Distal fibula locked plate versus nonlocked plate for treatment of Danis Weber type B fracture comparative prospective study

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Background
Ankle fractures are one of the most common fractures affecting both the young and old. they are the third most common fracture in elderly patients. The appropriate method of fixation of those fractures is debatable especially for osteoporotic patients, osteoprosis renders commonly used internal fixation methods technically demanding and prone to failure.
Aim
To compare distal fibula locked plate to nonlocked plate for treatment of Danis Weber type B fracture regarding union rate, union time, operation time, failure rate, and other complications.
Patients and methods
This study was conducted on 100 patients classified as a Weber B traumatic fracture. Fifty patients were undergoing open reduction internal fixation (ORIF) using locking plates (group A) and patients underwent ORIF using nonlocking plates (group B). The following parameters were assessed in both groups range of motion, union rate, union time, complications, operation time, American orthopedic foot and ankle society and failure rate.
Results
There was no statistically significant difference between both groups in operation time and blood loss. Length of hospital stays (days) and Time to full weight bearing, union time was lower in group A than group B. American orthopedic foot and ankle society was higher in group A than in group B. There was no statistically significant difference in range of motion (extension, flexion) between both groups. The rate of loosening of the distal screw and implant removal was higher in group B than in group A.
Conclusion
No statistically significant difference was found between both groups regarding functional, radiological outcomes, and complications in patients less than or equal to 60 years old. Therefore, one-third plate is preferred in a young age in terms of cost-effectiveness. In patients over 60 years old, using the locking plates yields better stability, and functional and radiological outcome than non-locking plates.

Keywords:
Danis Weber, distal fibula locked plate, nonlocked plate

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Introduction

Ankle fractures are one of the most commonly sustained orthopedic fractures affecting all ages. those fractures could result from a low injury trauma especially in elderly and osteoporotic patients up to high energy one in a younger patient [1,2].

The distal fibula fracture configuration differs according to the force resulting in the fracture where spiral fractures can occur during forced external rotation of a supinated ankle. Another mode of injury occurs during pronation of the foot (outward twisting of the foot) or direct trauma which usually results in a transverse fracture of the fibula above the level of syndesmosis [3].

Potts fractures of the ankle are the third most common fracture occurring in elderly patients, the incidence of this fracture is about 184 cases/100 000 people/year [4].

A vast population with ankle fractures are prone to complications especially if maltreated which can impact their quality of life significantly and lead to increased morbidity and mortality in the most severe cases [5,6].

Ankle fractures could be classified according to Danis Weber's classification according to the location of the fracture line relative to the syndesmosis on distal fibula fracture line localization relative to the syndesmosis. The fracture is classified as Weber type B if the fracture line is located at the same level of the syndesmosis [1].

The appropriate method of treatment depends on two factors: congruency of the tibiotalar joint and fracture stability examined with stress views. The fracture treatment goals are to restore joint congruency and to achieve stability of the ankle mortise [7]. Fixation by plate is the standard technique in surgical treatment either by locked or nonlocked plates [8].

In general, the locked plate offers a better offers better angular and axial stability of fractures due to its fixed angles construct which resists failure even in comminuted fractures or osteoporotic bones. Also, the locking plates decrease the periosteal compression, so that it does not interfere with the periosteal blood supply which could improve the rate of bone healing [9].

In the case of distal fibula fractures, the encouraging results of using the distal fibula locked plate leads to an increasing trend for using this type of plate over the conventional on third plate with lag screws [10].

Although the use of locking plates is considered a standard surgical approach for osteoporotic or short-end segment fractures, inconsistent data exist regarding the best type of fixation for distal fibula fracture as; either a nonlocking tubular or a locking pre-shaped anatomic plate for the distal fibular fractures [11].

Aim

To compare distal fibula locked plate to nonlocked plate for treatment of Danis Weber type B fracture regarding union rate, union time, operation time, failure rate, and other complications.

