clavicular length after fracture healing was significantly shorter in the TENS group. There was no significant difference in the mean Constant and DASH scores. Injured clavicle shortening was significantly larger in the CT subgroup. However, there was no statistically significant difference in Constant score and DASH score while comparing the CT subgroup to other subgroups. Although TENS fixation could result in a higher degree of length shortening after bony union especially in cases of comminuted fracture pattern yet there was no statistically significant difference in objective functional results as compared to other subgroups". The authors recommended TENS for surgical management of a displaced midshaft clavicle fracture even in cases of comminuted fracture pattern.

Fuglesang *et al.* (2017) [13] compared "the functional outcomes of plate fixation and TENS of completely displaced mid-shaft fractures of the clavicle in the active adult population. A total of 123 patients were enrolled in the study and randomised into either plate fixation or TENS groups. Patients completed the Quick Disabilities of the Arm, Shoulder and Hand (DASH) score at one to six weeks post-operatively. They were followed up at six weeks, three and six months and one year with radiographs, and their clinical outcome was assessed using both the DASH and the Constant Score. The authors found that plate fixation provided a faster functional recovery during the first six months compared with TENS, but there was no difference after one year. The duration of surgery was shorter for TENS (mean 53.4 minutes, 22 to 120) than for plate fixation (mean 69.7 minutes, 35 to 106). The recovery after TENS was slower with increasing fracture comminution and with open reduction". The authors found both the treatments to be effective in management of midshaft clavicle fractures but found plate fixing to be quicker than TENS in terms of recovery, though TENS had shorter operative time and fewer infections as compared to plate fixing.

Sahu *et al.* (2018) [14] carried out a study that included a total of 50 patients with midshaft clavicle fractures. Of these, one half (n=25; 50%) were managed using TENS while remaining half (n=25; 50%) were managed using ORIF plating. Mean

age of patients in two groups was 33.28 and 34.76 years respectively. Majority of patients (72%) were males. "Road traffic accident was the most common mode of injury (56%) followed by fall from height and sports (16% each). In both the groups, dominant side was more commonly involved than the non-dominant side". The fractures were classified as B1 and B2 in 25 (50%) cases each. On postoperative third day, majority of cases in TENS group had VAS scores for pain <2 (52%) whereas majority of cases in Plating group had VAS scores >2 (76%). Mean shortening was significantly less in TENS group (1.84±2.88 mm) as compared to that in the plating group (4.5±4.12 mm). Cosmetic satisfaction was also significantly higher in TENS as compared to plating group. Mean DASH and Constant Shoulder Score in TENS group (1.87±3.4 and 9.36±7.04) were significantly lower as compared to that in the plate group (4.8±9.0 and 15.08±9.4). Overall excellent outcome was seen in 84% of TENS as compared to 60% in plating group. The findings of the study showed a promising role of TENS as compared to plating in management of midshaft clavicle fractures.

Sharma *et al.* (2019) ^[15] in a comparative study that included 50 midshaft clavicle fracture cases used plating and TENS for surgical treatment in 25 cases each. Mean age of patients in plating and TENS groups was 35.84 and 36.02 years respectively. Mean surgical time was shorter in TENS (52.39 ±9.24 min) as compared to that in plating group (58.38 ±10.18 min) but this difference was not significant statistically. However, length of incision as well as average blood loss was significantly lower in TENS as compared to plating group. "There was no significant difference between two groups with respect to post-operative pain and range of movement at six months". However, proportion of those having excellent outcome was significantly higher in plating group (56%) as compared to that in TENS group.

Pandian *et al.* (2019) ^[16] in their study on 40 patients with displaced middle third clavicle fractures selected alternate patients randomized to either Plating (n=20) and nailing (TENS) (n=20). Mean blood loss in plating group (89 ml) was significantly higher as compared to that in TENS group (35.5 ml). Although mean operating time was longer in plating (53.75 min) as compared to that in TENS group (49 min) yet this difference was not significant statistically. Patients in plating group had significantly larger incision size (10.05 cm) as compared to that in TENS group (4.15 cm). All the cases in both the groups had successful union. Mean time for clinical and radiological union was 7 and 12.7 weeks in TENS as compared to 7.50 and 11.75 weeks in plating group. A significant difference existed between the two groups with respect to radiological union time. "The authors reported excellent outcomes in 13 patients (65%), good outcome in 5 patients (25%) and poor outcome in 2 (10%) patients in the plating group whereas in the TENS group 12 patients (60%) had excellent and 8 (40%) patients had good outcome. There was no patient with poor outcome in TENS group. There were 2 (10%) patients in plating group who developed superficial infection as compared to none in the TENS group. Implant irritation occurred in 3 patients (15%) in plating as compared to none in TENS group. Lateral TENS protrusion occurred in 2 patients in nailing group (10%)". The authors found TENS to be slightly superior than plating during surgery and postoperative period, however, they did not find a significant difference in long-term functional outcome of two modalities.

