

**ORIGINAL RESEARCH**

# A prospective comparative study of tension band wiring and malleolar screw fixation for medial malleolar fractures

<sup>1</sup>Virendra Choudhary, <sup>2</sup>Rajat Jangir, <sup>3</sup>Yogendra Singh, <sup>4</sup>Nihal Gomes

<sup>1,3</sup>Senior Resident, Department of Orthopaedics, Employees State Insurance Corporation, Alwar, Jaipur, Rajasthan, India

<sup>2</sup>Professor and Unit Head, <sup>4</sup>Senior Resident, Department of Orthopaedics, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India

### Corresponding author

Dr. Nihal Gomes

Senior Resident, Department of Orthopaedics, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India

Received Date: 24 September, 2023

Acceptance Date: 31 October, 2023

### ABSTRACT

**Background:** Ankle fractures most often occur as malleolar fractures. They often need surgical treatment and have a high likelihood of not healing, these intra-articular fractures must be adequately controlled. For medial malleolus fractures, open reduction and internal fixation with malleolar screws or tension band wire (TBW) are the two main treatment techniques.

**Methods:** The objective of this study was to compare the functional outcome of treatment by use of tension band wiring versus malleolar screw fixation for medial malleolus fractures among 60 patients admitted in Mahatma Gandhi Medical College & Hospital, Jaipur during the study period of 18 months. All patients were enrolled in this study and randomized and allocated into two groups. Group A (n=30) fixation of medial malleolus using tension band wiring and Patients in Group B (n=30) fixation of medial malleolus using two malleolar screw. Patients follow up at 6<sup>th</sup>, 10<sup>th</sup>, 12<sup>th</sup> week and 6<sup>th</sup> month was done and serial x-ray evaluation and partial weight bearing with stick according to fracture pattern and stability of fixation and full weight bearing was allowed respectively. **Results:** The mean age of Group A was 36.00±9.161 while in Group B was 38.33±9.297. Male and female ratios of both the groups were not statistically significant. Mode of injury, side involved and duration of hospital stay were statistically not significant in both the groups. Most common mode of injury was road traffic accidents. **Conclusion:** Cases managed by Tension band wiring had better functional outcome as compared to those treated by Malleolar screw.

**Keywords:** Malleolar fractures, tension band wire, malleolar screw, etc.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution- Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

### INTRODUCTION

Ankle joint with its complex anatomy and variegated fracture patterns has constantly baffled the surgeons working on it.<sup>1</sup> One of the most frequent lower limb fractures, ankle fractures make about 9% of all fractures. Ankle injuries are quite common and have a high morbidity rate, which is very expensive for society. Ankle fractures, among the various injuries that occur, are becoming more frequent, coming in third place after hip fractures and wrist fractures among senior patients. Ankle fractures probably make up an even higher percentage of injuries among younger patients.<sup>2</sup> Ankle fractures, which have an annual incidence of 187 per 100,000 people in the general population, are among the most frequent bone injuries treated by orthopaedic surgeons.<sup>3</sup>

Ankle joints are particularly prone to harm. This is

due to the fact that they are comparatively mobile and handle most of the strains brought on by weight bearing. When engaged in intensive exercise, for example, the ankle must withstand pressures more than five times that of the body weight. Compared to other joints in the body, the ankle joint can handle higher weight per square inch.<sup>4</sup> Being up to five times the weight of the body, the ankle is the most robust joint in the lower extremities.<sup>5</sup> Young patients often sustain malleolar fractures from high-energy trauma, such as car accidents or falls from great heights, whereas older patients get comparable injuries from low-energy trauma, frequently with comorbidities.<sup>6</sup> Anatomical joint restoration, which can be done by closed manipulation or open reduction and internal fixation, produces the greatest outcomes. A great way to restore the natural anatomy of the joint is by open

reduction and internal fixation. Internal fixation is the best method of treatment for unstable ankle fractures for three reasons. Treatment of soft tissue damage is tough because they are challenging to decrease and even more challenging to hold reduced until they combine when treated using closed techniques.<sup>7</sup>Pain, Instability, and early degenerative arthritis are some of the potential complications of ankle fracture, if not treated well. So, keep this in mind, open reduction and internal fixation has been superior over closed method of treatment.<sup>8</sup>This study is an attempt to compare the outcome of medial malleolar fracture treated by open reduction and internal fixation with Tension band wiring and malleolar screw. We would also attempt to delineate any specific indications and contraindications of either method.

