

Percutaneous Intramedullary Fixation of Distal Fibular Fractures

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Abstract

Background: Ankle It is frequently necessary to have surgery in order to get the best possible recovery from fractures, especially lateral malleolar fractures. The purpose of this research was to assess the clinical and radiological outcomes of percutaneous intramedullary screw treatment of lateral malleolar ankle fractures in the early stages. The method was to use intramedullary screws for percutaneous fixation in 25 patients who had lateral malleolar ankle fractures, whether the fractures included the medial or lateral malleoli. Preoperative evaluations were thorough, surgical procedures included closed reduction and screw fixation, and postoperative care was standardised. Complication monitoring, functional grading systems, and radiographic evaluations were all included of the follow-up examinations. The patients' average age was 39.84 ± 8.84 years, and there were 44% females and 56% men. Syndesmotic injuries were present in 32% of patients, whereas transverse fractures accounted for 76% of all fractures. According to McLennan and Ungersma criteria, 96% of patients showed satisfactory decrease in postoperative radiographic examination. In 88% of instances, union was reached within an average of 9.88 ± 1.657 weeks, 8% had malunion, and 4% did not achieve union. The average functional outcome scores, which include AOFAS and modified Olerud and Molander scores, were 85.72 ± 10.13 and 81.24 ± 9.22 , respectively. There were little complications; 8% had superficial infections and 12% reported discomfort after the operation. Clinical results, stability, union, and complication rates were all positively affected by percutaneous intramedullary fixation of distal fibular fractures with intramedullary screws.

Keywords: Ankle Breaks; Percutaneous; Intramedullary Screw Fixation; Radiological Assessment; Functional Results.

Introduction:

The At the ankle joint, the talus, distal fibula, and distal tibia all articulate. The ankle mortise, which houses the talus bone, is formed by the articular parts of the distal tibia and fibula coming together. The three malleoli that support this joint are the lateral (at the fibula's distal end), medial (at the tibia's medial lower end), and posterior (at the joint's posterior) malleolus (1).

The ankle mortise articulates with the talus body to provide support to the ankle joint. The key to a full recovery from an ankle fracture is keeping everything in its proper place. It is well acknowledged that in order to avoid or postpone the development of ankle joint arthritis after such injuries, it is crucial to achieve anatomical reduction by tight fixation (2).

Fractures of the ankle may range from very small injuries caused by simple twists in elderly or otherwise fragile patients to more serious ones caused by high-energy trauma in younger people. A synovial hinge, the ankle joint allows for mostly unidirectional motion (dorsiflexion and plantarflexion) (3).

Patients who do not need surgical intervention for their ankle fractures and have a stable fracture have a great prognosis. Within 6 to 8 weeks after the injury, they may progressively recover the ability to bear weight and perform near to their pre-injury level of function. On the

other hand, the current gold standard for treating unstable fractures is open reduction and internal fixation (ORIF) using screws and plates (4).

Minimally invasive methods, such as intramedullary fixation, have been developed in response to concerns over serious wound consequences. Concerns concerning hardware migration have hampered the utilisation of newly emerging procedures, such as intramedullary fixation with Rush rods and Steinmann pins (5, 6).

There has been some investigation into using cancellous screws alone to treat Weber A fibula fractures. These fixation devices, nevertheless, may let the distal fragment to rotate, much like smooth pins. Complete functional recovery may take more time, however full weight-bearing may happen as soon as 6 to 8 weeks after ORIF for patients with unstable fractures. Even after morphological reduction and solid fixation, about 14% of ankle fractures will develop post-traumatic arthritis, perhaps as a result of chondral damage (7, 8).

The researchers set out to see how percutaneous fixation with an intramedullary screw fared in terms of early radiological and clinical outcomes for lateral malleolar ankle fractures.