Devendran and Vasantharaman (2019) ^[17] in a prospective study that included forty cases of the clavicle fracture treated by either ORIF with locking plate (n=20; 50%) or by titanium

elastic nailing (n=20; 50%). "All the 20 cases of plating, two cases had a superficial infection and treated by higher antibiotics and one case after fracture healing implant exit done. The infection was settled.

All the 20 cases of nailing, 18 cases are good outcome, one case are non-union, and two cases had superficial infection after higher antibiotics infection was settled. The authors recommended locking compression plate for surgical management of displaced midshaft comminuted clavicle fracture. They found that compared to TENS, locking compression plate promised an excellent functional outcome with minimal complications".

Abraham *et al.* (2020) ^[18] reported a series of 116 displaced midshaft non comminuted clavicle fractures. Out of these 62 (53.4%) were treated with TENS and remaining 54 (46.6%) were treated with anatomical locking plates. Majority of patients (74.1%) were males. Mean age of patients in TENS and plating groups was 35 and 38 years respectively. Time taken for union was significantly shorter in TENS group (11.81±1.35 weeks) as compared to that in plating group (12.83±1.68 weeks). "The mean postoperative Constant Murley score in the ALP and the TEN groups were 92.8 (range 80–97), and 93.7 (82–97) respectively. The mean postoperative quick dash score in the ALP and TEN groups were 2.48(range from 0 to 6.8) and 2.1 (range 0–9.1) respectively. Both Anatomical locking plate and TEN are good options for the treatment of non-comminuted mid clavicular fractures as they have a similar functional outcome. TEN nail insertion has the advantage of being minimally invasive, having a faster union time and may be recommended in midshaft clavicle fractures without comminution".

Das and Pal (2020) ^[19] compared the functional outcome of locking plate fixation with TENS in a total of 40 midshaft clavicle fractures who underwent surgical management using either of these two modalities (n=20 each). The patients were followed up at the end of 4 week and then at 12th week and finally at 24th week. Outcomes were assessed using DASH Score (The Disabilities of the Arm, Shoulder and Hand Score). At 4 and 12 week follow-ups mean DASH scores were significantly higher in TENS as compared to plating fixation group.

However, there was no significant difference between two groups at 24th week follow-up. The study showed that "operative treatment with plate fixation or intramedullary fixation by titanium elastic nail, for clavicle fractures have comparable functional outcome".

Park *et al.* (2020) ^[20] compared TENS and plate fixing in management of midshaft clavicle fractures based on fracture classifications. "A total of 97 patients with MCF who underwent plate (48 patients) or TEN (49 patients) fixation were retrospectively reviewed. Both groups were divided into three subgroups by fracture type using the AO Foundation/Orthopaedic Trauma Association classification: simple fracture (type A), wedge fracture (type B), and multi-fragmentary fracture (type C). The observed outcome measures were bone union rate, related complications, functional scores, and patient satisfaction score. These outcomes were analyzed based on the fracture classification. They found that both the groups had excellent union rates ($p = 0.495$) and similar functional scores ($p > 0.05$). Visual analogue scale (VAS) for satisfaction was better in TEN than plate fixation ($p < 0.001$). In type A and B subgroups, there were no significant difference in functional scores between plate and TEN fixation ($p > 0.05$). In type C subgroup,

however, both VAS for pain and DASH score in TEN fixation were significantly worse than in plate fixation at 2 and 6 weeks postoperatively ($p < 0.05$). The incidences of clavicle shortening and skin irritation are higher especially in type C subgroup of TEN fixation ($p < 0.05$). Patient satisfaction of TEN fixation was higher than that of plate fixation, but TEN fixation had a higher incidence of early postoperative pain and migration in type C fractures. Therefore, type A and B fractures can successfully be treated with plate or TEN fixation, but type C fractures should be treated with plate fixation”.

Itagi and Pattanshetty (2021) [21] randomized “a total of 40 patients with displaced midshaft clavicle fractures to two groups (20 in plate “Group A” and 20 in titanium elastic system group). Clinical and radiological assessments were performed at the 6th week, 3rd and 6th month postoperatively. The functional outcome was assessed by Constant- Murley score. Both surgical techniques were compared in terms of radiological union, clinical functions and associated complications”. They found that TENS group had earlier union and better 27 functional outcome scores than plating group. The rate of complications was higher in the plate group compared with the Titanium elastic nail system group.

The authors found TENS to be better than plating for surgical management of isplaced midshaft clavicle fracture.

