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Background: The aim of this study was to examine the performance of the plate system with screws while treating Fibula bone fracture.

Methods: This was a retrospective study in which 36 patients (27M and 9F) were treated for fibula bone fracture in M.O.H. Jeetoo Hospital between September 2020 to December 2021 with a mean follow up of 1 year (1month, 3 months, 6months and 12months). Radiological results at every follow up showed bone union and related complications. Physical fitness of the patients was examined by the American Society of Anesthesiologists grade and the pain intensity was analyzed by VAS scoring table.

Results: The gradually dropping in VAS score indicates positive results to pain management. Consistently, all patients received physiotherapy under physiotherapists. No patient complained of problems or hardware-related issues at the time of the last follow-up, and every patient had proper bone union. At a six-month follow-up, radiological results also indicated proper union.

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Clinical Outcomes of Fibula Bone Fracture Treatment with Fibula Plate Fixation with Screws: A Retrospective Study

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Conclusions: Complications risks are minimal with plate fixation for fibula bone fractures. Better outcomes and accuracy depend upon the surgical skills that can lead to reduced complications.

Keywords: fibula fracture, fibular fixation, distal fibula, management, treatment.

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I. INTRODUCTION

The Fibula (calf bone) is a long bone located on the lateral side of the tibia positioned in the lower leg. The fibula bone is much slender and smaller than the tibia. It starts at the knee joint, directly behind the tibial head, and runs down the lateral part of the leg until it reaches the ankle joint. The interosseous border is a ridge on the medial surface of the fibula that connects the fibula to the tibia via the interosseous membrane. This association is a syndesmotomic joint, which means it has a little tendency of movement.^{1,2} The primary function of the fibula is to give lateral support to the ankle joint and lower limb. It also articulates with talus and tibia that provides a wide range of movement during rotation of the ankle.

Fibula bone structure is around 390 millimeters (mm) (15.4 inches) in skeletally mature men and around 360 mm (14.2 inches) in skeletally mature women. Fibula bone can be classified into the Proximal end (consists of head and neck), shaft and distal end.³ The Proximal end (Upper Extremity) has a non-uniform quadrate structure, introducing over a Flattened articular surface, directed Forward, medial ward and upward, for articulation with a proportional surface on the lateral condyle of the tibia. The Fibular diaphysis (Shaft) lies distal to the neck and consists of three surfaces, lateral, medial, and posterior. The diaphysis shape is determined by muscle attachment. Originally, it's a triangular shape and distally becomes further irregular shaped. The distal portion of the fibula forms the lateral malleolus that articulates with the sidelong talus bone, making part of the lateral ankle. Whereas the posterior and medial malleolus are formed by lateral and posterior tibia, respectively.⁴

Fibula fractures are most commonly connected with an ankle injury, however they can also occur alone (without involving the ankle) or in combination with tibia fractures (e.g., in severe injuries). Fibular stress fractures are less common than tibial stress fractures, although they do happen, especially in long-distance runners. These fractures are not as serious as weight-bearing bone fractures because the fibula only supports 17% of the body weight.⁵ There are different types of fracture associated with fibula bone such as a break around the ankle (lateral malleolus fracture), break occurs near the knee (fibular head fracture), break occurs middle of the leg caused by direct contact (shaft fracture).

The common causes of fibula fractures can be partitioned into 2 classes based on injury mechanism as low energy and high energy. The low energy injuries include falls on the ground and sports injuries. Whereas motor vehicle injuries, people struck by cars, and gunshot wounds are examples of high-energy injuries.⁶ Mainly, patients suffering with fibula fracture are associated with various symptoms such as swelling, pain and other signs of fracture include bruising and tenderness, deformity in the lower part of the leg and numbness.

In the current retrospective study, we performed categorization of fractures using AO system classification, including VAS score to ensure the surgical treatment method for fibula bone fractures. Internal fixation and open or closed reduction have been recommended as viable therapies for this injury. Fibula fractures can be treated in a variety of ways. The surgeon who performed the surgery assessed the measurements of the bone plates.

II. METHODS AND MATERIALS

This retrospective study was held at M.O.H. Jeetoo Hospital Mauritius from September 2020 to December 2021. Patients treated with Fibula bone plate system, the following data was collected from the patients: Age, Sex, Weight, Implant type, side of fracture and date of surgery. This study comprised a total of 36 patients (27

males and 9 females) meeting the inclusion and exclusion criteria.

Inclusion criteria

Male and female patients with a fibula bone fracture who were above 18 years or skeletally mature were included in the study. Patients who were physically fit except for the Fracture region, had a healthy BMI, and were not susceptible to disease were included.