Patients and methods:

Patients:

This The research included 25 individuals chosen at random who meet the criteria for

surgical repair of lateral malleolar ankle fractures, whether they also had medial malleolar ankle fractures or not. Taking place from October 2022 to September 2023, the research was carried out in the Orthopedic Surgery Department at Benha University Hospital.

We made sure to get patients' written informed permission. An explanation of the study's goal and a secret code number were given to each subject. The Research Ethics Committee at Benha University's Faculty of Medicine gave its approval before the research could begin.

Inclusion criteria were a transverse or short oblique fibular fracture pattern and a history of trauma-related lateral malleolus fractures (Weber A or B type).

Patients with immature skeletons, those with lengthy spiral or segmental fracture patterns, and those with previous fractures in the same limb that may have an impact on functional outcome were not eligible.

Methods:

All Before surgery, patients had X-rays of the ankle joints taken from all angles (anteroposterior, lateral, and mortise), as well as a complete medical history and physical examination (including both general and local evaluations). A closed percutaneous cancellous screw was used in the treatment. Cannulated screw fixation of the lateral malleolus, often in conjunction with fixation of the medial malleolus. Participants gave their verbal and written agreement to participate in the trial, receive therapy, and return for a 12-month follow-up before the operation. Personal details (name, age, sex, occupation, address, phone number), relevant health habits, co-morbidities (such as diabetes, hypertension, heart conditions, renal problems), details about the injury's cause, side affected, results of physical examination, lab tests, and radiological evaluations with their respective labels were all part of the recorded data.

Medical history, physical exam, investigations, consent, and imaging were all part of the evaluation process.

The preoperative examination was thorough and included a thorough patient history that included the following: age, profession, leg dominance, characteristics of the trauma, time between the incident and surgery, and any relevant habits or chronic diseases. As part of the physical examination, the patient's legs were examined for typical symptoms such as skin condition, deformities, edoema, and range of motion (both active and passive). The patient's neurovascular

state and any related muscle or tendon injuries were also evaluated. Preoperative laboratory testing included a full blood count, coagulation profile, evaluations of liver and kidney function, and X-rays (both frontal and side views) to identify the location, extent to which the joint was involved, the shape of the fracture, and any other related fractures.

Second, perioperative care, or surgical procedure Both spinal and general anaesthesia were used for the surgery, and a single dosage of a first-generation cephalosporin prophylactic antibiotic was given before the operation. The surgical procedure required the patient to lie face down. We treated medial, posterior malleolus, and distal tibia fractures after distal fibula fixation. A stab incision was done at the level of the fracture when closed reduction was unsuccessful. A tiny Weber clamp was used to percutaneously decrease the fibula until it was in the correct place, which was then validated using an image intensifier.

The use of image intensification was important in accomplishing and validating closed reduction from various angles. The use of a guide wire allowed for the maintenance of fracture reduction. After the intramedullary wire insertion was confirmed, a 5-mm skin incision was made around 1 cm distal to the tip of the fibula. An appropriate cannulated drill was used to access the cortex, and then an intramedullary screw with a washer was inserted.

Depending on the breadth of the medullary bone, a self-tapping bone screw (either 4.5 mm or 6.5 mm) made of cancellous, cannulated stainless steel alloy was usually used. With careful calculation, the length of the screw was chosen, guaranteeing sufficient grip on the proximal fragment while avoiding protrusion through the medial fibular cortex.

In order to facilitate early weight-bearing after six weeks, a posterior slab was put above the knee for four weeks after surgery. During slab immobilisation, patients were given low-molecular-weight heparin.

The quality of distal fibula reduction was assessed according to the following criteria: No fibula shortening, less than 2 mm of posterior displacement, and less than 1 mm of increase in the medial clear space were indicators of good reduction. An acceptable reduction would include a 2 mm fibula shortening, a 2 to 4 mm posterior displacement, and a 1 to 3 mm increase in the medial free space (MCS). Subpar reduction was defined as a fibula shortening of more than 2 mm, a posterior displacement of

more than 4 mm, and an increase in the medial clear space of more than 3 mm.