Patients and methods

Technical design

Setting of the study

This retrospective cohort study was carried out in the Orthopedic Surgery Department at Ain Shams University Hospitals, on 100 patients with Danis Weber type B fracture who underwent ORIF using distal fibula locked plate (group A, 50 patients) or non-locked plate (group B, 50 patients). All patients were treated by expert surgeons.

Sample size

The study was conducted on 100 patients diagnosed with distal fibula Danis Weber type 2 fractures presented to the Orthopedic Clinic. Half of the patients were being treated with a distal fibula locked plate (group A) and the other half was treated with a nonlocked plate (group B).

Method of patient collection

Subjects that will be included in the study should fulfill the following criteria:

Inclusion criteria

Patients with distal fibula fracture, classed as a Weber B fracture, ambulation before injury, traumatic fractures.

Exclusion criteria

Patients with open fractures, apart from grade I, patients with bilateral ankle fractures, patients with previous fracture of the involved limb, patients with peripheral arterial disease and/or leg ulceration before injury, patients who are unfit for anesthesia, patients with cognitive impairment, and pathological fractures.

Administrative design

Approval was obtained from the Faculty of Medicine Ain Shams University Research Ethics Committee (FMASUREC), and written informed consent were obtained from all patient parents.

Operational design

ON admission (Emergency Room)

This included patient assessment, patient counseling, Clinical evaluation (history, general examination, and local examination), radiological evaluation, and preoperative preparation of the patients: radiological evaluation: anteroposterior, Lateral, and mortise views radiography were applied for evaluation of the fracture pattern.

Informed consent

All patients were consented to the following: nature of the fracture and its degree and extent, the proposed surgery, preoperative investigations, details of the operative procedure, postoperative rehabilitation program and average time of this program, and the possible complications.

Operative technique

Patient mostly had spinal anesthesia and was put in the supine position, incision was made lateral slightly posterior over the lateral malleolus, and deep dissection was made carefully, reduction of the fracture could be made by a lag screw for plate insertion and fixation.

Postoperative

Patients were administered low molecular weight heparin for 4 weeks. After the surgery, the patient was placed in nonweight bearing slab 6 weeks, and then protected weight bearing was allowed. Full weight-bearing was initiated after 8 weeks or when the union was evident radiographically. At 6 weeks postsurgery, the patients started physiotherapy.

Outcome

The following parameters were assessed in both groups: range of motion, union rate, union time, complications, operation time, failure rate, and functional outcomes using American orthopedic foot and ankle society (AOFAS) reduction accuracy was classified as good, fair, or poor according to Lee *et al*. (good: no fibula shortening, posterior displacement < 2 mm, and <1 mm increase in the medial clear space; fair: fibula shortening ≤2 mm, 2–4 mm posterior displacement, and 1–3 mm increase in the medial clear space; poor: fibula shortening > 2 mm, posterior displacement >4 mm, and >3 mm increase in the medial clear space) [12]. Range of motion measured by goniometry and alignment determined through clinical examinations was retrieved. Union rate is defined as the average time to bone union (set at 6 months, delayed union comprises fixation between 6 and 9 months, and nonunion diagnosed after 9 months). The criteria for bony union is defined as the presence of a bridging bone in 3 out of 4 cortices on two orthogonal radiography images and full weight bearing without pain.

The American orthopedic foot and ankle society score (AOFAS)

Functional outcomes were assessed according to AOFAS scoring system. Clinical and radiological findings with the ankle-hind foot score (AOFAS). The AOFAS score has a maximum value of 100 points (50 points for function, 40 for pain, and 10 for alignment). AOFAS scale classified as excellent from 90 to 100 points; good from 75 to 89 points; fair from 50 to 74 points and poor less than 50 [13].

Statistical analysis

Statistical analysis was performed using SPSS version 28. Continuous data describe as mean, and standard deviation. Categorical data is described as number and frequency. Independent-sample *T* test used for comparing continuous data. χ^2 was used for comparing categorical data.

