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Tension band wiring versus cannulated screws in fixation of medial malleolus in ankle fracture: Comparative Study

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Abstract

Introduction: Most ankle injuries occur. The ankle is a complex joint; hence ankle fractures are frequent. Anatomy, soft tissue, and fracture fixation determine treatment. Malreduction may swiftly lead to end-stage degenerative joint disease. The best fixing method will prevent this and lead to the best fracture treatment. The aim of study tension band wire and cannulated screws in medial malleolus fixation are compared using modified Olerund and Molander grading system for clinical, radiological, and ankle functional outcomes. **Method:** This prospective randomised trial included 30 individuals aged 20-55, with the majority in their 30s. Tension band wire and two cannulated screws were used to treat closed medial malleolar fractures in half the sample. The patients were tested clinically and radiologically (6w-3 months and 6 months) and functionally (6months) using modified Olerund and Molander scoring method.

Results: Tension band wire union rate was quicker (10.5 weeks) than cannulated screws fixing (12w), with a p value of 0.045. Tension band wiring performed better than cannulated screws, confirming prior findings. We had limited complications: superficial wound infection (6.67%) in each group and delayed union (6.67%) in the cannulated screw group. Cannulated screws had one implant-related complication (6.67%). No deep infections, non-union, or implant failure occurred.

Conclusion: Tension band wiring may be more convincing fixation option for closed medial malleolus fracture as compared to cannulated screws fixation.

Keywords: Tension, band, wiring, cannulated, screws, fixation, medial, malleolus, ankle fracture

Introduction

Ankle fractures are common injuries, representing 10% of all fractures and being the second most common lower limb fractures after hip fractures [1, 2]. They are typically low-energy injuries caused by simple falls or sports, with the highest incidence in elderly women [3, 4]. Accurate reduction and stable internal fixation are essential for treating malleolar fractures, as improper reduction may lead to post-traumatic painful restriction of motion or osteoarthritis [5, 6]. During the 1930s to the 1960s, the majority of ankle fractures were treated non-operatively [7, 8]. However, poor long-term outcomes prompted further analysis and treatment methods. Nowadays, non-displaced fractures can still be treated with cast immobilization, but internal fixation may be more appropriate for individuals with high functional demands to hasten healing and rehabilitation [9]. The incidence of ankle fractures is up to 174 cases per 100,000 adults per year, with a mean age at injury of 45 years [10]. Ankle fractures have a bimodal distribution, with peak incidences in younger men and older women, and a 50-year gap between peaks. The high incidence of ankle fractures has been increasing sharply in line with the aging demographic over the last three decades in most Western populations. The ankle joint is a close-fitting hinge-like joint with stability provided by static stabilizers, such as the medial malleolus, deltoid ligament, lateral collateral ligamentous complex, and the tibiofibular syndesmosis [11]. Dynamic stability is provided by six important musculotendinous groups that act to stabilize and move the ankle [12]. A satisfactory outcome after ankle fracture treatment can be anticipated when the joint is congruent and stable, which is best achieved through open reduction and internal fixation of ankle fractures [13]. Both cannulated screws and tension band wiring are available implants for medial malleolus fracture fixation, with no clear consensus on the best choice, as each method has its pros and cons [14, 15].

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The aim of study is compare the clinical and radiographic union, and ankle functional outcome using modified Olerund and Molander scoring system between tension band wiring and cannulated screws in fixation of closed medial malleolus in ankle fractures.

Method

This comparative prospective study aimed to evaluate and compare the clinical and radiographic union, as well as the functional outcomes, of two different fixation methods, tension band wiring, and cannulated screws, in the management of medial malleolus fractures. The study was conducted at Roshawa and Erbil Teaching Hospital in Erbil province, Iraq, between April 2018 and August 2019. The study sample comprised 30 patients aged between 20 and 55 years who presented with isolated or bimalleolar ankle fractures. Patients with closed fractures were included in the study, while those with small piece medial malleolar fractures, pathological fractures, poor bone quality, comminuted fractures, skeletally immature patients, and type D isolated medial malleolar fractures were excluded. The study received ethical approval and informed consent was obtained from all participants. Preoperative evaluations were carried out, including the assessment of distal neurovascular status and X-ray imaging in the form of AP, lateral, and mortise views. Fractures were classified based on the Lauge Hansen or Herscovici classification systems. The patients were then randomized into two groups: Group 1 underwent tension band wiring fixation, and Group 2 received cannulated screws fixation. In Group 1, the anteromedial incision allowed for proper visualization of the ankle joint and preservation of the tibialis posterior tendon. Kirschner wires were inserted perpendicular to the fracture site, followed by the insertion of a 3.5mm unicortical screw and the construction of a figure-eight steel wire for interfragmentary compression. In Group 2, 1.6mm guide wires were inserted perpendicular to the fracture site, followed by cannulated drilling and the insertion of two 4.5mm partially threaded cannulated screws for compression. Postoperative follow-up involved immobilizing the ankle in a posterior plaster splint and