## OBJECTIVES

**Objectives;** To assess the functional outcome of treatment by use of tension band wiring and malleolar screw fixation for medial malleolus fractures. And finally to compare the functional outcome of treatment by use of tension band wiring versus malleolar screw fixation for medial malleolus fractures.

## METHOD

A prospective randomised comparative study carried out using malleolar screw and tension band wiring for internal fixation of medial malleolus fracture among 60 patients admitted in Mahatma Gandhi Medical College & Hospital, Jaipur after obtaining ethical clearance permission vide reference number MGMCH/IEC/JPR/2021/381 during the study period of 18 months (February 2021 to August 2022) with satisfying the following inclusion & exclusion criteria were included in this study.

Inclusion Criteria was all patients with closed or Gustilo Anderson Grade 1 displaced transverse fracture of medial malleolus in patients of both sex and who were more than 18 years old.

Excluded patients were those who refused to give consent, patients with comminuted fractures, with deformities of ankle prior to fracture and compound fractures with Gustilo Anderson Grade ii and iii. All patients were enrolled in this study and randomized and allocated into two groups. Group A (n=30) fixation of medial malleolus using tension band wiring and Patients in Group B (n=30) fixation of medial malleolus using two malleolar screw. All patients received in O.P.D satisfying the inclusion criteria were included all closed displaced transverse fracture of medial malleolus with Gustilo Anderson

grade I and age more than 18 years. Fractures were classified according to Lauge-Hansen classification. In all cases medial malleolus was fixed by either malleolar screw or tension band wiring while, lateral column fixed by in almost cases by one third tubular plate. Assessment of vascularity, active toe movement and any sensory loss recorded. Standard AP and lateral view x-rays were taken, close reduction of fracture done and fracture immobilized with below-knee POP slab. Antibiotics were started if indicated. Patients were encouraged to actively move toes and limbs were elevated to minimize any swelling. Pre-operative preparation thorough history taking and detailed physical examination with a special emphasis on the type of injury. Routine laboratory investigation carried out to assess patient's fitness for anaesthesia with Betadine skin preparation, antibiotic injection and pre-anaesthetic evaluation.

Post-operative procedure of patient advised to keep limb elevated and to perform active toe movements. Post-operative antibiotic injection for 2 days. It's followed by oral antibiotic up to 5<sup>th</sup> post-operative day. Stitch removal was done on 14<sup>th</sup> post-operative day. Stitch line was observed for healing by primary intention, marginal necrosis, stitch abscess, superficial or deep infection, any discharge necrosis. Below knee POP cast applied for 4 weeks after stitch removal. Partial weight bearing and mobilization of ankle and foot was started after 6 weeks or depending on X-ray and full weight bearing was permitted after 3 months.

## STATISTICAL ANALYSIS

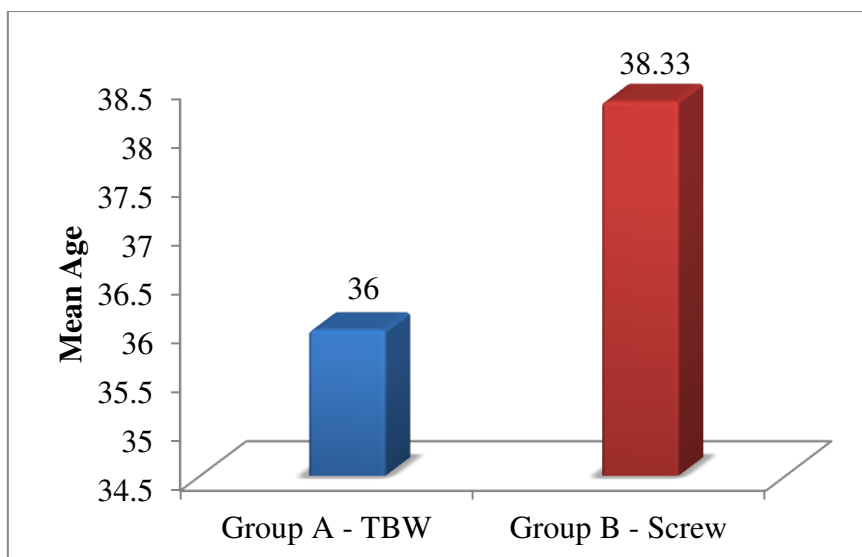
All the demographic details, base line data and postoperative data were recorded in the case report form over the course of the study. The Categorical data was presented as numbers (percent) and were compared among groups using Chi square test. The quantitative data was presented as mean and standard deviation and were compared by student's t-test. Probability was considered to be significant if less than 0.05. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 22.0 statistical Analysis Software.