Thirdly, Rehabilitation and Post-Operative Care

As part of postoperative care, patients were given antibiotics, analgesics, and medications to reduce swelling. During the first week after surgery, patients were seen for wound care and reassurance at a two-week interval, and then every two weeks for the first six months.

The patients were instructed to remain non-weightbearing until the four-week postoperative visit, and at the two-week mark, they were equipped with a short (below-knee) slab. Patients were instructed to start weight-bearing as soon as they were able to do so and to switch to a controlled ankle motion boot four to six weeks after surgery.

The non-weightbearing phase might be prolonged by 2 to 6 weeks if there are concerns about fracture or syndesmotom healing, diabetes complications, or patient mobility. The treating surgeons checked the patient's wounds, neurovascular condition, pain, and range of motion at each follow-up appointment.

Evaluation Procedures: At each subsequent appointment, radiographs were captured of the ankle from all angles, including the anterior, posterior, and mortise views. The treating surgeon and a musculoskeletal radiologist reviewed the data separately, and researchers who were not engaged in patient care reviewed it as well. The radiographs were examined for signs of fixation failure, fracture line, and maintenance of reduction.

The AOFAS grading system was used to evaluate functional results and discomfort at the 3-month period. The findings were classified as Excellent (>84), Very Good (83-75), Good (74-62), Fair (61-57), or Poor (<57) according to the American Orthopedic Foot and Ankle Society (AOFAS) criteria.

Approval code:

Statistical analysis

The data was input into the Statistical Package for the Social Sciences (IBM SPSS) version 23 once it had been edited, coded, and gathered. For parametric data, medians with interquartile ranges (IQR) were used to display quantitative information; for non-parametric data, standard deviations, ranges, and means were used. Numbers and percentages were used to represent the qualitative characteristics.

Results:

This Twenty-five patients who were eligible for surgical treatment for lateral malleolar ankle fractures were included in the research. These

patients might have medial malleolar involvement or not. In all groups that were evaluated, the average age was 39.84 ± 8.84 years, taking into account both demographics and medical problems. Eleven women (44.0%) and fourteen men (56.0%) made up the sample population under investigation. Eighteen patients, or 72% of the total, had active job types, whereas seven patients, or 28%, had non-active work types. No smokers were found among the patients; eight of them (32.0%) were smokers and seventeen (68%) were not. When it came to co-morbidities, four patients (16%) had diabetes mellitus (DM), and four more (16%) had hypertension (HTN). Nine patients, or 36% of the total, had right-sided leg fractures, whereas sixteen patients, or 64% of the total, suffered left-sided leg fractures. Seven patients (28 percent) in the research group had fractures as a result of twisting, four patients (16 percent) as a result of falls, and fourteen patients (56 percent) as a result of motorcycle accidents. List 1

Regarding fracture characteristics, eight patients in the study group had syndesmotom damage, and eight patients (or 76% of the total) had transverse fractures (32 percent). Comminuted fractures were also seen in four individuals (16 percent). The patients were all delayed until the posttraumatic edoema cleared up, which usually happened in the second week, with an average delay of 10.39 ± 2.17 days, as shown in Table 2. The total amount of time required for the operation in the group that was evaluated ranged from 25 to 50 minutes, with an average of 33.8 ± 5.52 minutes. Using plain digital X-rays taken after surgery, the assessment was carried out according to the criteria set forth by McLennan and Ungersma Radiographics. Only one patient (four percent) had fair outcomes out of the twenty-four that were evaluated.