Vajrangi *et al.* (2022) [22] conducted “a quasi- experimental study on 38 patients with mid-shaft clavicle fracture who were treated by plate fixation (n=19) or intramedullary nail fixation (n=19) respectively. The average age of presentation was 42 years in plate fixation and 31 years in nail fixation group. Robinson’s classification type 2B1 was the most common type of fracture in both groups. The Visual Analogue Scale (VAS) score reduced significantly from pre perative to postoperative day 1 in both the groups but there was no significant difference between the two groups. The Disabilities of the Arm, Shoulder and Hand (DASH) score at 6, 12 and 24 weeks reduced significantly in both the groups but showed no statistically significant difference between the two groups. However, intramedullary nail fixation group had a shorter duration of hospital stay and showed an earlier improvement in the DASH score during the first six months after surgery. Complications included implant loosening (three patients) in plating “Group A” and implant failures (two cases) in nailing group”. On the basis of these findings, the authors concluded that both plating as well as nailing provided good functional outcome and permitted early return to occupational activities.

Yadav *et al.* (2022) [23] “performed closed/open reduction and internal fixation in 62 patients (40 male and 22 female) with TENs and locking plates, respectively, which were followed up at regular intervals following the surgery (at two, six, 12, 24, and 48 weeks). The surgical outcome was assessed both from functional and radiological standpoints. The influence of surgical fixation on functional outcome was evaluated based on the Constant-Murley score and the fracture recuperation based on union times. When compared to plate fixation, TENs had lesser union times. Still, there was no statistical difference in union time between the two groups. The functional assessment graded by Constant urley score had a similar distribution of scores between the two groups. With a follow-up of twelve months, the Constant-Murley scores between the groups were not statistically different. While the average score for plate fixation was slightly higher than that of TENs, the nonunion rate was found to be similar in both groups. It

was concluded by them that surgical interventions using both TENs and plate fixation are suitable for managing clavicle midshaft fractures as they have a similar functional outcome. The authors were of the view that considering early recovery with minimal surgical complications, TENs can be a preferred treatment choice for managing displaced midshaft clavicle fractures”.

Huttunen *et al.* [20] in their study reported the it to be 35.6 per 100,000 person-years in 2001 which increased to reach at 59.3 per 100,000 person-years in the year 2012. Children and young adults below 25 years of age are most commonly affected by it 4

Kihlström *et al.* [25] described the etiologies of clavicle fracture into four major categories, *viz.*, falls (from same level, from another level and unspecific falls), transport accidents, non-traumatic fractures and others Andermahr *et al.* [26] described mean cortical thickness was only 2.05 mm at the midpoint of the clavicle. Combined with the fact that the clavicle is slightly curved at the middle third, the midshaft is especially weak and susceptible to fracture21,33.

Waldmann *et al.* [27] described the following indications for non-operative management of midshaft clavicle fractures.

Conclusion

As majority of article shows that, treatment of patients with midshaft clavicle fractures with TENS patients had an excellent success, compared with plating. In comparison to patients treated with plates, thus we concluded that TENS is therefore superior to plating for the treatment of clavicular fractures.

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Author’s Contribution

Not available

Conflict of Interest

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References

1. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg.* 2002 Sep-Oct;11(5):452-6.
2. Kihlström C, Möller M, Lönn K, Wolf O. Clavicle fractures: epidemiology, classification and treatment of 2 422 fractures in the Swedish Fracture Register; an observational study. *BMC Musculoskelet Disord.* 2017 Feb 15;18(1):82.
3. Nowak J, Mallmin H, Larsson S. The aetiology and epidemiology of clavicular fractures. A prospective study during a 2-year period in Uppsala, Sweden. *Injury.* 2000;31(5):353-358.
4. Robinson CM. Fractures of the clavicle in the adult. Epidemiology and classification. *J Bone Joint Surg Br.* 1998;80(3):476-484.
5. Andermahr J, Jubel A, Elsner A, *et al.* Anatomy of the clavicle and the intramedullary nailing of midclavicular fractures. *Clin Anat.* 2007;20(1):48-56.
6. Wijdicks FJ, Houwert M, Dijkgraaf M, de Lange D, Oosterhuis K, Clevers G, *et al.* Complications after plate fixation and elastic stable intramedullary nailing of