## RESULTS

In this study, Demographic details shown in the below graph the mean age in tension band wire and malleolar screw group is  $36.00 \pm 9.161$  and  $38.33 \pm 9.297$  years respectively ( $P > 0.05$ ). The minimum age was 21 years and maximum age was 62 years. Majority of the fractures occurred in 31-40 years of age group.

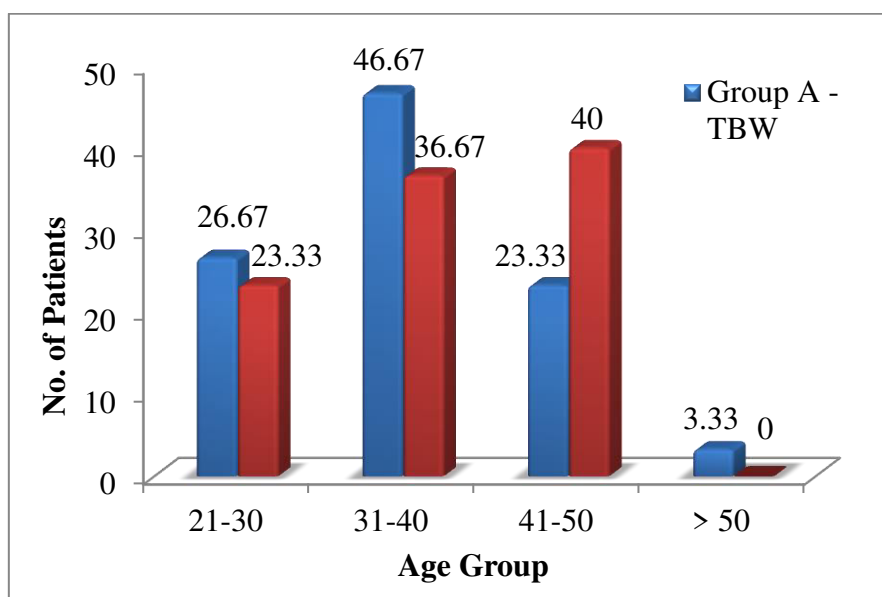
**Table 1: Age distribution in the study**

Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Group A - TBW	30	36.00	9.161	1.673	0.332 (NS)
Group B - Screw	30	38.33	9.297	1.697	



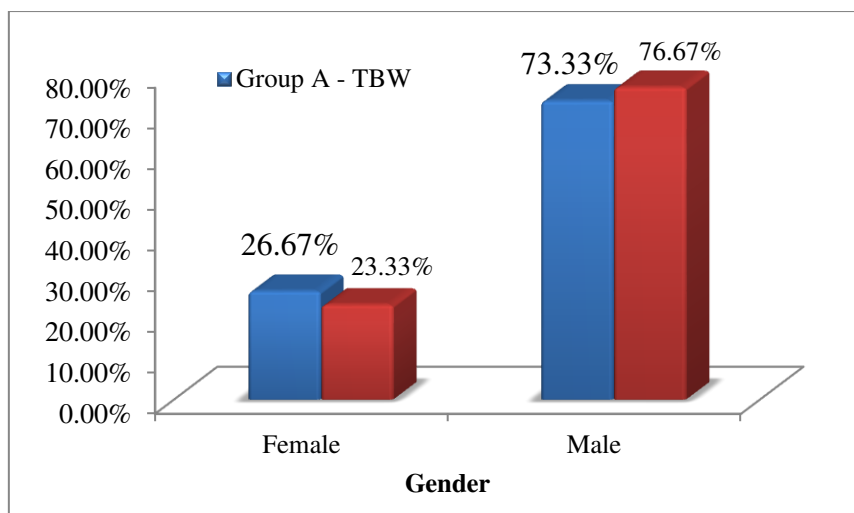
**Table 2: Age distribution in the study**

Age Group	Group A – TBW		Group B - Screw	
	No.	%	No.	%
21-30	8	26.67	7	23.33
31-40	14	46.67	11	36.67
41-50	7	23.33	12	40.00
> 50	1	3.33	0	0.00
Total	30	100.0	30	100.0



