Type of the Paper (Research Article)

Lag screw only fixation in unstable distal fibular fractures in adult patients

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Received: 8 April, 2025 Reviewed: 12 May, 2025
Accepted: 8 May, 2025 Published online: 6 November, 2025

Abstract

Background: About ten percent of all fractures are adult ankle fractures, making them a prevalent injury. Neutralizing plate has been the traditional method for fixation of distal fibula fracture; however, this method has a number of complications. Based on recent clinical and biomechanical research has shown that lag screw-only fixation is a successful fixation technique for adults.

Aim of the work: To evaluate lag-screw-only fixation's effectiveness of the oblique non-comminuted fractures of distal fibula in adult patients using the American Orthopedic Foot and Ankle Society (AOFAS) scoring scale.

Patients and methods: Twenty patients were involved in the study who sustained distal fibula fracture. All were operated on via lag screws fixation only. Eight patients had distal fibular fractures as a uni-malleolar, while eleven had bi-malleolar fractures. The AOFAS scoring scale used for evaluating the functional result of the ankle of all patients after three and six months after surgery.

Results: The mean AOFAS score among study group had shown a significant increase from 81.8 to 87.8 at six months postoperatively with p-value <0.001.

Conclusion: Fixation of non-comminuted fractures of distal fibula with lag screws only in selected patients reduces postoperative wound complications and infection, as well as skin irritation and lateral ankle pain, resulting in no need for additional surgery and obtaining acceptable functional and radiological results.

Key words: Lag screw, lateral malleolus, fracture

1. Introduction

About 10% of all fractures are adult ankle fractures, making them a prevalent injury. Their average occurrence rate, which is 168.7/100,000 person-years, has been increasing due to increased human activity, overweight, and old age [1]. According to reports, the average age of fracture was 41 years old. Men suffer from ankle fractures at a somewhat higher rate than women (53% vs. 47%) [1]. The distribution of ankle fractures is bimodal, with younger men and older women having the highest rate [2].

Ankle fractures are ordinarily fixed with open reduction and internal fixation. It permits complete exposure, efficient fracture site reduction, and strong fixation. Open reduction and internal fixation, however, have a significant chance of complications. Consequently, the optimum surgical technique is still the area of greatest research for ankle fractures [3].

Fixation of the distal fibular fractures with plate osteosynthesis has a number of complications, including infection that may require a long-term antibiotics or even another surgery for plate removal and debridement [4]. Additionally, many patients find that laterally placed plates are palpable and irritate them, demanding another surgery for plate removal [4].

There are several fixation techniques for ankle fractures as buttress plate, tension band, k-wire and isolated lag screw. However less soft tissue damage methods are widely used in clinical practice such as isolated lag screws [5].

2. Subject and methods

2.1. Study design

A prospective case series study of the functional results of using lag screws to treat a non-comminuted fracture of the distal fibula

2.2. Subjects

The study included twenty patients.

2.3. Inclusion criteria:

- The age of patient should be <50 years old.

- Patient with good bone quality
- Displaced long oblique distal fibula fracture with a line longer than 2x the diameter of the bone suitable for fixation with 2-3 lag screws alone.
- Closed fracture

2.4. Exclusion criteria

- Patients with comminuted fractures.
- Transversal fracture.
- Infected fracture.
- Revision cases.

2.5. Preoperative assessment

2.5.1. Clinical assessment

Surgery was operated by spinal or general anesthesia according to anesthesia doctor and general medical condition of patient.

Clinical assessment of the patients in the ER according to Advanced Trauma Live Support (ATLS) score: ABCDE survey if the patient was a polytrauma patient.and assessment of the ankle condition as edema, the skin condition "bullae" or open fracture", neurovascular examination, and the exclusion of compartmental syndrome.

2.5.2. Radiological assessment

To adequately assessment of the ankle injury and degree of displacement. An anterolateral view, lateral view, and mortise view were performed for the injured ankle is ordered.

2.6. Surgical techniques

On a radiolucent table, while the patient on a supine position a sub-gluteus pad was placed ipsilateral to the fractured side. We applied the tourniquet to the mid- and upper thigh (Fig. 1).

A **B** **C**

Figure (1): Surgical methods. A) Supine position of the patient on a radiolucent table to allow using the radiograph, B) &C) Showing lateral approach of lateral malleolus [6].

