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A Prospective Comparative Study of Hook Plate and Tension Band Wiring in Lateral End Clavicle Fractures

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Abstract
Background and Objectives: *Clavicle fractures are common injuries due to its subcutaneous position, accounting for approximately 2.6-4% of all adult fractures and 35% of all the injuries in shoulder girdle. Distal clavicle injuries account for 15-20% of all clavicle fractures. Fractures of the distal clavicle are a challenging and controversial issue for orthopaedic surgeons. With a wide range of treatment options and numerous recommendations in the literature, this type of fracture remains one of the most debated in clinical practice. To date, there is no universally accepted "gold standard" treatment for these injuries. This study is undertaken with the primary objective to study the functional outcome of lateral end fractures of clavicle treated with hook plate and with tension band wiring.*
Materials and Methods: *It is a prospective study conducted from February 2023 to February 2025 in Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya. 30 cases of lateral end fractures of clavicle treated with hook plate and tension band wiring. Outcomes were assessed based on operative parameters, functional score (Constant and Murley score), time to union and complications.*
Results: *In this study, around 73% cases were male, with most cases falling in the 30-39 age group, with the mean age of 37.73±9.78 years in HP group and of TBW group was 41.87±11.51 years. Right clavicle was affected more (63%) than left side, with majority injuries (67%) occurring as a result of Road Traffic Accident (RTA).*
In the present study, complete union of the fracture was seen in all 15 patients of the HP group (100%) and 14 patients of the TBW group (95%). There were 6 complications in the hook plate group and 13 in the TBW group (P=0.021). In the HP group, the mean Constant and Murley score was 88.13±6.53 points (70–95) and TBW group, the mean score was 84.60±9.41 points (66–94) (p-value: 0.245).
Conclusion: *Both hook plating and TBW for treatment of displaced fractures of lateral end of clavicle could achieve good results and have proven to provide good fracture reduction and stability, and achieve a bony union with a very close period between them, so the choice of the surgical technique must consider the patient's lifestyle and occupational requirements, as hook plating leads to earlier mobilization and an earlier return to work and daily life routine with fewer complications than the tension band wiring.*
Keywords: *lateral end fractures of clavicle, hook plate, tension band wiring, TBW, Constant and Murley score, distal clavicle.*

INTRODUCTION:

Clavicle fractures are common injuries due to its subcutaneous position, accounting for approximately 2.6-4% of all adult fractures and 35% of all injuries in the shoulder girdle. Clavicular fractures have been classified by location of the fracture into 3 groups: fracture of middle third (80%), fractures of lateral third (10-15%), fractures of medial third (5%) [1]. Distal clavicle injuries account for 15-20% of all clavicle fractures [2]. Distal clavicle injuries follow a bimodal distribution, affecting both the young and elderly populations. In younger individuals, these injuries are commonly caused by falls from bikes, road traffic accidents, or contact sports. In contrast, in older adults, lateral end clavicle fractures are often the result of falls, with osteoporosis contributing to bone comminution. The rate of delayed union and non-union for completely displaced type 2 lateral end clavicle fractures treated conservatively is around 30% [3].

Fractures of distal clavicle are a challenging and controversial issue for orthopaedic surgeons. With a wide range of treatment options and numerous recommendations in the literature, this type of fracture remains one of the

most debated in clinical practice. To date, there is no universally accepted "gold standard" treatment for these injuries. However, to our best understanding, there has been limited information on the comparison of clinical outcomes after use of hook plates (HP) and tension band wiring (TBW) in the treatment of Neer type II lateral end clavicle fractures.

This comparative study aims to evaluate and comparing the outcomes of hook plate fixation and tension band wiring for the management of distal end clavicle fractures. By assessing parameters such as functional outcomes, union rates and complications.

MATERIALS AND METHODS:

The study was done at Department of orthopaedics, Adichunchanagiri Institute of Medical Sciences, B G Nagara from February 2023 to February 2025 with sample size of 30. Patients who had lateral end clavicle fractures were evaluated clinically and radiologically using X-rays and Neer classification [4]. Those meeting inclusion criteria underwent surgery using either hook plate or tension band wiring. The patients were followed up for 6 months and functional outcome was evaluated by using Constant and Murley score [5].

Inclusion criteria:

1. All closed and type I open lateral end fractures of clavicle
2. Acute fractures
3. Neer type 2 fractures
4. Age above eighteen years
5. Patients who are medically fit for surgery.