Results

This retrospective study included 100 patients with Danis weber B distal fibula fracture, from them 50 patients underwent ORIF using locking plates (group A) and 50 patients underwent ORIF using nonlocking plates (group B). The mean age in group A was 53.2 years old and 52.2 years old in group B. 54.0% in group A were males and 60.0% in group B were female. Regarding comorbidities, 20% in group A had hypertension and 10% had diabetes. 30% in group B had hypertension and 20% were diabetic patients. 36.0% of patients in group A and 40% in group B suffered from osteoporosis. There was no statistically significant difference between both groups regarding socio-demographic parameters (Table 1).

The fracture was caused by a high energy mechanism in the majority of included patients in both groups. Approximately, 65.0% had right distal fibula fracture. The fractures were unimalleolar in 60.0% and 50.0% of group A and group B, respectively. There was no statistically significant difference between both groups regarding fracture pattern (Table 2).

Regarding operative properties, there were no statistically significant difference between both groups in operation time, blood loss, and length of hospital stay (P>0.05). Reduction accuracy was good in the majority of included patients (Table 3).

Table 1 Socio-demographic parameters of included patients in both groups

	Group A	Group B	*P* value
Age	63.2 ± 8.0	62.5 ± 7.6	0.654
BMI	26.7 ± 3.2	26.1 ± 3.1	0.344
Sex			
Male	27 (54.0%)	20 (40.0%)	0.229
Female	23 (46.0%)	30 (60.0%)	
Osteoporosis	18 (36.0%)	20 (40.0%)	0.418
Comorbidities			
DM	5 (10.0%)	10 (20.0%)	0.196
Hypertension	10 (20.0%)	15 (30.0%)	
Renal diseases	5 (10.0%)	5 (10.0%)	

Independent samples *t*-test; Chi-square test

Table 2 Pattern of Fracture in both groups

	Total	Group A	Group B	X2	*P* value
Mechanism of Fracture					
High energy	75 (75.0%)	35 (70.0%)	40 (80.0%)	1.33	0.356
Low energy	25 (25.0%)	15 (30.0%)	10 (20.0%)		
Side of fracture					
Right	65 (65.0%)	30 (60.0%)	35 (70.0%)	1.099	0.402
Left	35 (35.0%)	20 (40.0%)	15 (30.0%)		
Fracture type					
Unimalleolar	55 (55.0%)	30 (60.0%)	25 (50.0%)	2.12	0.361
Bimalleolar	30 (30.0%)	15 (30.0%)	15 (30.0%)		
Trimalleolar	15 (15.0%)	5 (10.0%)	10 (20.0%)		

Chi-square test.

Time to full weight bearing was 2.1 ± 0.4 weeks, 2.3 ± 0.3 weeks in group A and group B, respectively. AOFAS were higher in group A than in group B (*P*=0.005). There was no statistically significant difference in range of motion (extension, flexion) between both groups (Table 4).

There were no significant differences between group A and group B. Both groups had a similar union time (group A: 1.7 ± 0.7 weeks, group B: 1.8 ± 0.3 weeks) and a 100% union rate (*P*>0.05) (Table 5).

Table 3 Operative properties and postoperative hospital stay

	Group A	Group B	*P* value
Operative time (min)	93.7 ± 10.7	91.2 ± 7.8	0.185
Blood loss (ml)	73.7 ± 8.8	75.8 ± 12.9	0.343
Length of hospital stays (days)	1.3 ± 0.4	1.4 ± 0.3	0.428
Accuracy of reduction			
Good	48 (96.0%)	44 (88.0%)	0.296
Fair	2 (4.0%)	6 (12.0%)	

Independent samples *t*-test; Chi-square test.

Table 4 Functional outcome after both techniques

	Group A	Group B	*P* value
Time to full weight bearing (weeks)	2.1 ± 0.4	2.3 ± 0.3	0.264
AOFAS	85.4 ± 5.6	79 ± 10.3	**0.005**
Extension	22.08 ± 1.7	22.18 ± 1.55	0.748
Flexion	38.34 ± 2.26	38.3 ± 2.24	0.929

Independent samples *t*-test.