The lateral malleolus first was felt, then a longitudinal incision measuring about 4-5 cm was made at the fracture site along the anterior fibula margin, dissecting all the way down to the subcutaneous bone using a lateral approach under a fluoroscope. The level was located between the peroneous previs and peroneous tertius muscles if the fracture was Weber C. Following that, periosteal stripping was carried out.

The reduction clamp was then used to realign the fibula while paying attention to the peroneus tendons. Medial clear space, rotation, length of fibula, and talocrural angle under the C-arm were also assessed.

Following approach and reduction. A 3.5 mm drill was passed through the fibula's anterior cortex, creating a gliding hole perpendicular to the fracture line as the lag screw compresses the fracture fragments. In order to achieve high compression, a2.5 mm drill was passed through the posterior cortex using a sleeve (pilot hole) to drill the far cortex, then a countersink tool was used to drill the near cortex, creating a platform in the anterior cortex for the head of the screw. A self-tapped, 3.5 mm fully threated screw inserted to fix and compress the fracture with appropriate length in order to exit the far cortex. One or two more screws were then used, spaced one centimeter apart, to fix the fracture. (Fig. 2&4&5).

After that, we had to evaluate the medial malleolus and syndesmosis fluoroscopically by using stress view ankle.

We could also use a syndesmotic screw especially if we suspect syndesmotic injury by using a 3.5-mm screw with a washer at a level 2-5 cm above the plafond through 3 or 4 cortices with a proper axis as the fibula located slight posterior to the tibia (Fig. 3).

Finally, skin stitches, dressing, and then below knee slab or cast was done.

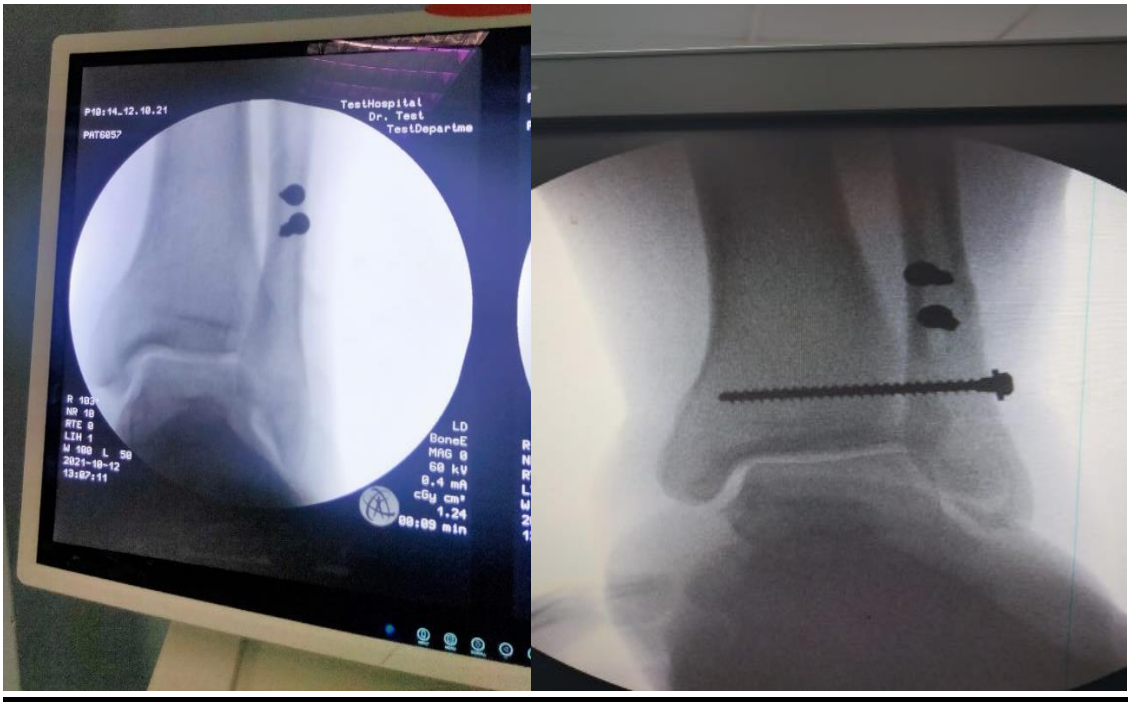

Figure (2): Illustration of fixation of lateral malleolus by 2 lag screw.