Exclusion criteria:

1. Patient less than 18 years.
2. Open fractures type 2 and 3
3. Associated neurovascular injuries.
4. Established non-union and undisplaced fractures
5. Any medical contraindication to surgery or general anaesthesia

Surgical approach:

All procedures were done with the patient supine with a bolster placed beneath the scapula. In the HP group, the operative procedure has been A 5-cm incision in line with the clavicle was made from the lateral clavicle to the lateral acromioclavicular margin, and the deltoid-trapezoidal fascia was incised to expose the fracture. The fracture site is identified and cleaned of debris and hematoma. The fracture is reduced and it may be held with either a K-wire. Elevating the distal fragment to meet the proximal fragment may aid in reduction. The appropriate plate was selected and hook passed under the acromion posterior to acromio-clavicular joint. The plate was secured to the shaft of clavicle with 3.5 mm cortical screws. The wound closed in layers over the plate. In the TBW group, after reduction tension band wire fixation was done through the acromioclavicular joint or trans-acromial with 2 parallel K wires and fracture reduction was checked with an image intensifier. An anteroposterior drill hole was made with 2mm drill bit on proximal part of the fracture. A stainless-steel wire was passed through the hole. The SS wire was tied in a figure of eight manner keeping the knot superiorly around the K-wires. The K-wires were bent and buried inside the soft tissue. The wound was closed in layers The operated shoulder was protected with a triangular sling for four weeks. Active motion exercises of the elbow, wrist, and hand after 2 weeks. The arm sling was removed after the 6th week and movements over 90° were allowed. All study patients were followed at regular intervals for 4 weeks for the first 3 months, and subsequently at 6 months. The functional outcome at 6 months was assessed by Constant and Murley score. The data was analysed using Epi Info software. Descriptive analysis was done for various demographic variables like age, gender, mechanism of injury and associated injuries. To compare conservative and operative management, we used chi square test and p value less than 0.05 was taken to be statistically significant.

Figure 1: Hook plating

Figure 2: Tension band wiring

RESULTS:

In this study, around 73% cases were male, with most cases falling in the 30-39 age group, with the mean age of 37.73±9.78 years in HP group and of TBW group was 41.87±11.51 years. Right clavicle was affected more (63%) than left side, with majority injuries (67%) occurring as a result of Road Traffic Accident (RTA). The mean operation time for HP group was 77.5±8.65 minutes, compared to 56.5±4.85 minutes for TBW group ($p<0.001$). Blood loss was significantly lower in the TBW group, 95.65±13.7 ml vs 125.20±23.5 ml in hook plating ($p<0.001$). Mean duration of hospital stay in group A was 5.2 ±1.53 days, in group B was 7.27±1.7 days. The mean time to return to daily live routine and activities (weeks) was 10.20±2.34 in the TBW group and 8.33±2.32 days in the HP group.

Complete union of the fracture was seen in all 15 patients of the HP group (100%) and 14 patients of the TBW group (95%). Mean time to union of the HP group of about 11.67±1.8 weeks and for TBW, it was about 12.93±3.02 weeks. In the HP group, the mean Constant and Murley score was 88.13±6.53 points (70–95) and TBW group, the mean score was 84.60±9.41 points (66–94) (p-value: 0.245). Subjectively, outcomes in the TBW group were categorized as excellent in 7 cases, good in 5 cases, fair in 3 cases. In contrast, outcomes in the HP group were assessed as excellent in 9 cases, good in 4 cases, and 2 instances of fair outcomes were noted.

There were 6 complications in the hook plate group and 13 in the TBW group. Complications like, infection was recorded in 3 cases (20%) of the TBW group, with no instances reported in the HP group. Implant failure was observed in 5 cases (33%) of the TBW group, whereas no occurrences were noted in the HP group. Acromial osteolysis was observed in only 1 case (10%), which occurred in the HP group. 5 cases (33%) had either shoulder pain or stiffness.4 cases (27%) underwent implant removal either due to shoulder stiffness or implant failure. Regarding complications, significant difference was found between the two study groups (p-value: 0.021). At the earliest appearance of K-wire migration (2 cases) in the above patients, we restricted mobilization till union to prevent further migration to prevent loss of reduction. In the present study, 1 patient had hardware prominence in HP group, 2 loss of reduction and 1 wire breakage and we removed implant early after fracture union. We had three patients with superficial infection, in which we managed with intravenous antibiotics. One case of the TBW group had non symptomatic non-union and for which patient had opted for conservative management.