Table 5 Radiological outcome

	Group A	Group B	*P* value
Union time (weeks)	1.7 ± 0.7	1.8 ± 0.3	**0.461**
Union rate (%)	50 (100%)	50 (100%)	1.0

Independent samples *t*-test; Chi-square test.

Table 6 Loss of reduction and implant failure

	Group A	Group B	*P* value
Proximal screw loosening	0	2 (6.0%)	0.242
Distal screw loosening	0	4 (8.0%)	0.124
Implant removal	3 (6.0%)	10 (20.0%)	0.012
Implant failure	1 (2.0%)	3 (6.0%)	0.617

Chi-square test, exact fisher test.

Comparing loss of reduction and implant-related issues between group A and group B, there are notable differences. Group B had higher rates of distal screw loosening (8% vs. 0%), implant removal (20% vs. 6%), proximal screw loosening (6.0% vs. 0%) and implant failure (6.0% vs. 2.0%) compared with group A (Table 6).

In patients less than or equal to 60 years old, there were no statistically significant difference between both groups regarding AOFAS, union time, range of motion, and final distal fibula length.

In patients greater than 60 years old, postoperative AOFAS was higher in group A than in group B. Union time was lower in group A than in group B. Full weight bearing was lower in group A than in group B in patients over 60 years old (Table 7).

Regarding age of patients, there were no statistically significant differences between both techniques in the percentage of implant failure, fibula shortening, distal screw loosening, and complications in patients less than or equal to 60 years old. However, in patients over 60 years old, the percentage of postoperative fibula shortening and distal screw loosening were higher in group B than in group A (Table 8).

Discussion

After hip and wrist fractures, ankle fractures are the third most prevalent type of fracture in the elderly, with an annual incidence of 184 for every 100 000 people. By 2050, these injuries are estimated to grow by 25%, making them routine in the offices of most orthopedic specialists [14].

Osteoporosis makes internal fixation techniques more difficult and prone to failure, making ankle fracture treatment more complicated. The locking plate technique was developed to prevent surgical problems like osteoporosis [4,15].

Conventional nonlocking plates, such as one-third tubular plates or dynamic compression plates, can

Table 7 Classification for radiological and functional outcomes regarding the age in both groups

	Less than or equal to 60 years			Greater than 60 years		
	Group A	Group B	*P* value	Group A	Group B	*P* value
AOFAS	89.50 ± 1.15	88.85 ± 1.6	0.674	82.67 ± 5.74	74 ± 10.59	0.002
Union time	1.4 ± 0.2	1.5 ± 0.3	0.856	1.6 ± 0.41	2.2 ± 0.23	0.001
Full weight bearing	1.8 ± 0.44	1.9 ± 0.12	0.784	2.1 ± 0.23	2.9 ± 0.37	<0.001
Extension	22.76 ± 1.57	22.05 ± 1.2	0.921	22.10 ± 1.56	22.27 ± 1.55	0.681
Flexion	38.35 ± 2.32	38.25 ± 2.29	0.892	38.33 ± 2.25	39.33 ± 2.7	0.921

MD: mean difference; independent samples *t*-test.

Table 8 Loss of reduction and complications in both groups regarding the age

	Less than or equal to 60 years			Greater than 60 years		
	Group A (*n*=20)	Group B (*n*=20)	*P* value	Group A (*n*=30)	Group B (*n*=30)	*P* value
Implant failure	1 (5%)	0	0.311	0	3 (10.0%)	0.076
Fibula shortening	1 (5.0%)	0	0.311	6 (20.0%)	21 (70%)	**<0.001**
Proximal screw loosening	0	0	–	0	3 (10%)	0.076
Distal screw loosening	0	2 (10%)	0.147	0	11 (36.7%)	**<0.001**
Complications						
Delayed wound healing	1 (5.0%)	2 (10%)	0.448	0	3 (10%)	0.112
Superficial infection	1 (5.0%)	3 (15%)		1 (3.3%)	0	

be utilized in the process of plate osteosynthesis. However, plate osteosynthesis can also be performed with the assistance of a variety of locking plates that were developed at a later time. Some examples of these locking plates include locking compression plates and anatomical locking compression plates [16]. As a result, we decided to conduct this study to compare the outcomes of ORIFs performed with locking plates with those performed with non-locking plates for the treatment of Weber-Danis B distal fibula fractures.