Figure (3): Illustration of syndesmotic screw application.

Figure (4): AP view of ankle fixed by 2 lag screw of lateral malleolus and medial malleolus.

Figure (5): Lateral view of ankle fixed by 2 lag screw of lateral malleolus and medial malleolus.

2.8. Postopertive follow up:

Following surgery, a below knee splint was placed as an additional external maintenance and pain management device for 4 weeks for uni malleolar fracture and 6 weeks for bi malleolar fracture. A cushion was employed beneath the ankle, calf, and non-weight bearing (NWB) on the affected leg while beginning knee exercises day one following surgery.

Anteroposterior, lateral, and mortise views of ankle x-rays were used to value fracture reduction and fixation.

2.9. Statistical Analysis:

Data was gathered and coded to ease data manipulation before being double entered into Microsoft Access and analyzed using the Statistical Package for Social Science (SPSS) software version 22 on Windows 7 (SPSS Inc., Chicago, IL, USA).

Simple descriptive analysis of qualitative data in the form of numbers percentages, and arithmetic means as a measure of central tendency, standard deviations as a measure of dispersion of quantitative parametric data.

In each research group, quantitative data were checked for normality using the

One-Sample Kolmogorov-Smirnov test, and then inferential statistic tests were used.

For quantitative parametric data:

- Independent samples T test was used to compare quantitative measures

between two independent groups

- One-way ANOVA test used to compare quantitative measures between

more than two independent groups of quantitative data.

- Paired t-test used to compare two dependent quantitative data.

For qualitative data:

- Chi square test used to compare between two of more than two

qualitative groups.

- Bivariate Pearson correlation test to test the

association between quantitative parametric variables

- The P-value< 0.05 was considered as statistical significant

3. Results

3.1 Descriptive analysis

Twenty participants participated in this study. The age range of our patients was 16–48 years old, with a mean age of 35.1±9.4 years of the study group. Of them, 45% were men and 55% were women. (Table 1).

The study based on follow up of the cases at least 6 months with maximum duration recorded for follow up was 8 months, with a mean 6.6±0.9 months. 80% of cases developed fracture due to twisting, versus 20% due to RTA. sixty percent of cases showed fracture of left side. Fifty-five percent showed bi-malleolar type fracture, 40% had a Uni- malleolar type, and 5% tri-malleolar type. One case was associated with Olecranon injury fixed by k-wiring and tension band and one case sustained ipsilateral tibia shaft injury fixed by intramedullary nail. Three cases (15%)

needed syndesmotic screws and none of them needed removal. (Table 2). The mean duration between fracture and operation was (2.1±1.8) days, and the mean Duration of the whole operation was (39.1±8.5) minutes with the mean duration of lateral malleolus only fixation was (27.3±3.7) minutes.

Variables	Number (n=20)	
Age (years)		
Mean ±SD	35.1±9.4	
Range	16-48	
Sex		
Male	9	45%
Female	11	55%

Table (1): demographic data.

Variables (n=20)	Frequency	
	Number	**%**
Mode of trauma		
Twisting	16	80%
RTA	4	20%
Side of fracture		
Right	8	40%
Left	12	60%
Type of fracture		
Uni-malleolar	8	40%
Bi-malleolar	11	55%
Tri-malleolar	1	5%
Syndesmotic screw		
No	17	85%
Yes	3	15%

Table (2): Different injury characteristics frequency within the study group.

3.2. Post-operative clinical assessment:

The mean duration to start range of motion was (4.5±0.7) weeks, mean duration to full weight bearing was at (7.1±1.1) weeks, the mean Duration of lateral ankle pain disappearance was (4.7±0.9) weeks. The mean AOFAS score after 3 months was (81.8±5.4) and after 6 months was (87.8±4.9). Nine of cases had an excellent score > 90 and eleven patients had a good score > 80. The mean duration of time of healing was (8.4±1.0) weeks ranged between 7 and 12 weeks.The mean AOFAS score among study group had shown a significant increase from 81.8 to 87.8 at six months post operation with p-value <0.001 (Fig. 6).