A total of around six months of follow-up was required in the whole study population. On average, the duration of union for all patients was 9.88 ± 1.657 weeks. Complete union occurred in 22 patients (88 percent), whereas one patient reported nonunion, and 2 patients (8 percent) exhibited symptoms of malunion. Table 3:

An average AOFAS score of 85.72 ± 10.13 in was recorded. Seventeen individuals, or 68% of the total, demonstrated The outcomes were excellent in two cases (8%), very good in another, and good in a third. In Figure 1, the mean score for the complete group that was investigated, which ranged from 60 to 92, using

the modified Olerud and Molander ankle scoring system was 81.24 ± 9.22 . Thirteen patients (or 52% of the total) shown outstanding outcomes, six (24% of the total) demonstrated acceptable outcomes, and three (12%) demonstrated fair outcomes. As shown in Figure 2, out of the total number of patients included in the study, 2 (or 8%), had issues related to superficial infections. Additionally, 3 patients reported experiencing discomfort in the ankle or surrounding areas (12 percent). Presentation of the case (Table 4):

First, we have a male communication engineer, age 27, who was hurt playing football and ended up in the emergency room with injuries to his right lower leg. After the collision, he had acute, continuous pain in his right ankle and leg, as well as widespread swelling around his foot and ankle. Aside from a right ankle X-ray showing a lateral malleolus fracture, his medical and surgical history were ordinary. The findings of a systemic general examination and trauma evaluation were normal. After a thorough evaluation at the emergency room revealed no issues with the nervous system, blood vessels, or muscles and joints, a posterior slap was applied below the knee. A percutaneously placed partly serrated cannulated screw measuring 65 mm in length and 4.5 mm in diameter was inserted under fluoroscopic supervision following closed reduction three days later. A posterior slap was also applied below the knee during this procedure. Good fracture union, progressive decrease in edoema, and acceptable skin condition were seen at the 2, 4, and 6-week postoperative follow-up appointments. The slap was withdrawn after 4 weeks, which allowed the

patient to begin extending their ankles and partially bearing some of their body weight. Picture 3

In the second case, a female student, aged 24, went to the emergency room after suffering injuries to her right lower leg in a car accident. Immediately after the event, she felt widespread swelling around her ankle and foot in addition to intense, persistent pain in her right leg and ankle. Except for a bimalleolar ankle fracture seen in the right ankle X-ray, the patient's medical and surgical history was found to be unremarkable during the first examination, which included a trauma evaluation and a systemic general assessment. After a thorough evaluation at the emergency room revealed no more problems with the nervous system, blood vessels, or muscles, a posterior slap was applied below the knee. She had surgery two days later that included closed reduction and percutaneous fixation with the help of a 65mm long, 4.5mm diameter partially serrated cannulated screw that was guided by fluoroscopy. Two additional cannulated screws, each with a diameter of 4.5mm, were applied to the medial malleolus and below-knee posterior slap. Progressive fracture union, decreased edoema, and better skin condition were seen at the 2, 4, and 6-week postoperative follow-up appointments. Ankle range of motion beginning and partial weight-bearing were made possible when the slap was withdrawn after 4 weeks. At the 3- and 6-month follow-ups, the patient expressed her delight with the complete range of motion restoration in her ankle, which allowed her to easily continue her sports routines. **Figure 4**

Table (1) Output of relationship between two groups' demographic results

		All studied group
		No. = 25
Age	Mean \pm SD	39.84 \pm 8.84
	Range	22 – 55
Sex	Female	11 (44.0%)
	Male	14 (56.0%)
Occupation	Active	18 (72%)
	Sedentary	7 (28%)
Smoking	Yes	8(32.0%)
	No	17(68%)
DM	Yes	4(16%)
	No	21 (84%)
HTN	Yes	4(16%)
	No	21 (84%)
Previous operation	Yes	3 (12.0%)
	No	22 (88%)
Side	Right	9(36%)
	Left	16 (64%)
Dominance	Right	23 (92.0%)

Causes of the fracture	Left	2 (8.0%)
	Twisting	7 (28%)
	Fall	4 (16%)
	Motorcycle accident	14 (56%)

Dispersion of fracture characteristics among all groups examined (Table 2):