**Table 2: Sex distribution in the study**

		Group A – TBW	Group B - Screw	P value
Female	Count	8	7	0.766 (NS)
	% of Total	26.67%	23.33%	
Male	Count	22	23	
	% of Total	73.33%	76.67%	
Total	Count	30	30	
	% of Total	100.0%	100.0%	



Majority of the patients underwent male participants ( $P > 0.05$ ). Most common mode of injury was road traffic accidents (78.3%). Fall from height was the second most common mode of injury (18.3%). 3.3% cases had injury by slipping or stumbling. Left side was involved more frequently than right side. The mean hospital stay in tension band wire and malleolar screw group is  $3.67 \pm 0.802$  and  $3.80 \pm 0.805$  years respectively. ( $P > 0.05$ ) Mean time to radiological union was  $9.20 \pm 0.714$  weeks for tension band wire group and  $12.03 \pm 1.189$  weeks for Malleolar screw group ( $p = 0.000$ ). Outcome procedure of 27 (90%) cases in tension band wire group had excellent to good results. Whereas, 24 (80%) cases in Malleolar screw group had excellent to good results ( $P > 0.05$ )

(Table 1). Distribution of Range of Motion at final follow-up of plantarflexion was significant higher compared to dorsiflexion. At final follow up it was observed that there was no significant association between range of motion and procedure (Table 2). Mode of procedure of 2 patients in tension band wire group developed infection whereas; 4 patients of malleolar screw group had this complication. 3 patients in tension band wire group developed arthritis whereas; 1 patient of malleolar screw group of the ankle joint. Stiffness of ankle joint was more common in malleolar screw group as compared to the tension band wire group. No patients was found in delayed/union complications (Table 3).

**Table 4: Distribution of outcome according to procedure**

		Group A – TBW	Group B - Screw	P value
Excellent	Count	25	23	0.492 (NS)
	% of Total	83.33%	76.67%	
Good	Count	2	1	
	% of Total	6.67%	3.33%	
Fair	Count	3	6	
	% of Total	10.00%	20.00%	
Total	Count	30	30	
	% of Total	100.0%	100.0%	

**Table 5: Distribution of Range of Motion at final follow-up**

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Dorsiflexion	Group A - TBW	30	18.10	3.527	.644	0.085
	Group B - Screw	30	16.27	4.525	.826	
Plantarflexion	Group A - TBW	30	37.17	6.752	1.233	0.286
	Group B - Screw	30	34.90	9.345	1.706	

**Table 6: Distribution of type of complications according to mode of procedure**

		Group A – TBW	Group B - Screw	P value
Infection	Count	2	4	0.389 (NS)
	% of Total	6.67%	13.33%	
Arthritis	Count	3	1	0.301 (NS)
	% of Total	10.0%	3.33%	
Stiffness	Count	4	7	0.317

	% of Total	13.33%	23.33%	(NS)
Delayed/ union	Count	0	0	-
	% of Total	0.0%	0.0%	
Total	Count	30	30	
	% of Total	100.0%	100.0%	

## DISCUSSION

Majority of ankle fractures can't be reduced anatomically by close manipulation. Interposition of periosteum and small intermediate fragments of bone and cartilage commonly prevent close reduction. The most disabling sequel of fractures about the ankle is post traumatic arthritis. Anatomical restoration is the most important contribution the surgeon can make. This series includes randomly selected 60 cases of closed fracture Pott's ankle. All patients were admitted in the Department of Orthopaedics of Mahatma Gandhi Medical College and Hospital, Jaipur. A detailed history and thorough clinical examination was carried out as per Performa attached.

The AP and lateral views of the ankle were taken. In this series of ankle fractures, fixation of medial malleolus was done with Tension band wiring in 30 cases and in other 30 cases malleolar screw was used as fixation modality. In displaced fracture of lateral column, fixation was done with one third tubular plate using AO principle and in three cases lateral column was fixed by k-wire, as the distal fragment was too small. All fractures were classified by the Lauge Hansen method. In this series minimum age was 21 year and maximum age was 62 years. Mean age in male was  $37.98 \pm 8.980$  years and in female was  $34.73 \pm 9.263$  years. Peak incidence of trauma occurred in 31-40 age years group. This age group was more vulnerable to injury due to more involvement in outdoor activities, athletic activities and involvement in manual works. David Segal (1979)<sup>9</sup> rightly mentioned that ankle fracture is not "old men's" fracture but occur more commonly in young adults. Bauer et al (1985)<sup>10</sup> in his study on 108 patients having malleolar fracture treated by operative and conservative modality had mean age 44 years (range 16-77 years), Beris et al (1997)<sup>11</sup> in his study of 88 patients having malleolar fracture treated surgically, mean age was 43.8 years. Nelson F. Schoo et al (2009)<sup>12</sup> in his study of ankle fracture analyzing complication rates following open reduction and internal fixation of ankle fractures, mean age was 51 (range 18-103 years).