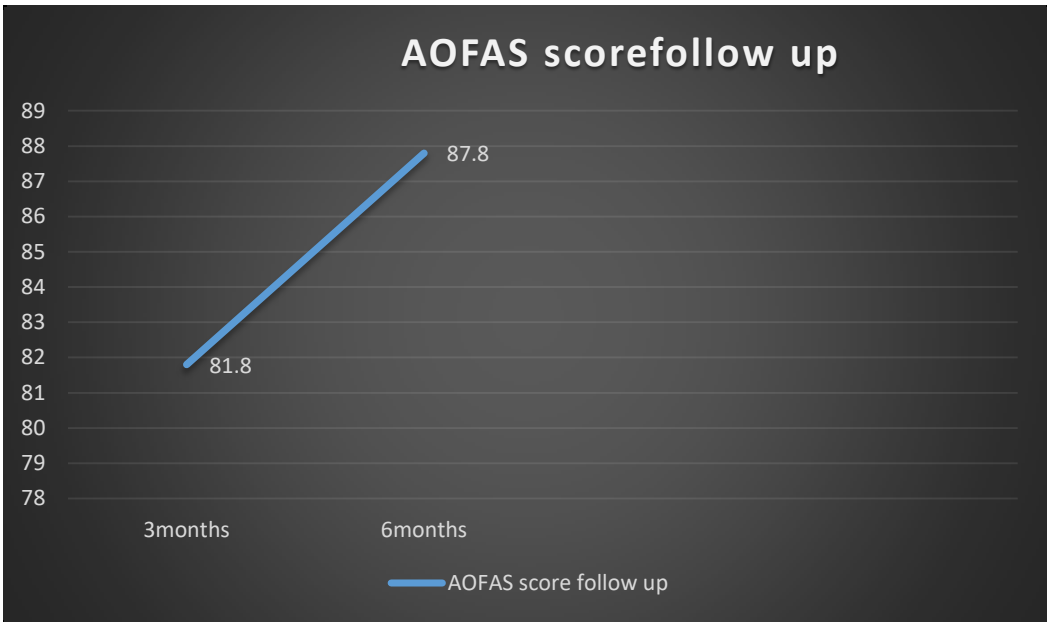

Figure (6): Illustration of AOFAS score evaluates study group follow-up**.**

There was a negative correlation with between AOFAS score at six postoperative months and duration needed for lateral ankle pain disappearance. So decrease in duration of persistent lateral ankle pain will associate with increase in the score of AOFAS at 6 months postoperative (Fig.7).

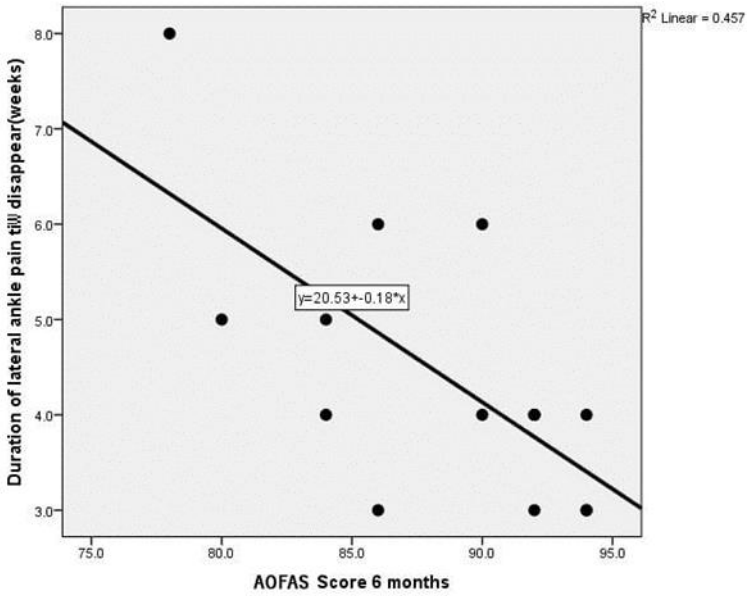

Figure (7): Illustration of associations between six-month AOFAS scores and duration of lateral pain disappearance

3.3. Post-operative complications

There was one case had shown postoperative wound infection treated with antibiotics only and one case had refracture 2months post operation following twisting injury and treated by plate and screws, with no other complications as nonunion, nor DVT.

4. Discussion:

Ankle fractures are a common source of ankle pain, which may restrict ankle function. Adult ankle fractures are a common injury, accounting for 10% of all fractures. Ankle fractures are more prevalent in adults with a mean age of 41 [1].