initiating toe flexion and extension exercises. Regular radiographic assessments and follow-up visits were scheduled to monitor healing progress. At the 6-month mark, both clinical and radiographic evaluations were conducted to assess union and functional outcomes using the modified Olerund and Molander scoring system. The study aimed to determine whether there were significant differences in clinical and radiographic union and functional outcomes between the two fixation methods. The findings will provide valuable insights into selecting the most appropriate treatment option for medial malleolus fractures. In summary, this prospective comparative study assessed the efficacy of tension band wiring and cannulated screws for the fixation of medial malleolus fractures. By analyzing clinical and radiographic union and functional outcomes, the study aimed to guide orthopedic surgeons in making informed decisions regarding fracture management. The results will contribute to improved patient care and treatment strategies for this common ankle injury. The study utilized SPSS version 22 for statistical analysis, classifying it into descriptive and inferential categories. Descriptive analysis presented nominal variables as frequencies and percentages, while quantitative variables were represented using mean and standard deviation. Graphs like bar charts and pie charts with error bars at 95% confidence interval were used. Inferential analysis included Fisher exact test, Chi-square, Two Independent Sample T-test, and Shapiro-Wilk test. The significance levels were set at $p>0.05$ (not significant), $p<0.05$ (significant), and $p<0.01$ (highly significant). The statistical analysis aimed to provide a clear understanding of the data, draw associations between variables, and derive meaningful conclusions.

Results

A total number of 30 cases has been included in the study, they were divided into two groups ,15 patients in group one treated by ORIF with tension band wiring [TBW], group two treated by ORIF with 2 cannulated screws. Their mean age was $36.87\pm SD$ in group one ranging from (20-54 years), $36.60\pm SD$ ranging from (20-55years). As in table 1.

Table 1: Distribution of subjects among groups by demographic data

Variables	Categories	Groups				Statistics	P value	Total	
		Tension		Cannulated				N	%
		N	%	N	%				
Age (Years)*	20-29	4	26.67	4	26.67	0.282	1[NS]	8	26.67
	30-39	4	26.67	4	26.67			8	26.67
	40-49	5	33.33	5	33.33			10	33.33
	50-59	2	13.33	2	13.33			4	13.33
	[^] Mean±SD	36.87±10.68(20-54)		36.60±10.95(20-55)		0.068	0.947	36.73±10.63	
Gender**	M	9	60.00	10	66.67	0.144	0.705[NS]	19	63.33
	F	6	40.00	5	33.33			11	36.67
Side**	RT	9	60.00	10	66.67	0.144	0.705[NS]	19	63.33
	LT	6	40.00	5	33.33			11	36.67
Trauma*	RTA or fall from height	5	33.33	4	26.67	0.159	1[NS]	9	30.00
	Twisting	10	66.67	11	73.33			21	70.00
Classification*	IMM	4	26.67	4	26.67	0.545	1[NS]	8	26.67
	PAB	2	13.33	2	13.33			4	13.33
	PER	3	20.00	2	13.33			5	16.67
	SER	6	40.00	7	46.67			13	43.33

*=Fisher exact, **=Chi-square, ^=T-test

Results in these Table 2 illustrate that approximately subjects are equally distributed among groups in all demographic data (age, gender, side, trauma and classification) with no significant association between demographic data and groups ($p>0.05$), and

no statistically significant difference between two groups regarding the age. The right ankle was more commonly involved in both groups, [9:6] in group one and [10:5] in group two. The fracture was classified according to Lauge Hansen classification;

the most common encountered mechanism was supination external rotation. 6 cases (40%) in group 1 and 7 cases 46% in group 2. Isolated medial malleolar fractures were 4 cases (26.6%) in each groups, the second most common. Supination adduction type was excluded from the study (vertical type

fractures fixed with screws perpendicular to the fracture, parallel to the tibial plafond). The mean time for radiological union in group 1 was 10.5weeks ranging from (9-14 weeks), and 12weeks in group two, ranging from (10-18 weeks).

