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## Hook Plating versus Tension Band Wiring in Treatment of Displaced Lateral End Clavicle Fracture

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### ABSTRACT

**Background:** Lateral end clavicular fractures represent about 15% of clavicular fractures. Nonunion rate is about 22 to 44% due to interacting forces between arm weight and trapezius muscle.

**Aim of the work:** To assess the clinical and radiological outcomes of fixation by HP versus TBW and to determine which technique provides enough stability to permit early range of motion.

**Patients and Methods:** A prospective comparative study was done on 40 patients (20 patients fixed by HP and others 20 by TBW) and followed up at Al-Azhar University Hospitals between December 2019 to April 2021.

**Result:** The mean age of patients was 35.5 years in HP group and 37.4 years in TBW group with predominance in males than females (25 males and 15 females). Bone union occurred in 37 (92%) of cases and non union occurred in 2 (5%) cases in TBW group and 1 (2.5%) case in HP group with average union time about 10 weeks in two groups and mean constant murley score was 86.5 in HP group and 87.6 in TBW group. Superficial infection occurred in 4 cases in TBW group (10%) with no recorded cases in HP group.

**Conclusion:** Fixation of lateral end clavicular fractures using HP or TBW results in good functional outcome and low rate of complication where plating has many advantages such as minimal complications, easier technique and early motion of the affected shoulder.

**Keywords:** Tension; Band; Hook; lateral; clavicle.

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**Authorship:** All authors have a substantial contribution to the article.

### INTRODUCTION

Clavicular fractures represent about 2.6% to 12% of all fractures and 44 to 66% of all shoulder fractures. Lateral third clavicular fractures account for 15%.<sup>1</sup> Clavicle is considered the junction between thoracic wall and upper limb, it receives large muscles insertions, and has an efficient role shoulder biomechanics.<sup>2</sup> Clavicular fractures are classified into proximal, mid-shaft and distal fractures. Most of them are mid-shaft fractures that unite satisfactorily with non-operative treatment. It is important to recognize this distinct clavicle fracture as different entity and treat it properly.<sup>3</sup> Most of lateral end clavicular fractures are minimally displaced and heal with proper functional outcome when non-operative treated. Fractures with complete displacement are less common but have a higher risk of subsequent nonunion. Most of displaced fractures occur in elderly patients and may have a satisfactory outcome after non-operative treatment in a low functional demands patients.<sup>4</sup> Minorities of patients are younger so the operation is recommended as a primary treatment and may develop loss of strength, pain, decreased range of motion if non union occurred with non-operative treatment.<sup>4</sup> Operative modalities

include coraco-clavicular screws, TBW, HP, suspensory devices and locked plates. Complications of operative treatment may include non-union and mal-union fractures, pin migration, impingement of the plate, bleeding and plate removal.<sup>5</sup>

The aim of this study is to analyze and compare the results of fixation of lateral end clavicular fractures using HP versus TBW and to determine which technique provides good motion, stability and subsequently fracture union and complication rate.

### PATIENTS AND METHODS

All patients in this study were managed and followed up at Al-Azhar University Hospitals. A prospective case series study was performed in a period between December 2019 to April 2021. Forty 40 patients (25 males and 15 females) with fracture lateral end clavicle (Neer type II) were divided into two 2 groups; 1st group fixed by Hook Plate (HP) and 2nd group fixed by Tension Band Wire (TBW) with inclusion criteria (recent, extraarticular, unilateral, Neer II with normal function before trauma) while exclusion criteria (open, comminuted and pathological fractures).

All patients were followed up for a minimum period of 11 months and maximum for 16 months with

average period of 12 months.

		HP group (N = 20)		TBW group (N = 20)		Stat. test	P-value
Age(years)	Mean	35.5		37.4		T = 0.66	0.510 NS
	±SD	8.8		9.2			
Sex	Male	12	60%	13	65%	X <sup>2</sup> = 0.1	0.744 NS
	Female	8	40%	7	35%		
Occupation	Heavy manual	12	60%	13	65%	X <sup>2</sup> = 0.1	0.744 NS
	Light manual	8	40%	7	35%		
Side	Right	11	55%	10	50%	X <sup>2</sup> = 0.1	0.752 NS
	Left	9	45%	10	50%		
DM	No	17	85%	18	90%	X <sup>2</sup> = 0.22	0.633 NS
	Yes	3	15%	2	10%		
Smoking	No	11	55%	13	65%	X <sup>2</sup> = 0.41	0.519 NS
	Yes	9	45%	7	35%		
Mode of trauma	RTA	17	85%	18	90%	X <sup>2</sup> = 0.22	0.633 NS
	Falling down	3	15%	2	10%		
Dominant hand	Right	18	90%	19	95%	X <sup>2</sup> = 0.3	0.548 NS
	Left	2	10%	1	5%		

**Table 1:** Comparison between studied groups as demographic data.

**Clinical assessment**

Clavicle fractures typically induce pain, swelling, bruising and obvious deformity with limited range of motion with neurovascular examination to exclude brachial plexus or vascular injury.