A buttress lateral plate is the most often used surgical fixation treatment for oblique distal fibular fractures; The surgeon can get the anatomical reduction by performing an open reduction, but These plates are usually felt due to the subcutaneous nature of the fibula's lateral edge. As a result, they can irritate the skin and must occasionally be removed to alleviate lateral ankle discomfort for the patient [7]. Therefore, using lag screw only to fix of lateral malleolus injury with good bone stock and non-comminuted fractures is an attractive method for treatment by achievement anatomical reduction with less surgical

trauma, complication and good outcome results [7].

In order to evaluate the effectiveness, benefits, drawbacks, and functional results of employing lag screws alone to treat oblique non-comminuted distal fibular fractures, this study used the AOFAS rating scale at three and six months postoperatively.

Regarding AOFAS scores we were able to get good results for ankle functional outcome. The mean AOFAS score at three months of surgery was (81.8±5.4) and raised to (87.8±4.9) after six months, with p-value<0.001. According to these scores nine patients had an excellent postoperative ankle recovery, while eleven patients had a good result at 6 month follow up.

In a similar study, McKenna et al. fifty patients were selected in a study half of them treated by lag screw only fixation of distal fibular fracture comparing with the other half which treated by plate osteosynthesis noticed that lag screw-only obtained an average AOFAS score was eighty six as compared to seventy six for the plate osteosynthesis treated group [8]. They also noticed that one of disadvantages of lag screw fixation for distal fibula fractures was long duration of cast immobilization after operation that annoyed some patients [8].

In a comparison study between plate versus lag screw fixation of unstable fracture of the ankle joint with an associated lateral malleolus injury in adolescent, Paez et al. recorded that lag screw as plate achieved good outcome of healing without loss of reduction with additional advantage of shorter time for surgery and less symptomatic implants [9].

Regarding the time required for union in our study, the mean fracture union duration for all study group patients was 8.4±1.0 weeks.

Likewise, Kim and Oh. observed 60 patients treated with two cortical lag screws for Danis-Weber type B fractures. A stable anatomic reduction was achieved in 95% and the average union period as shown by radiographs was 3.1 months. Advantages of preventing plate osteosynthesis were mentioned by these authors. They included a decreased risk of hardware removal, less periosteal dissection, and reduced chance of cartilage injury from ankle joint penetration [10].

However, limited fixation is biomechanically weaker than lateral or posterolateral plate osteosynthesis [11]. The fact that there was no fracture reduction

loss in the current series indicates that fracture fixation is obviously stable even though it is not entirely rigid. There is no proof that the clinical result or fracture healing are harmed by this less rigid fixation. So Covino et al. [12] noted that there is no discernible difference between inter-fragmentary and plate osteosynthesis. They felt that inter-fragmentary fixation prevented screw penetration into the ankle joint and avoided potential complication associated with lateral plate fixation.

Also as regard as this technique, we did not need any more surgery to remove screw as Jacobson et al. [13] needed as sixty six percent of patients with lateral plates experienced implant discomfort that prompted removal. Seventy-five percent of these individuals felt better once the plates were removed.

McKenna et al. report that five patients out of twenty-five of the plate osteosynthesis group needed another intervention for wound debridement or metal removal, while 16% of treated patient that had wound infections required antibiotic treatment only [8].

In their study, Lee and Chen found that 95.5% of patients requesting plate removal had bothersome lateral plate issues, compared to 45.5% of patients in the plate group receiving treatment for lateral malleolar fractures [14].

Regarding lateral ankle pain duration until subsidence, we noticed that the mean duration was (4.7±0.9) weeks which was enough to make the pain disappears. In comparison to McKenna et al., who noticed that eighty-five percent of patients from a group that fixed by lag screw only, lateral ankle pain disappeared within 2-4 weeks, on the other hand 6 months were the duration for fifty-five percent of patients from a group that fixed by plate osteosynthesis [8].

Also, Brown et al. [15] described that 39 out of the 126 (31%) patients treated with lateral plate fixation had pain at lateral side of the ankle related to the plate and there was need for removal, also noticed that functional outcome score was poorer for patients complained of pain at lateral ankle plate.

Based on our findings and the reviewed literature, the fixation of non-comminuted distal fibular fractures with lag screws-only has many advantages over other methods of fixation, a decrease in soft tissue surgical trauma, a high union rate, an acceptable AOFAS score, less post-operative complications, and no need for further

surgery all of which lead to the attainment of a functional result that is adequate.