In our study, we enrolled 100 patients with Danis weber B distal fibula fracture in a retrospective study, we divided them into two groups.

Group A is 50 patients who underwent ORIF using locking plates.

Group B is 50 patients who underwent ORIF using nonlocking plates.

Regarding Socio-demographics, previous studies mostly focused on age, sex, and osteoporotic condition of patients but in our study, we took into consideration the comorbidities of patients as our mean age of included persons was 62.5 years old. Regarding comorbidities, 20% in group A had hypertension and 10% had diabetes. 30% in group B had hypertension and 20% were diabetic patients. 36.0% of patients in group A and 40% in group B suffered from osteoporosis. The majority of included patients had Unimalleolar fractures. The fracture caused by high-energy mechanism in the majority of included cases in both groups.

Regarding operative properties, there were no statistically change among the groups in operation time and blood loss (*P* over 0.05) and length of hospital stays. Reduction accuracy was good in the majority of included patients. Time to full weight bearing were lesser in locking plate group than nonlocking plate group. About functional outcome, the group using locking plates had a higher AOFAS score than the group using non-locking plates. When comparing the two groups' ranges of motion (extension and flexion), the results showed no discernible statistical distinction. The group that had the locking plate had a longer distal fibula after surgery than the group that did not have the locking plate. The group using locking plates had faster union times than the group using nonlocking plates.

Regarding loss of reduction and complications, our investigation found that distal screw loosening increased in the nonlocking plate group compared with the locking plate group (*P* under 0.05). Implant failure was not statistically distinct across groups. In terms of postoperative complications, neither group differed significantly from the other.

Shih *et al.* [17], enrolled 72 patients over 50 years old with the Arbeitsgemeinschaft für Osteosynthesefragen/Orthopedic Trauma Association (AO/OTA) 44 B lateral malleolar fractures, from them, 34 patients were treated with locking plates, and 38 patients were treated with nonlocking plates, the fracture was caused by high energy mechanism in the majority of included cases, noticed a significant disparity in foot and ankle outcome score (FAOS) in favor of locking plates). The fractures have all healed successfully. In comparison with the nonlocked plate group, the patient treated by the locked plates group showed considerably lower rates of distal screw loosening, fibula shortening of more than 2 mm, as well as higher FAOSs.

Targeted older patients who confirmed hardware removals. The locking group removed 6 hardware (17.65%) as well as the nonlocking group 16 (42.11%), a statistically significant variance (*P*=0.039).

Comparing with our study we additionally considered comorbidities in sociodemographic, there was compatible mode of trauma, our study shows also higher FAOS with using locking plates, regarding

complication postoperative fibula shortening mal reduction is greater in TP and distal screw loosening was higher in nonlocking plates than locking plates in more patients.

A retrospective cohort trial by Schepers *et al.* [18], on 165 persons received a one-third tubular plate and 40 cases were treated with a locking plate. The mean age of the included participants was 48.2 years old. The majority on included patients suffered from unimalleolar, Danis weber B distal fibula. It concluded that there more wound complications with locking plates than with conventional plates.

It also only considered mean age, osteoporosis, unlike our study that took into consideration more comorbidities. Our study revealed insignificant differences between both plates in wound complications.

Herrera-Perez *et al.* [4] demonstrated insignificant variations in AOFAS scores or average time to union in osteoporotic individuals over the age of 64 who were treated with either locking or nonlocking TPs. On the other hand, the time to weight bearing was dramatically reduced in the group that had their TP locked. As a result, they suggested that locking plates might provide additional advantages in situations where it is necessary to consider both the length of immobility as well as the risk of simultaneous harm to soft tissue.