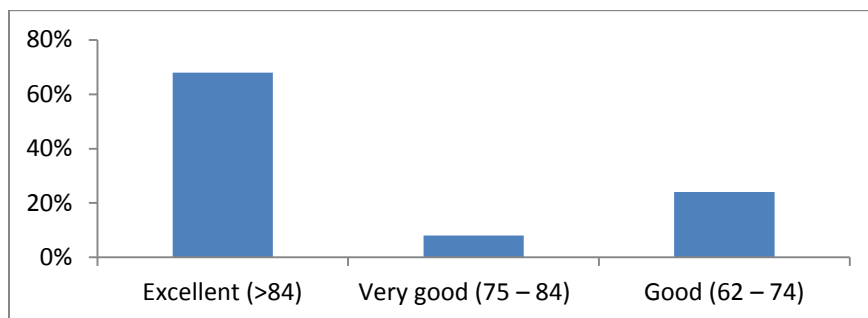
Fracure morphology	Transverse fracture	No. = 10
	oblique	18 (76%)
Syndesmosis	+ve	6 (24%)
	-ve	8 (32%)
		17 (68%)

The distribution of operational results in all groups evaluated is shown in Table 3.

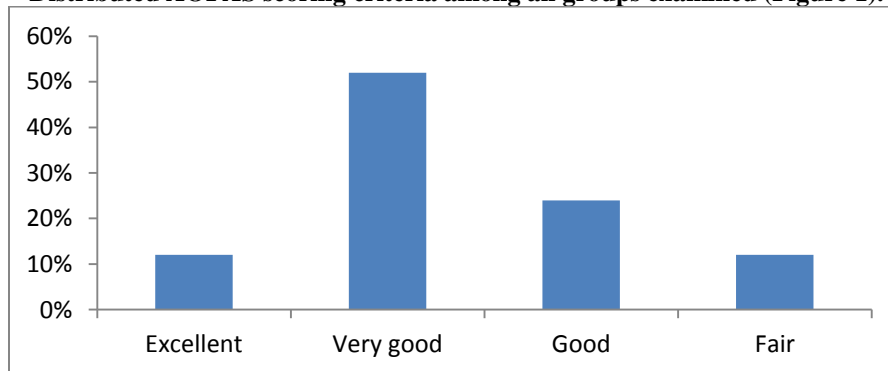
Follow-up, wk		All studied group
Time to bone union, wk	Mean ± SD	No. = 10
Complete Anatomic reduction	N	11.96 ± 1.03
Final outcome	Complete union	9.88 ± 1.657
	Malunion	22 (88%)
	Nonunion	22 (88%)
		2 (8%)
		1 (4%)

Table 4: Complications in All studied group

Total	Complications	All studied group
	Complicated	No. = 25
	Not complicated	5 (20%)
Superficial infection		20 (80%)
Ankle or regional pain		2 (8%)
		3 (12%)



Distributed AOFAS scoring criteria among all groups examined (Figure 1).



Distributed throughout all groups examined is the modified ankle scoring system based on Olerud and Molander criteria (Figure 2).