Table 2: Descriptive and statistical test of union rate (weeks) among groups

Groups	Minimum	Maximum	Mean	±SD	T test	DF	P value	Effect size
Tension	9.00	14.00	10.50	1.60	2.097	28	0.045[Sig]	0.766 Medium
Annulated	10.00	18.00	12.00	2.26				

DF=degree of freedom, Cohen's D, small=0.2, Medium=0.5, Large =0.8

According to the data, normality test (Shapiro-Wilk test) is applied and the data of union rate is normally distributed ($p>0.05$); the healing period or the union rate (weeks) in Tension group is less than that in cannulated one with statistically clinical significant difference between them ($p<0.05$) and medium practical significant difference between them (Effect Size=0.766), Table 3. We assessed our patients functionally using the modified Olerund and Molander scoring system,

[approximately 6 months after operation] a questionnaire of 9 categories, the first 3 questions assess the main clinical symptoms. The second two questions are concerned about the situation of everyday life, the last four questions is to show the patient ability to perform simple tasks. A sum of 100 points is divided into (> 91 excellent results, 80-90 Good, 70-79 fair and less than 70 as poor) P value of less than 0.05 is considered statistically significant.

Table 3: Modified Olerund and Molander scoring system.

1. Pain	None	25
	While waking on uneven ground	20
	While walking on outdoor surface	10
	While walking indoor	5
2. Stiffness	constant and severe	0
	None	10
3. Swelling	stiffness	0
	none	10
	Only in evening	5
4. Work, activities of daily life	constant	0
	Same before injury	20
	Loss of tempo	15
	Change to simpler job	10
5. Support	Severely impaired work capacity	0
	No support	10
	Wrapping taping	5
6. Stair climbing	Stick or crutches	0
	No problem	10
7. Running	impaired	5
	possible	5
8. Jumping	impossible	0
	possible	5
9. Squatting	impossible	0
	Possible	5
Sum 100		0

Three patients in group 1 had excellent results [20%], and two patients [13.3%] in group 2. 10 patients had good results [66.6%] in group 1. 9 patients [60%] had good results in group

2, 1 patient [6.67%] got fair score in group one and 3 patients {20%} in group two. Poor results were 1 patient in each group [6.67%]. As show in table 4.

Table 4: Association between scale and groups

	Groups				FEPT	P value	Total	
	Tension wire		Cannulated screw				N.	%
	N.	%	N.	%				
Excellent	3	20.00	2	13.33	1.501	0.048 Sig.	5	16.67
Good	10	66.67	9	60.00			19	63.33
Fair	1	6.67	3	20.00			4	13.33
Poor	1	6.67	1	6.67			2	6.67

This table illustrate that the excellent and good results in the tension band are higher than that of the cannulated; (86.67%) for the tension band and 73.33% for cannulated; both groups are

equally distributed in the poor category; finally, for the fair, three cases record in the cannulated while only one case found in the tension band with significant association between groups.

1. Superficial wound infection

Wound infection and skin sloughing developed 5 days postoperatively in 2 patients (6.6%). One in each group. The condition improved by oral antibiotic and daily skin care and dressing.

2. Delayed union

A 50 years old female who was treated by cannulated screw fixation developed delayed union (about 18 weeks). There were poor sign of fracture healing on the x-ray at 12weeks, persistent tenderness above the medial malleolus. The patient was a smoker, partial weight bearing was extended for more than

12weeks and the patient was instructed to visit us after another 6 weeks to assess her condition. The fracture gradually developed union on follow up.

3. Implant related complications (6.7%)

One patient treated by cannulated screws fixation (with two washers) developed palpable swelling (cannulated screw head) above the medial malleolus, there were discomfort in shoe wearing with recurrent skin abrasions due to friction. Shortly after fracture union, the decision was to remove the implant by 19 weeks.