- dislocated midshaft clavicle fractures: A retrospective comparison. *Int Orthop*. 2012 Oct;36(10):2139-45.
7. 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.
 8. 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.
 9. Wang YC, Fu YC, Chou SH, Liu PC, Tien YC, Lu CC. Titanium Elastic Nail versus plate fixation of displaced midshaft clavicle fractures: A retrospective comparison study. *Kaohsiung J Med Sci*. 2015 Sep;31(9):473-9.
 10. Huttunen TT, Launonen AP, Berg HE, Lepola V, Felländer-Tsai L, attila VM. Trends in the Incidence of Clavicle Fractures and Surgical Repair in Sweden: 2001-2012. *J Bone Joint Surg Am*. 2016 Nov 2;98(21)
 11. Kihlström C, Möller M, Lönn K, Wolf O. Clavicle fractures: epidemiology, classification and treatment of 2 422 fractures in the Swedish Fracture Register; an observational study. *BMC Musculoskelet Disord*. 2017 Feb 15;18(1):82.
 12. Waldmann S, Benninger E, Meier C. Nonoperative Treatment of Midshaft Clavicle Fractures in Adults. *Open Orthop J*. 2018 Jan 17;12:1
 13. Fuglesang HFS, Flugsrud GB, Randsborg PH, Oord P, Benth JŠ, Utvåg SE. Plate fixation versus intramedullary nailing of completely displaced midshaft fractures of the clavicle: a prospective randomised controlled trial. *Bone Joint J*. 2017 Aug;99-B(8):1095-1101.71
 14. Sahu AK, Lenka BS, Mishra AK, Panda CK, Kar M. A comparative study between plating versus titanium elastic nail system in mid-shaft clavicle fracture management. *Int J Res Orthop* 2018;4:741-6.
 15. Sharma V, Patil P, Gaonkar NK, Garud A, Choudhary S. A comparative study of stabilization of shaft clavicle fractures using intramedullary nailing vs plating. *IJOS* 2019;5(2):06-13.
 16. Pandian PM, Thulasiraman D, Vijay KM, Aravind MC. Prospective comparative study of functional outcome of displaced midshaft clavicle fractures treated by locking plating versus minimally invasive titanium elastic nail fixation. *IJOS* 2019;5(2):142-150.
 17. Devendran R, Vasantharaman R. Comparative Analysis between Locking Compression Plate and Titanium Elastic Nail Fixation for Clavicle Fractures. *Int. J Sci Stud* 2019;6(12):167-170.
 18. Abraham VT, Marimuthu C. A study on the outcome of displaced midshaft non-comminuted clavicle fractures treated with anatomical locking plate versus titanium elastic nail. *Journal of Orthopaedics, Trauma and Rehabilitation*; c2020. p. 1-5.
 19. Das B, Pal SC. A Comparative Study of Functional Outcome of Midshaft Orthopaedics Clavicle Fractures Treated by Locking Plate versus Minimally Invasive Titanium Elastic Nail Fixation. *Ann. Int. Med. Den. Res*. 2020;6(2):OR10-OR13.
 20. Park JS, Ko SH, Hong TH, Ryu DJ, Kwon DG, Kim MK, Jeon YS. Plate fixation versus titanium elastic nailing in midshaft clavicle fractures based on fracture classifications. *J Orthop Surg (Hong Kong)*. 2020 Sep Dec;28(3):2309499020972204.
 21. Itagi PB, Pattanshetty AS. A comparative study of plate fixation versus titanium elastic nail in treatment of displaced midshaft clavicle fractures. *IJOS* 2021;7(4):672-676.
 22. Vajrangi A, Shetty SV, Shenoy RM. A Comparative Study between Plate Fixation and Intramedullary Fixation for Displaced MidShaft Clavicle Fractures in Adults. *Malays Orthop J*. 2022;16(1):40-5.
 23. Yadav S, Phalak MO, Shevate I, Salunkhe R, Deshmukh A, Patel S, Patil GL. Comparative Study of Postoperative Outcomes of Clavicle Midshaft Fracture Treated by Nailing vs. Plating. *Cureus* 2022;14(3):e22862
 24. Huttunen TT, Launonen AP, Berg HE, Lepola V, Felländer-Tsai L, Mattila VM. Trends in the Incidence of Clavicle Fractures and Surgical Repair in Sweden: 2001-2012. *J Bone Joint Surg Am*. 2016 Nov 2;98(21).
 25. Kihlström C, Möller M, Lönn K, Wolf O. Clavicle fractures: epidemiology, classification and treatment of 2 422 fractures in the Swedish Fracture Register; an observational study. *BMC Musculoskelet Disord*. 2017 Feb 15;18(1):82.
 26. Andermahr J, Jubel A, Elsner A, *et al*. Anatomy of the clavicle and the intramedullary nailing of midclavicular fractures. *Clin Anat*. 2007;20(1):48-56
 27. Waldmann S, Benninger E, Meier C. Nonoperative Treatment of Midshaft Clavicle Fractures in Adults. *Open Orthop J*. 2018 Jan 17;12.

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