In this series male female ratio was 4:1. The men outnumbered the women for apparent reasons. Apart from few exceptions most women are house wives and men go for jobs. Hence men were exposed to trauma much more. Sex ratio in our series is almost similar to series of Burwell and Charnley (1965)<sup>13</sup> and Kenneth A. Egol et al (2006)<sup>14</sup> in which male were predominant. Klossner (1962)<sup>15</sup>; Wilson and Skllbrd (1977)<sup>16</sup>; Solonen & Louttamus (1968)<sup>17</sup>; Joy et al, (1974)<sup>18</sup>; Colton, (1971)<sup>19</sup>; Olerud & Molander (1984)<sup>20</sup>; Beris et al (1997)<sup>11</sup>; Nelson and Soohu

(2009)<sup>12</sup> recorded higher incidence in female compare to male.

In this study left (56.66%) side got involved more often than right (43.33%). While In most western series right side was more often involved. In this study most common mode of injury was road traffic accident in 47 cases (78.33%) followed by fall from height in 11 cases (18.33%), slipping and stumbling was responsible in 2 cases (3.33%). Kenneth A. Egol et al (2006)<sup>14</sup> in his study had 71% due to fall, 17% due to road traffic accident and 12% was due to sports related injuries. Increasing number of vehicles on the road is responsible for rise in traffic accidents in our country. People involved in manual labour class were the most common occupational group sustained injury due to fall from height. While most western series noticed slipping and or stumbling as the main cause of ankle fracture. The present series noticed that whenever there was delay in treatment it caused organization of traumatic exudates and fibrosis and made surgery and anatomic reduction difficult.

In this series, the mean dorsiflexion in tension band wire group was 18.10 degrees whereas for malleolar screw group, the mean dorsiflexion was 16.27 degrees. The p value for this observation was 0.085 and hence this association was not found to be significant. Similarly, the mean plantarflexion in tension band wire group was 37.17 degrees whereas for malleolar screw group, it was 34.90 degrees. The p value for this observation was 0.286 and hence this association was not found to be significant. Lindsjo et al; (1985)<sup>21</sup> in his study of 162 cases having fracture dislocations ankle, operatively treated according to AO principles, they recorded restriction of ankle dorsiflexion up to 10 degree in 31.00% cases and plantar flexion in 17.00% cases. It came out that in our study restriction of ankle movement was more in malleolar screw group than in tension band wire group.

In this study it was noticed that size of skin incision was on the smaller side when malleolar screw used as a fixation modality as compare to tension band wire. Smaller Incision has advantage of lesser soft tissue exposure with lesser chances of stiffness and infection. Pain was present in higher number of patients in the malleolar screw group while patients of tension band wire group did better. Clinical presence of swelling around ankle joint showed higher incidence in tension band wire as compared to malleolar screw group. This might have to do with surgery. Malleolar screw group usually had lower surgical soft tissue damage as compared to tension band wire. The difference in management by two modalities was also highlighted by the complications

encountered during follow up. 2 patients in tension band wire group developed infection whereas; 4 patients of malleolar screw group had this complication. 3 patients in tension band wire group developed arthritis whereas; 1 patient of malleolar screw group of the ankle joint. Stiffness of ankle joint was more common in malleolar screw group as compared to the tension band wire group. The mean time to radiological union was 9.20 weeks in tension band wire group and 12.03 weeks in malleolar screw group with a p value of 0.000. This association is highly significant. Thus, it is evidently clear that patients managed by tension band wire group had better functional outcome as compared to the patients managed by malleolar screw group.