Our research was limited by a small sample size, a brief follow-up period, and the absence of a direct comparison with lateral plate osteosynthesis.

5. conclusion:

Fixation of non-comminuted distal fibula fractures with lag screws only in selected patients reduces postoperative wound complications and infection, as well as skin irritation and lateral ankle pain, resulting in no need for additional surgery and obtaining acceptable functional and radiological results.

Lag screw only fixation didn't show any problem with union, weight bearing time, or loss of reduction in selected cases with good bone stock, less than fifty years old, long oblique fracture line 2x diameter of bone and non- comminuted fracture. Even syndesmotic screw can be applied in such a technique wherever required.

Funding: This research is not funded.

Authors'contributions:

EAS: Protocol/project development, Data collection and management, manuscript writing/editing. MSE: Data analysis, manuscript writing, and editing. HAA: Data management, Manuscript writing/editing. HAK: Protocol/project development, Data analysis, Manuscript writing/editing. All authors have read and approved the manuscript.

Informed consent: All patients provided written informed consent.

Ethical approval statement: The ethical committee of the Fayoum Faculty of Medicine in Egypt gave its approval to the protocol numbered (M549)**.**

Conflicts of Interest: No conflicts of interest are disclosed by any of the authors.

AI Declaration: Not applicable

Reference:

1. Jiang L, Wu J, Li M, Liu X, Luo C, Qu X. Cannulated screw and Kirschner fixation for the treatment of medial and lateral malleolar epiphyseal fractures in children: a retrospective study of 36 cases. J Orthop Surg Res. 2019 Aug 8;14(1):254.

4. Mehta SS, Rees K, Cutler L, Mangwani J. Understanding risks and complications in the management of ankle fractures. Indian J Orthop 2014;48(5):445-52.

5. Fowler TY, Pugh K, Litsky AS, Taylor BC, French BG. MD. Medial Malleolar Fractures: A Biomechanical Study of Fixation Techniques. Orthopedics. 2011. 34(8):349-55.

6. Müller, M. E., Allgöwer, M., Schneider, R., & Willenegger, H. Manual of Internal Fixation.1991.

7. Tornetta P III. Ankle injuries. In: Principles of Orthopaedic Practice,ed by Dee R. New York, McGraw-Hill,1997,531–45.

8. McKenna PB, O'shea K, Burke T. Less is more: lag screw only fixation of lateral malleolar fractures. Int Orthop. 2007 Aug;31(4):497-502.

9. Paez CJ, Lurie BM, Bomar JD, Upasani VV, Pennock AT. Plate Versus Lag Screw Only Fixation of Unstable Ankle Fractures Involving the Fibula in Adolescent Patients. J Pediatr Orthop. 2021 Feb 1;41(2): 161-6.

10. Kim SK, Oh JK. One or two lag screws for fixation of Danis-Weber type B fractures of the ankle. J Trauma. 1999 Jun;46(6):1039-44.

2. Brockett CL, Chapman GJ. Biomechanics of the ankle. Orthop Trauma. 2016 Jun;30(3):232-8.

3. Lynde MJ, Sautter T, Hamilton GA, Schuberth JM. Complications after open reduction and internal fixation of ankle fractures in the elderly. Foot Ankle Surg. 2012 Jun;18(2):103-7.

11. Bankston AB, Anderson LD, Nimityongskul P. Intramedullary screw fixation of lateral malleolus fractures. Foot Ankle Int,1994, 15:599–607.

12. Covino BM, Barsanti CM, Wolfe J and Wang GJ . Internal Fixation of Lateral Malleolus Fractures: A Clinical and Biomechanical Comparison of Two Techni- ques. Orthopaedics Transaction Journal,1990, 5:90.

13. Jacobsen S, Honnens de Lichtenberg M, Jensen C, et al. Removal of internal fixation—the effect on patients' complaints: a study of 66 cases of removal of internal fixation after malleolar fractures. Foot Ankle Int 1994;15:170–1.

14. Lee YS, Chen SW. Lateral fixation of open AO type-B2 ankle fractures: The Knowles pin versus plate. Int Orthop. 2009;33:1135–9.

15. Brown OL, Dirschl DR, Obremskey WT. Incidence of hardware-related pain and its effect on functional outcomes after open reduction and internal fixation of ankle fractures. J Orthop Trauma,2001,15:271–4.