**Radiological investigation:**

a single antero-posterior view erect position to demonstrate maximal deformity of the clavicle by the effect of gravity especially when considering surgery with chest radiograph to evaluate the deformity relative to the normal side.

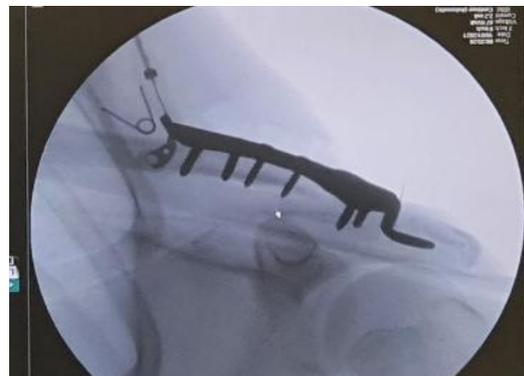
**Surgical approach**

**Hook plate method**

Skin incision about 7cm was done along anterior border then soft tissue dissection down to the bone, periosteal elevation, exposure of fracture ends then reduction maintained by reduction clamp and fixation of the fracture by AO hook plate which was placed along superior surface and inserted behind acromion process then irrigation of the wound by saline 0.9% was performed then covering of wound with dressing was done after closure.



**Fig. 1:** A picture showing incision and fixation of lateral end clavicular fracture hook plate.



**Fig. 1:** fluroscopic image showing fixation of lateral third clavicle by hook plate.

**Tension band wire method**

Skin incision about 7cm was done along anterior border then soft tissue dissection down to the bone, periosteal elevation, exposure of fracture ends and reduction maintained by reduction clamp. Under c-arm guidance, first k-wire was inserted through anterior aspect of lateral end intramedullary and engaged into the posterior border and the second k-wire was inserted through posterior aspect of lateral end intramedullary and engaged into the anterior border. 3.2 Drill Bit was done proximal to k-wire ends antero-posteriorly to put transosseus tension

band to augment and overcome migration. Then closure of the wound by layers.



Fig. 3: Tension band wire insertion under image.



Fig. 4: Wound closure

Post-operative care and follow up

Antibiotics for 48 hours with arm sling applied for 2 to 3 weeks then removal of stitches was done after 2 weeks at least provided that wound healing was complete. Passive motion was initiated second day after surgery as tolerated in the form of pendulum exercises and active motion was initiated after 3 weeks as tolerated with regular visits in amanar of 2 weeks, 1 month, 3months and 6months postoperatively.

Methods of assessment

The patient was evaluated clinically and radiologically for at least 6 months and comparison was done according to operative time, union time, constant –Murley score and complication.

RESULTS

According to operative time and union time there was no significant difference between studied groups as P value > .001. According to Costant-Murley score, there was highly significant difference between studied groups as P value < .001.

		HP group (N = 20)	TBW group (N = 20)	Stat. test	P-value
Operative time(min)	Median	77.5	70	MW = 156.5	0.242 NS
	IQR	70 – 80	61.25 – 80		
Union time(weeks)	Median	10	10	MW = 200	1.0 NS
	IQR	9 – 12	9 - 12		

		HP group (N = 20)	TBW group (N = 20)	Stat. test	P-value
Constant-Murley Score	Median	86.5	87.6	MW = 154	0.221NS
	IQR	84 – 89	85.25 – 90		

Table 2: Comparison between studied groups as regard operative time, union time and Costant-Murley score.

According to complications, there were significant differences between studied groups as regard symptomatic hardware, subacromial impingement, coracoclavicular widening and wound infection due to P value < 0.05 and non-significant differences according to implant failure, osteolysis and shoulder impingment as P value > 0.05.