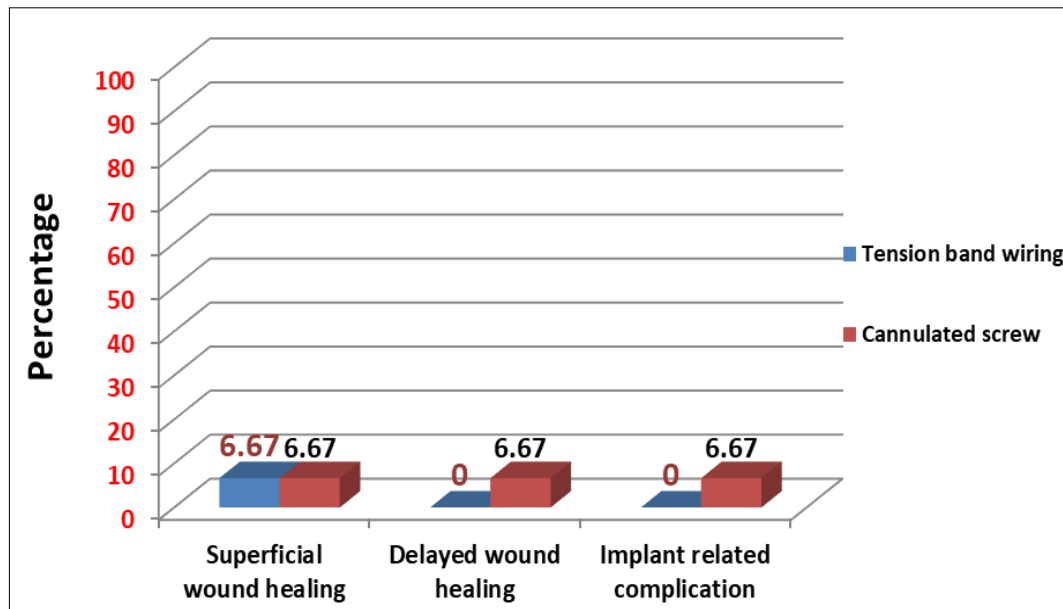


Fig 1: Cluster chart bar of complication in tension band and cannulated screw.

Discussion

Ankle fractures tolerate mistake poorly. Rigid adherence to reduction criteria will help to diminish the chance of poor functional outcome and post-traumatic arthritis. While innovation can be helpful in developing new ideas in orthopedic, there is a strong warning against internal fixations constructs that deviate from common methods in ankles fracture [15]. Both tension band fixation and cannulated screws are common available fixation options, both technically easy but without definite criteria to a method preference. In our study the mean time for radiological union was 10.5 weeks [Ranging from 9-14w] for group one and 12 weeks for group two [ranging from 10-18w]. The union rate (weeks) in Tension group is less than that in cannulated one with statistically clinical significant difference between them ($P=0.045$). This result is accommodate with Mehmet Turker [16] *et al.* who reported a mean time of radiological union of 10 w for tension band wiring and 12 w for cannulated screws. The results is roughly comparable Jitendra Khachariya [17] *et al.* who achieved a union rate of (9.2w) for tension band wiring and (11.6w) for cannulated screws. According to Olerund and molander scoring system, excellent results were 20% in group one and 13.3% in group two. Good results were 66.6% in groups 1 and [60%] in group 2. The sum of percentages of excellent-good score in this study accommodate with the result scored by AL-lamy [19] *et al* and vinod jagtap [20] (90% for TBW and 80% for Cannulated screws) with a statistical significant value of (0.048).The results is also comparable with the results obtained sang-Hanko M and Young [21] who mentioned that the score of excellent and good results

was 78% in cases treated by screws and 89% in patients treated by tension band wiring. Implants related complications developed in one case [6.7%] in the cannulated screw group. The management was by early hardware removal. We have experienced only one case of delayed union [6.67%] In group 2 and no case of non-union, this case was a 50 years' female with isolated medial malleolus fracture, the union took more than 18 weeks. Ostrum [18] and litsky concluded that tension band wiring is biomechanically stronger and clinically acceptable treatment option when compared to screw fixation. Tension band wiring was four times stronger in resisting pronation and applying compression. This might explain the faster rate of union achieved in group one as compared to group two. One case [6.7%] in each group complicated by postoperative superficial wound infection and skin sloughing [19].

Conclusion

Our investigation demonstrated that tension band wire may be better than cannulated screw fixation for closed medial malleolus fracture. Tension band wiring radiological union before cannulated screw. Tension bands have less issues. Tension band wire may be more convenient than cannulated screws because to its better functional output, quicker union, lower risk of problems, and lower cost.

Conflict of Interest: Not available

Financial Support: Not available

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