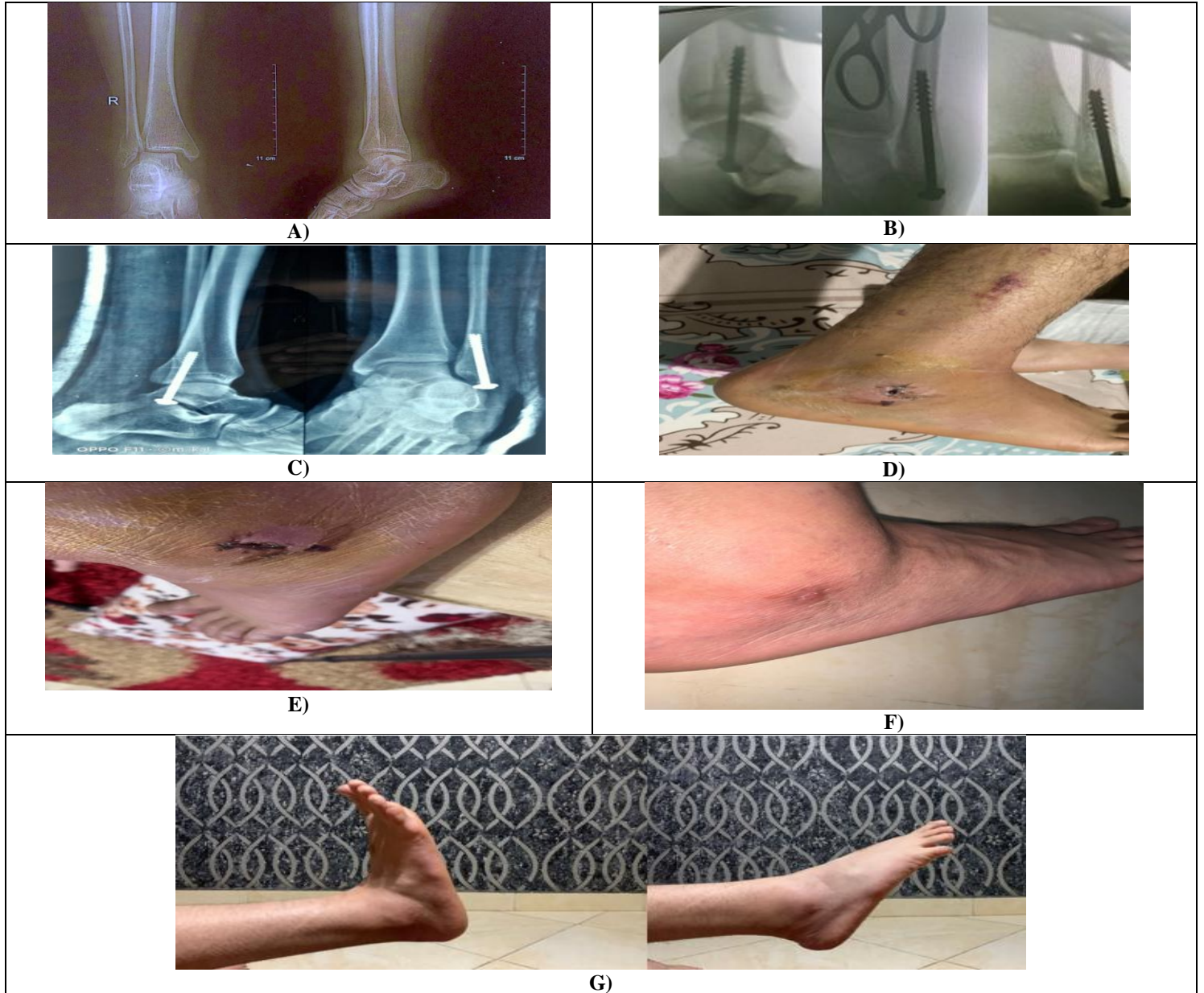


Figure 3: (A) Right ankle preoperative x-ray, (B) Imaging during surgery C) X-ray taken four weeks after surgery; D) pic taken two weeks after surgery revealing the skin entry incision; E) photo taken four weeks after surgery showing the removal of the flap; F) photo taken six weeks after surgery showing the healing of the skin entry wound; and G) photo taken eight weeks after surgery showing the ankle joint's nearly full range of motion.



A) Right ankle preoperative PXR (A), B) Right ankle immediately after surgery (C), D) Right ankle six weeks after surgery (D), and E) Right ankle range of motion six months after surgery (E), with the black arrow indicating the damaged side.

Discussion:

Ankle Of all the bone injuries seen in clinical practise, fractures are among the most prevalent. The prevalence of osteoporosis has grown, and the elderly are becoming more active, both of which contribute to their rising occurrence (9).