		HP group (N = 20)		TBW group (N = 20)		Stat. test	P-value
Symptomatic hardware	No	1	85%	1	50%	X <sup>2</sup> = 5.6	0.018 S
	Yes	3	15%	1	50%		
Subacromial impingment	No	1	65%	2	100%	X <sup>2</sup> = 8.5	0.003 S
	Yes	7	35%	0	0%		
Coracoclavicular widening	No	2	100%	1	70%	X <sup>2</sup> = 7.05	0.007 S
	Yes	0	0%	6	30%		
Implant failure	No	1	90%	1	80%	X <sup>2</sup> = 0.78	0.375 NS
	Yes	2	10%	4	20%		
Distal clavicle osteolysis	No	1	95%	2	100%	X <sup>2</sup> = 1.02	0.311 NS
	Yes	1	5%	0	0%		
shoulder impingement	No	2	100%	1	95%	X <sup>2</sup> = 1.02	0.311 NS
	Yes	0	0%	1	5%		
Wound infection	No	2	100%	1	80%	X <sup>2</sup> = 4.44	0.035 S
	Yes	0	0%	4	20%		

Table 3: Comparison between studied groups as regard complications.

Cases Presentation

Case 1

Male patient 36 yrs old with distal end clavicular fracture fixed by hook plate.



Fig. 5: preoperative x ray.



Fig. 6: Immediate post operative x-ray.

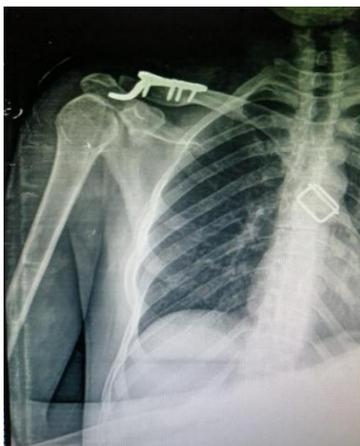


Fig. 7: Four months post operative.



Fig. 8: a-b showing ROM after removal.

Case 2

Female patient 38 yrs old with distal end clavicular fracture fixed by TBW.



Fig. 9: Pre operative x-ray.



**Fig. 10:** Immediate Post operative x ray.



**Fig. 11:** 4 months post operative x –ray.



**Fig. 12:** a-b showing ROM post removal.

**DISCUSSION**

Comparison between two types of treatment with reasonable sample sizes in distal clavicular fracture is challenging. Its anatomical properties (narrow, less dense ) make fixation with screws difficult. The subcutaneous position gives rise to skin irritation caused by the implants thus requires removal.<sup>6</sup> All fixation methods have superiorities or deficiencies when compared to each other and none of them has been nominated as the ‘gold standard.’<sup>7</sup> In this study, lateral end clavicular fracture Neer type II was more common among young active patients. The patients age ranged from 23 years old to 54 years old with mean age of 35.5 years in hook plate group and 37.4 years in TBW group and this is comparable to Daglar B, et al.<sup>8</sup> in which the mean age was  $29,8 \pm 8,7$  years (range 19-51), also comparable to Daniel W, et al.<sup>9</sup> in which the mean age was 36.2 years range (22-60) years and Kalamares M, et al.<sup>10</sup> in which the mean age was 28.8 years range from (16 to 41). In this study, lateral end clavicular fracture Neer type II is predominant in males than females as the study included 25 males and 15 females and this is comparable to Daglar et al.<sup>8</sup> which included 11 males and 3 females, also comparable to Daniel et al.<sup>9</sup> which included 26 males and 10 females and to Kalamares et al.<sup>10</sup> which included 7 males and 2 females. In this study, bone union occurred in 37 cases (92%) and non union occurred in 2 cases (5%) in TBW group due to implant failure and infection and 1 case (2.5%) in hook plate group due to implant failure. The bone union was 10 weeks average in two groups (Ranged from 9 to 12 weeks) and this is comparable to Daniel et al.<sup>9</sup> in which the rate of union was 95% with 3 months average union time. In this study, all patients acquired satisfactory motion range compared to the normal side with excellent shoulder function. Mean constant murley score was 86.5 in HP group (ranged from 84 to 89) and 87.6 in TBW group (ranged from 85.25-90) so, this indicates a satisfactory joint function and This is comparable to Daglar et al.<sup>9</sup> in which the mean Constant score was  $95.4 \pm 3.0$  at 12 months and this mean excellent shoulder function according to these scores. There

was a good results in most of patients. The best results were obtained when the HP was removed before 6 months, which was done in most of cases and This is also comparable to Kalamares et al.<sup>10</sup> in which the mean constant shoulder score was 96. These results may be due to use of this type of fixation that allows early rehabilitation resulting in normal range of motion. In this study, infection was recorded in 4 cases with TBW fixation (10%) and was controlled with antibiotics with no recorded cases in HP group and this is comparable to Kalamares et al.<sup>10</sup> in which wound infection occurred in one case (11% of cases).

### CONCLUSION

Surgical treatment of lateral end clavicular fractures using different methods of fixating results in a good functional outcome with low complication rate. Plating of lateral third clavicular fractures has many advantages such as easy application, less complications, short stay in hospital and early mobilization of the affected shoulder.

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