Bone-specific locking compression distal fibula plates are an addition to the portfolio of implants that are accessible, even though their cost is greater than six times that of a typical fibula fixation construct (implant cost). These plates are handy for unstable fractures with low bone quality [19].

In Huang *et al.* [20], study, scores on the AOFAS were significantly higher for the locking plates (locking group: 88.4 ± 6.9, nonlocking group: 84.0 ± 6.2, *P*=0.002) in favor of the locking plates.

Our study matches Huang *et al.* [20], study that AOFAS is superior in locking plates but not match Herrera-Perez *et al.* [4] in that matter but we supported Herrera-Perez *et al.* [4] as weight bearing time is dramatically reduced in locking plates.

In Zahn *et al.* [21], study has shown that operative fixation can be more difficult for individuals with osteoporosis or more distal fibular fractures due to inadequate screw purchase. Combining the concepts of dynamic compression with internal fixation via locking screws is made possible by locking plates. Locking plates seem preferable from a biomechanical stability standpoint due to these added benefits. As a result, it appears that patients who benefit most from the biomechanical advantages of locking plates are those who [21]. And our study is compatible with them in that the locking plate is superior in biomechanical stability terms.

The trial by Tsukada *et al.* [22], was a controlled, randomized study with union rate as the 1^{ry} goal, which did not identify any statistically significant variations among locking plates as well as nonlocking plates after three months (*P*=0.22), a period of 6 months (*P*=0.18), or twelve months (*P*=0.47), According to the results of our research. The diamond concept provides a conceptual framework for an effective bone repair response. One of the fundamental variables in bone healing is mechanical stability, which is one of the components of this framework.

In Sop *et al.* [23] retrospective study, 8.6% of the individuals who were included in the study had their devices removed. A larger proportion of participants in the nonlocked 1/3 tubular plate group compared with locking plates, but the distinction was not statistically significant [23]. Their findings need to be interpreted with caution because individuals who were included in the locking plate group were significantly older than those who were included in the nonlocking plate group, and they failed to provide the total number of osteoporotic patients.

In terms of operative revision, no distinction could be considered statistically significant among the two groups. One was identified in the group with the contoured locking plate, while four were discovered in the group with the one-third tubular plate (*P*=0.610) [24].

A recent systematic review and meta-analysis of eleven trials found no variation in complications or device removals [25].

Overall as well as wound complication rates were similar for nonlocking and locking plates (13.5% vs. 15.4%, *P*=0.76) along with 3.97 versus 3.85%, *P*=1.00 [26]. No change was detected in the amount of complications in older persons [24].

Which is compatible with our study

So in participants not above 60 years old, there was no statistically significant distinction in functional, radiological, or complication results across the two groups. Postoperative AOFAS scores were greater in

group A compared with group B among persons aged 60 and up. Group A had a shorter union time than group B. In people who were over 60 years old, the distal fibula was longer at the end of treatment in group A than in group B. In group B, patients were more likely to experience fibula shortening and distal screw loosening after surgery.

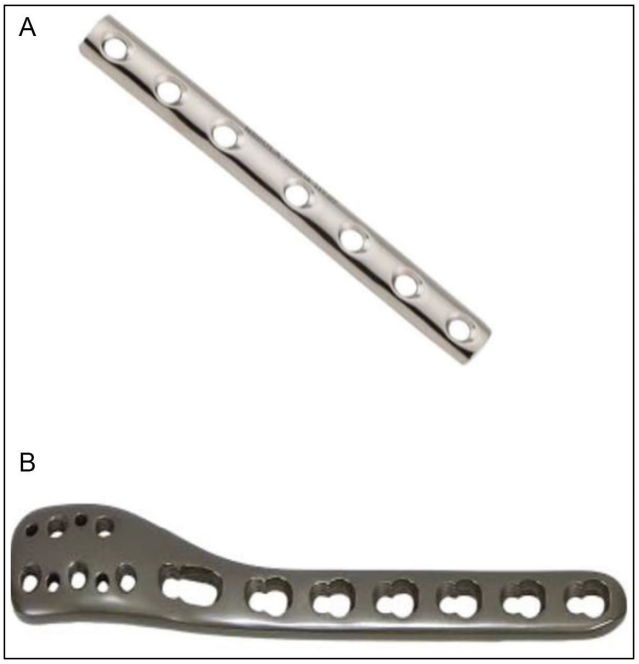
Because of the higher prevalence of osteoporosis among the elderly, locking plates are viewed as particularly useful in this population [27]. There is some evidence that locking plates may increase biomechanical stability, particularly in osteoporotic bone. For the most secure osteosynthesis, orthopedic trauma surgeons frequently employ locking plates in elderly individuals [16]. Therefore we concluded that no significant difference between locking and nonlocking plates in population not above 60 year's old so nonlocking plate is preferred in terms of cost-effectiveness but in populations over 60 locking plates give superior results because of the high prevalence of osteoporosis.