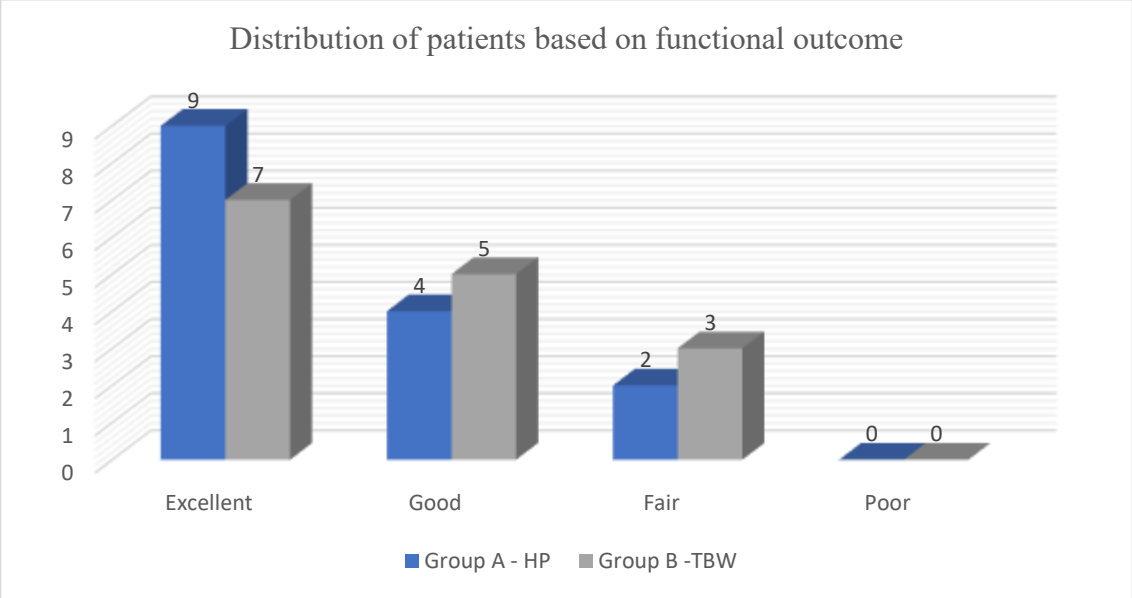
Table 1: Comparison between study groups on demographic data

Characteristics	**HP group (n=15)**	**TBW group (n=15))**	**p-value**
Age(years)			
Mean	37.73	41.87	0.25
SD	9.78	11.51	
Sex, n (%)			
Male	12 (80)	10 (67)	0.46
Female	3 (20)	5 (33)	
Affected side, n (%)			
Right	10 (67)	9 (60)	1.0

Left	5 (33)	6 (40)	
Mode of injury, n (%)			
RTA	12 (80)	8 (53)	0.30
Self-fall	2 (13)	5 (33)	
Fall from height	1(7)	2 (13)	

Table 2: Comparison between study group as operative time, blood loss, duration of hospital stay, time to bony union, time to return to work, and the CMS

Results	HP group	TBW group	p-value
Operation time (mins)	77.5±8.65	56.5±4.85	<0.001
Blood loss (ml)	125.20±23.5	, 95.65±13.7	<0.001
Duration of hospital stay (days)	5.2 ±1.53	7.27±1.7	0.0016
Time to return to work (weeks)	8.33±2.32	10.20±2.34	0.036
Time to bony union (weeks)	11.67±1.8	12.93±3.02	0.167
Constant and Murley score (6 months)	88.13±6.53	84.60±9.41	0.245



Graph 1: Distribution of patients based on functional outcome

Figure 3: Pre-op x-ray: immediate post op x-ray: x-rays at 3 months and 6 months follow-up (Hook plating)

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Figure 4: Shoulder movements at 6 months in hook plating

Figure 5: Pre-op x-ray: immediate post op x-ray: x-rays at 6 months follow-up (TBW)

Figure 6: Shoulder movements at 6 months in tension band wiring

DISCUSSION:

Distal clavicle fractures account for 10-26% of most clavicle fractures and are most common among middle-aged men [6]. The majority of the injuries are caused by traffic accidents and accidental falls. Management of distal clavicle had significantly changed ever since Neer's observation of the highly unstable nature of the fracture with high rate of non-union associated with it [6,7]. There are very few fractures in orthopaedics which have so many treatment options available yet, without any gold standard treatment for this peculiar fracture. In this prospective analysis, 30 lateral end clavicle fracture cases were managed with hook plate and tension band wiring, 15 cases each and functional outcome was evaluated after 6 months using Constant and Murley score.

In this study, average age of lateral end clavicle fracture with the mean age of 37.73±9.78 in HP group and of TBW group was 41.87±11.51 with 22(73%) of patients being male and 8(27%) patient's females. These findings were with previous studies by Elmohamady et al. [8], who reported mean ages of 37.4 years in the TBW group and 35.5 years in the HP group, and Flinkkilä et al. [9], who noted mean ages of 35 years in the TBW group and 43 years in the HP group. Similarly, Lee et al. [10] reported mean ages of 35.9 years in the TBW group and 43.4 years in the HP group. Additionally, we found that road traffic accidents (RTAs) were seen as most common cause of lateral end clavicle fractures (Neer type 2), a trend that was also observed in the above-mentioned studies.