Transsyndesmotoc ankle fractures are the most common kind. The gold standard for surgically fixing these fractures is open reduction and internal fixation with a lag screw and neutralising plate (10). Unfortunately, up to 20% of fragile older patients have soft tissue problems as a result of this method's soft tissue dissection. Furthermore, symptomatic implants need further surgery in about 30% of instances. Anatomic reduction at the ankle and tibiofibular joints should be the goal of surgical fixation, with axial and rotational stability being ensured (11).

To tackle these problems, a number of less intrusive methods have been developed, such as intramedullary implants. Due to implant migration or distal fibula fragment rotation, subsequent displacement was common with initial intramedullary implants because they were smooth. Though implant prices have gone up, new developments with locked intramedullary implants have shown encouraging results (12).

Reducing fibula fractures with intramedullary screws was first done over a hundred years ago. Wound problems are less common since it is fast, safe, and easy to do, according to recent research (13).

Percutaneous fixation of lateral malleolar ankle fractures with an intramedullary screw was the subject of this research, which intended to assess the early radiological and clinical findings.

A total of 25 patients who were surgical candidates for lateral malleolar ankle fractures were included in the research.

From a demographic perspective, the average age of the participants was 39.84 ± 8.84 years, with 11 females making up 44.0 percent of the sample and 14 men making up 56.0 percent. Eighteen people, or 72 percent, were in actively employed, while seven people, or 28 percent, were in other occupations. Eight people (or 32 percent) smoked and seventeen people (or 68 percent) did not. Among the comorbidities, hypertension affected 16% and diabetes mellitus (DM) another 16%. (HTN). On the right side, 36% of the fractures were located, whereas on the left side, 64% were.

In terms of trauma causes, 28% of patients experienced twisting, 16% fell, and 56% were involved in motorcycle accidents. Syndesmotoc

damage affected 32% of patients and transverse fracture morphology 76%.

The patients were all delayed until their posttraumatic edoema resolved, which typically took around 10.39 ± 2.17 days. With an average of 33.8 ± 5.52 minutes, the operating duration varied from 25 to 50 minutes. After surgery, 96% of patients had excellent outcomes and 4% had fair results based on the McLennan and Ungersma criteria for radiographic assessment.

The average union time was 9.88 ± 1.657 weeks, and the follow-up period was around 12 weeks. Most injuries occurred as a result of falls and traffic accidents (50.0 percent) (16.7 percent). The vast majority of people (66.6 percent) were unharmed, whereas 33.3% were.

While 88% of patients experienced union, 8% exhibited signs of malunion, and 1% had nonunion. With an average AOFAS score of 85.72 ± 10.13 , 68% demonstrated outstanding outcomes, 8% shown very good results, and 24% demonstrated good results. Among the complications, 8% had a more advanced form of superficial infection and 12% complained of discomfort in the ankle or nearby areas.

The overall risk of wound infection with intramedullary screw fixation for fibula fractures is 0.6%, which is lower than the 4.6% risk with neutralising plates and lag screws, according to the research summary (14).

For successful ankle fracture treatment, it is essential to stabilise the lateral malleolus. Intramedullary fixation offers a number of benefits over other fixing procedures, including less soft tissue incision, less wound problems, and more mechanical stability (15).

By avoiding extensive cutting of soft tissues, intramedullary screw fixation lessens the likelihood of wound complications and the discomfort associated with hardware sites that are common in open procedures. In addition to preventing peroneal tendon injury and screw penetration into the ankle joint, this closed method is preferable to plate or lag screw fixation. It gets rid of the necessity for a tourniquet and shortens the duration of the surgery. Open reduction and internal fixing should be explored if an appropriate reduction is not obtained.

Conclusion:

Percutaneous There was a low complication rate, excellent stability, and successful union after intramedullary screw fixation of a distal fibular fracture.

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Contribution of the author

Everyone who wrote a word to the research had an equal say.

Potential biases

Absence of any potential bias

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