Finally, given the small sample size of this investigation, future high-quality randomized controlled trials may be required to corroborate these results.

Conclusion

There were no statistically significant differences between both groups regarding functional, radiological outcomes, and complications in patients less than or equal to 60 years old. Therefore, one-third plate is preferred in young age in terms of cost-effectiveness. While, in patients over 60 years old, treatment of Danis Weber type B distal fibula fracture with ORIF using locking plates caused better stability, and functional and radiological outcomese than nonlocking plates. Locking plate group caused higher AOFAS and postoperative length of the distal fibula and lower union time, time to full weight bearing, percentage of implant removal, loosening of the distal screw, and distal fibula shortening (2 mm) than nonlocking plates. Therefore, a locking plate is preferred in patients over 60 years old (Figs 1–3).

Figure 1



Articles' algorithm selection according to PRISMA guidelines. Figure 1(a) one third plate. Figure 1(b) Distal fibula locked plate

Figure 2

(a) One third plate postoperative radiography. Figure 2 (b) Distal fibula locked plate postoperative radiography.

Figure 3

AOFAS Ankle-Hindfoot Scale

Patient Name: _____
Patient MRN: _____
Date: _____

I. Pain (40 points)

☐ None	+40
☐ Mild, occasional	+30
☐ Moderate, daily	+20
☐ Severe, almost always present	+0

II. Function (50 points)

Activity limitations, support requirements

☐ No limitations, no support	+10
☐ No limitation of daily activities, limitations of recreational activities, no support	+7
☐ Limited daily and recreational activities, cane	+4
☐ Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	+0

Maximum walking distance, blocks

☐ Greater than six	+5
☐ Four-six	+4
☐ One-three	+2
☐ Less than one	+0

Walking surfaces

☐ No difficulty on any surface	+5
☐ Some difficulty on uneven terrain, stairs, inclines, ladders	+3
☐ Severe difficulty on uneven terrain, stairs, inclines, ladders	+0

Gait abnormality

☐ None, slight	+8
☐ Obvious	+4
☐ Marked	+0

Sagittal motion (flexion plus extension)

☐ Normal or mild restriction (30° or more)	+8
☐ Moderate restriction (15° - 29°)	+4
☐ Severe restriction (less than 15°)	+0

Hindfoot motion (inversion plus eversion)

☐ Normal or mild restriction (75% - 100% normal)	+6
☐ Moderate restriction (25% - 74% normal)	+3
☐ Marked restriction (less than 25% of normal)	+0

Ankle-hindfoot stability (anteroposterior, varus-valgus)

☐ Stable	+8
☐ Definitely unstable	+0

III. Alignment (10 points)

☐ Good, plantigrade foot, ankle-hindfoot well aligned	+10
☐ Fair, plantigrade foot, some degree of ankle-hindfoot malalignment observed, no symptoms	+5
☐ Poor, nonplantigrade foot, severe malalignment, symptoms	+0

IV. Total Score (100 points):

_____ Pain Points +
_____ Function Points +
_____ Alignment Points =

_____ Total Points/100 points

American orthopedic foot and ankle society scoring system adopted by D'souza [28].

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Conflicts of interest
No conflict of interest.

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