The mean operation time for HP group was 77.5±8.65 minutes, compared to 56.5±4.85 minutes for TBW group ($p<0.001$). This aligns with findings by Dodia AV et al. [11], who reported mean operation times of 77.5 minutes in Hook plating group patients and in TBW group patients mean operating time was 70 minutes and the difference was not significant. Elmohamady A et al. [8]in a prospective comparative study on 38 lateral end clavicular fracture, observed that the mean operating time was significantly shorter in the TBW group (69.75±8.9) than the Hook plating group (90.35±5.3).

Blood loss was significantly lower in the TBW group, 95.65±13.7 ml vs 125.20±23.5 ml in hook plating ($p<0.001$). Hospital stay was not significant different for both TBW patients an HP patient. Mean duration of hospital stay in group A was 5.2 ±1.53 days, in group B was 7.27±1.7 days. The mean time to return to daily live routine and activities (weeks) was10.20±2.34 in the TBW group and 8.33±2.32 days in the HP group.

In the present study, complete bony union was observed in all 15 patients of the HP group (100%) and 14 patients of the TBW group (95%), time to union of the HP group of about 11.67±1.8 weeks (ranging from 9 to 16 weeks) and for TBW, it was about 12.93±3.02 weeks (ranging from 9 to 20 weeks). According to Eskandar et al. [12], there was no difference in the average duration of union between TBW group and the plate group, with the plating taking 8.94±1.2 and the latter 9.55±1.9 weeks. These findings closely parallel those reported by Elmohamady et al. [8], who documented union rates of 90% in the TBW group and 95% in the HP group, with a mean union time of 10 weeks in both groups, same rates shown by Lee YS et al. [10], who reported union rates of 95% in the TBW group and 100% in the HP group

Constant Murrey score are measures of functional outcome. Interestingly, despite the differences in surgical characteristics, both groups showed similar functional outcomes. In the HP group, the mean score for the affected shoulder using the scoring system of Constant and Murley was 88.13±6.53 points (70–95). In the TBW group, the mean score for the affected shoulder was 84.60±9.41 points (66–94) indicating satisfactory joint function. Subjectively, outcomes in the TBW group were categorized as excellent in 7 cases, good in 5 cases, fair in 3 cases. In contrast, outcomes in the HP group were assessed as excellent in 9 cases, good in 4 cases,and 2

instances of fair outcomes were noted. These findings were consistent with studies reported by Elmohamady et al. [8], who documented mean Constant–Murley scores of 87.6 in the TBW group and 86.5 in the HP group. Similarly, Flinkkilä et al. [9] reported mean Constant–Murley scores of 84 in the TBW group and 90 in the HP group, while Lee et al. [10] observed mean Constant–Murley scores of 88 in the TBW group and 90 in the HP group. There was a no notable distinction in the results between the TBW group (85.32±3.9) and the HP group (87.38±4.2) in study by Eskandar et al. [12]. According to Dodia AV et al. [11], CMS scores in the HP group was 93 and in the TBW group had 88.5. In TBW group, mean score was 86.9 points. In HP group, mean score was 85.7points in the study by Leu T et al. [13].

In the present study, infection was recorded in 3 cases (20%) of the TBW group, with no instances reported in the HP group. Implant failure was observed in 5 cases (33%) of the TBW group, whereas no occurrences were noted in the HP group. Acromial osteolysis was observed in only 1 case (10%), which occurred in the HP group. 5 cases (33%) had either shoulder pain or stiffness.4 cases (27%) underwent implant removal either due to shoulder stiffness or implant failure.

There are few limitations noted in the present study. First, we did subjectively categorize the surgical management into two types. Second, among the type II fractures of distal clavicle, there was no certainty whether the type II was purely a type IIB or it included the type IIA. Further research with larger sample sizes and extended follow-up periods is recommended to consolidate these findings and refine treatment protocols. To conclude, two surgical methods (HP and TBW) for treatment of lateral end fractures of clavicle could show satisfactory results. To show there were no differences in functional scores among two groups of patients. Although the union rate was high and surgical complication rate was low in the HP group compared to TBW group.

CONCLUSION:

Although surgical fixation is generally accepted as treatment of choice in lateral end fractures of clavicle, its natural course if left untreated is not well-known. Surgical treatment of such fractures is more acceptable than conservative management, in order to prevent non-union and functional disability due to reduced shoulder range of motion.

In conclusion, both hook plating and tension band wiring for treatment of displaced fractures of the lateral end clavicle can provide good results. Both surgical techniques have proven to be able to provide good fracture reduction and stability, and achieve fracture union with a very close period between them, so the choice of the surgical technique must consider the patient's lifestyle and occupational requirements, as hook plating leads to earlier mobilization and an earlier return to work and daily life routine with fewer complications than the tension band wiring.

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