Exclusion criteria

The patients were restricted to the study if any of the following belows apply: age above the 75 years, Patient death during surgery, subjects habitual to consumption of alcohol or drugs, suffering from any chronic disease such as diabetes, neuromuscular disorder, hypertension, hypotension and allergic to metals can cause unacceptable risk of fixation failure during post-operative state.

The AO system classification was used to classify the fibula fractures, and these included: 4F3A, 4F3B, 4F2A and 4F2B. Out of 36 patients, 14 were assessed with 4F3A, 11 were assessed with 4F3B, 7 were assessed with 4F2A and 4 were assessed with 4F2B type of fractures were recorded. The fracture happens due to fall on ground (9), sports injury(16), motor vehicle injury (11).

ASA (American society of Anesthesiologist) was used to assess the patient's physical fitness prior to surgery. This system aims to evaluate and talk about a patient's medical co-morbidities before anesthesia. The visual analog scale (VAS) is a grading scale used to measure pain Intensity (Figure1). It is widely used in clinical studies to evaluate severity of pain. Pain scale parameters were recorded following VAS score on 1 month, 3 months, 6 months and 12 months.

0–10 Numeric Pain Rating Scale

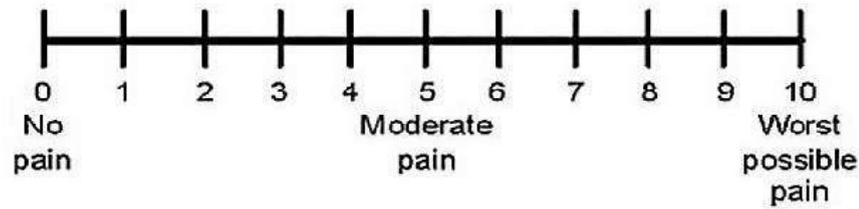


Figure 1: VAS Scoring

Materials

Fibula plate fixation with screws manufactured by Auxein Medical Private Limited, Sonipat, India, were used for Fibula bone union. Plate fixation with screws constitute titanium as per ISO 5832-3 (Ti-6Al-4V ELI).

Treatment

Before starting treatment, all the patients were diagnosed by radiographic evaluation. The AP (Anteroposterior) view is taken along the foot's long axis. This view is responsible for assessing signs of associated ankle and instability by examining the talus coronal inclination, tibio-fibular clear space, tibio-fibular overlap and medial clear space in fibula fracture.⁷ The lateral view is useful in demonstrating the AP displacement in the fibula fracture.⁸ On the basis

of Anteroposterior and lateral view the fibula fractures were treated based on their location and type. Plate fixation with screws was regarded as the gold standard for the treatment of fibula fractures at the hospital where the study was conducted. The same type of material was used for bone plates with screws for fixation.

Depending on the fracture pattern and soft tissue features, the surgical technique was left to the choice of the treating surgeon. Thirty six cases of fibula fracture were treated with a specific type of implant (3.5 mm Wise-Lock Lateral Distal Fibula Plate (Left), 3.5 mm Wise-Lock Lateral Distal Fibula Plate (Right), 3.5mm One Third Tubular Plate, 3.5 mm Semi Tubular Plate (Figure 2).



- a) 3.5mm Wise-Lock Lateral Distal Fibula Plate Tubular Plate
- b) 3.5mm One Third Tubular Plate
- c) 3.5mm Semi

Figure 2: Implants

III. RESULTS

By the first intention, all incisions had healed completely. There were total 36 patients; 27 males (75%) and 9 females (25%) with the age range of 24-74 years (mean 44.8 years) were included in the study. The average time of surgery was 70 minutes. In the retrospective study, the patients

had diaphyseal segment and distal end segment fractures of varying dominant side (63.8% Left, 36.1% Right) (Table1). The maximum cause of fibula fracture was (44.4%) in patients (16) due to sports injury, 30.5% in patients(11) due to motor vehicle injury and 25% in patient (9) due to fall on ground (figure3). According to the American

Society of Anaesthesiologists (ASA), 29 patients (26 men and 3 women) were classified as grade 1, indicating a normal healthy patient, while 7 patients (6 men and 1 woman) were classified as

grade 2, indicating mild systemic disease. Patients classified as grade 3 by the American Society of Anesthesiologists (ASA) were not included in the study.