## CONCLUSION

There are many procedures for fixing medial malleolus fractures, including TBW and malleolar screw, both of which provide an excellent range of motion, a functional result, and a low complication rate. Both groups' postoperative and subsequent pain levels were quite comparable. In contrast to the malleolar screw group, the TBW group has a significantly earlier union rate. Medial malleolus fractures may be fixed surgically using either technique. Tension band wiring had better functional outcome as compared to those treated by Malleolar screw. To choose the best fixation technique for a medial malleolus fracture, larger studies with a larger sample size or a randomised control trial between fixation techniques should be conducted.

## DECLARATION

**Funding:** None

**Conflict of Interest:** None declared

**Ethical approval:** Obtained

## REFERENCES

- Ahl et.al (1988): A clinical and Roentgenographic Stereophotogrammetric study. *Clinic Orthopaedic and Related Research*. N. 245-1989.
- Ashhurst, A.P.C. and Bromer R.S. (1922): Classification and mechanism of fractures of leg bones involving the ankle. *Arch. Surg.* 4:51.
- Ebraheim NA, Ludwig T, Weston JT, et al. Comparison of surgical techniques of 111 medial malleolar fractures classified by fracture geometry. *Foot Ankle Int.* 2014
- Roy I, Davidovitch, Kenneth A. et al. Ankle fractures. In: Robert W. Buchholz, Charles, James D. Heckman, Paul Tornetta, Rockwood and Greens fractures in adults. edition 7. Philadelphia: Lippincott Williams & Wilkins publishers; 2009. p. 1975-2017.
- Simon WH, Friedenborg S, Richardson S. Joint Congruence; A correlation of joint congruence and thickness of articular cartilage in dogs. *J Bone Joint Surg.* 1973; 55:1614.
- Mehta SS, Rees K, Cutler L, et al. Understanding risks and complications in the management of ankle fractures. *Indian J Orthop.* 2014; 48:445-452.
- Gavin Bowyer. Injury of ankle and foot. In: Gavin Jamieson. *Systems of orthopaedics and fracture*, 9th ed. London: Hodder Arnold; 2010. p. 912-16
- Weber MJ. Ankle fractures and dislocations. In: *Operative orthopaedics*, Chapter 50, 2nd edn., Ed. Chapman MW, Madison M. Philadelphia: J.B. Lippincott Company. 1993; 3:731-748.
- David Segal (1979): Ankle fractures. *Inst. Course Lectures*, Vol. XXVIII, St. Louis, the C.V Mosby Co. 72.
- Bauer et al (1985): Malleolar Fractures: Non operative Versus Operative Treatment. *Clinical Orthopaedic and Related Research*. N.199 Oct. 1985.
- Beris et.al; (1997): Surgical Treatment of Malleolar Fractures *Clinical Orthopaedics and Related research* Number 341, pp 90- 98.
- Nelson E Soohoo, et.al (2009): Complication Rates Following Open Reduction and Internal Fixation of Ankle Fractures. *J. Bone Joint Surg. Am* 91:1042-9.
- Burwell, H.N. & Charnley, A.D (1965): The treatment of displaced fracture at the ankle by rigid internal fixation and early joint movement. *J. Bone Joint Surg.* 47-8: 634-660.
- Kenneth A. Egol. (2006): Predictors of Short-Term Functional Outcome Following Ankle Fracture Surgery. *J. Bone Joint Surg.* Vol. 88-A - Numbers 5 May - 2006.
- Klossner, O. (1962): Late results of operative and non-operative treatment of severe ankle fractures. *Acta. Chir. Scand. (Supplementum)*, 293:1-93.
- Wilson, F.C. & Skilbred, L.A. (1977): Long term results in the treatment of displaced bimalleolar fractures. *J. Bone Joint Surg.* 48-A: 1065-1078.
- Solonen, K.A. & Laittamus, L. (1968): Operative treatment of ankle fractures. *Acta. Orthop. Scand.* 39:223.
- Joy, G., Patzakis, and M.J Harvey, J.P. jr. (1974): Precise evaluation of the reduction of severe ankle fractures. *J. Bone Joint Surg.*, 56A:979.
- Colton, C.L (1971): The treatment of Dupuytren's fracture dislocation of the ankle. *J. Bone Joint Surg.* 63-71.
- C. Oleruds and Molander et.al. (1984): Bimalleolar and Trimalleolar Ankle fractures Operated with Non rigid Internal Fixation. *Clip. Orthop. Relat. Res*; N.206 May 1986.
- Lindsjo U. (1985). Operative treatment of ankle fracture dislocation: *Clin. Orthop. Retal. Res*; 199:28-38.1.