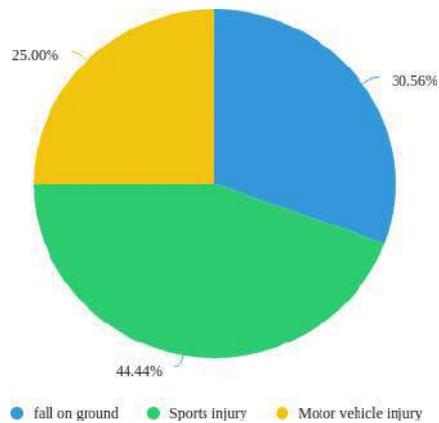


Figure 3: Showing Causes of fibula fracture

The Pain intensity was analyzed by the VAS system after the surgery by a follow up period of 1 month, 3 months, 6 months and 12 months.

3 months 2.7, after 6 months 1.4 and 12 months after 0.3 were observed (figure4). 3 Patients suffered from mild pain and 2 of them reported swelling but over the period was in a better state.

According to the VAS scale the decline in score was noticed throughout the follow up period. After 1 month the average VAS score was 3.8, after

The fibula plates were successful in all of the patients.

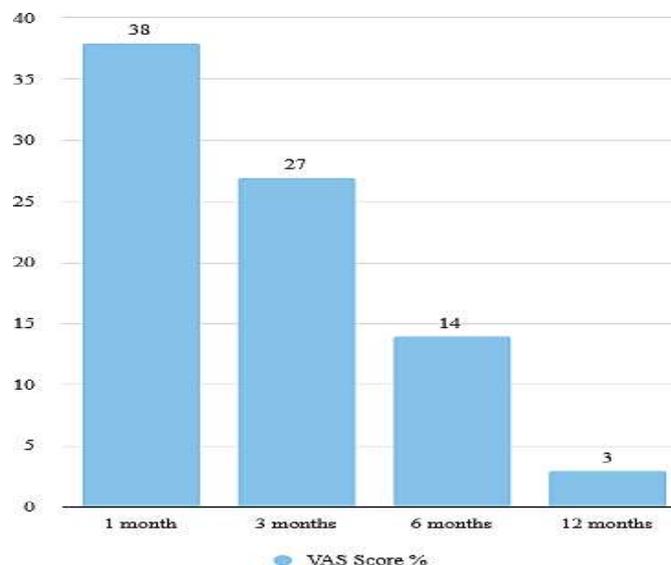


Figure 4: Represents VAS score percentage over a follow up period

Table 1: Demographic data

Demographics	Number of Patients (N)	Percentage (%)
Mean age in years	44.8	
Sex		
Male	27	75
Female	9	25
Dominant side		
Left side fibula	23	63.8
Demographics		
Right side fibula	13	36.1
ASA		
Grade I	29	80.5
Grade II	7	19.4
Grade III	0	0
Grade IV	0	0
Grade V	0	0
Types of fractures		
Diaphyseal Fracture	11	30.5
Distal Fracture	25	69.4

IV. DISCUSSION

The fibula is a leg bone that connects to the lateral side of the tibia. Fibula fractures are the most common 2-6cm proximal to the distal end of the fibula. Ankle fractures are frequently associated with it. Fracture of fibula can be treated with different methods such as skeletal traction, bone plates, intramedullary nailing.

This study describes the outcomes of the plate fixation in the patients. The fibula plate fixation with screw showed better results for fibula bone union and success rate of mobilization.

All patients get continuous physiotherapy by an experienced physiotherapist which helps patients

to recover faster and early mobilization. At every follow up X-ray revealed that fusion had begun.

All the radiological measurements of bone union were examined by the same surgeon who did the surgery. No complications reported such as loosening of plates, breakage of implant plates, corrosion and related size issues. Evaluation of pain and aesthetic appearance of the patient showed that 91.6% patients (33) were satisfied with reduction in pain and 8.3% patients (3) were unsatisfied as they bear mild pain. Aesthetic appearance showed satisfaction in 77.7% patients (28) and 22.2% patients(8) was unsatisfied as appearance did not turn to normal (Table2).

Table 2: Evaluation parameter

Evaluation Parameter	No. of patients	
	Satisfied N (%)	Not Satisfied N(%)
Pain (n=36)	33 (91.6%)	3 (8.3%)
Aesthetic appearance (n=36)	28 (77.7%)	8 (22.2%)

V. CONCLUSION

Fibula fractures are commonly occurring fractures that are being treated with experienced orthopaedic surgeons. In the present clinical study fibula fracture treated with plate fixation shows better outcomes and approaches in

maintaining stability and early mobilization with least complications. Better outcomes depend on surgical skill and intraoperative reduction accuracy.

Declaration

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Conflict of interest: None declared

Ethical approval: No Ethics Committee approval is required since it is a retrospective data.

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