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THE EFFECT OF SCREW FIXATION AND BUTTRESS PLATE FIXATION ON CLINICAL AND RADIOLOGICAL RESULTS IN THE SURGICAL TREATMENT OF POSTERIOR MALLEOLAR FRACTURES

POSTERİOR MALLEOL KIRIKLARININ CERRAHİ TEDAVİSİNDE VİDA SABİTLEME VE DESTEK PLAKASI SABİTLEMESİNİN KLİNİK VE RADYOLOJİK SONUÇLAR ÜZERİNDEKİ ETKİSİ

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ABSTRACT

Objective: Posterior malleolar fractures (PMF) are common among ankle fractures and their proper management is crucial to maintaining ankle stability. The purpose of this study was to compare the clinical and radiological effects of screw versus support plate fixation in the surgical treatment of PMF.

Material and Methods: Between December 2016 and February 2018, 82 patients who underwent surgical treatment for PMF were analyzed retrospectively. Patients were divided into two groups based on the type of fixation material used: screws and buttress plates. Using the American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score, range of motion measurements, and radiographic evaluations, clinical evaluations were conducted.

Results: A total of 60 patients were included in the study, 33 of whom were treated with plate osteosynthesis and 27 with screw osteosynthesis. The demographic and clinical characteristics were similar between the groups. The AOFAS scores, range of motion measurements, and complication rates were comparable between the screw and plate fixation groups. The radiological evaluation showed no significant difference in posttraumatic arthritis levels between the two groups.

Conclusion: The screw fixation alone provides similar clinical and radiological results compared to buttress plate fixation in the surgical treatment of PMF. These results are in advance of the growing evidence supporting screw-only osteosynthesis for Haraguchi type 1 and 2 posterior malleolus fractures.

Keywords: Ankle fracture, bone screw, posterior malleolar fracture, surgical procedures

ÖZ

Amaç: Posterior malleol kırıkları (PMF) ayak bileği kırıkları arasında yaygındır ve uygun tedavileri ayak bileği stabilitesini korumak için çok önemlidir. Bu çalışmanın amacı, PMF'nin cerrahi tedavisinde vida ile destek plağı tespitinin klinik ve radyolojik etkilerini karşılaştırmaktır.

Gereç ve Yöntemler: Aralık 2016 ile Şubat 2018 tarihleri arasında PMF nedeniyle cerrahi tedavi uygulanan 82 hasta retrospektif olarak analiz edildi. Hastalar kullanılan fiksasyon materyalinin türüne göre iki gruba ayrıldı: vidalar ve destek plakları. Amerikan Ortopedik Ayak ve Ayak Bileği Derneği (AOFAS) ayak bileği-arka ayak skoru, hareket açıklığı ölçümleri ve radyografik değerlendirmeler kullanılarak klinik değerlendirmeler yapıldı.

Bulgular: Çalışmaya 33'ü plak osteosentezi ve 27'si vida osteosentezi ile tedavi edilen toplam 60 hasta dâhil edildi. Demografik ve klinik özellikler gruplar arasında benzerdi. AOFAS skorları, hareket açıklığı ölçümleri ve komplikasyon oranları vida ve plak fiksasyon grupları arasında karşılaştırılabilirdi. Radyolojik değerlendirmede iki grup arasında posttravmatik artrit düzeyleri açısından anlamlı bir fark saptanmadı.

Sonuç: PMF'nin cerrahi tedavisinde tek başına vida tespiti, butress plak tespiti ile karşılaştırıldığında benzer klinik ve radyolojik sonuçlar sağlamaktadır. Bu sonuçlar, Haraguchi tip 1 ve 2 posterior malleol kırıkları için sadece vida osteosentezini destekleyen artan kanıtların ilerisindedir.

Anahtar kelimeler: Ayak bileği kırığı, kortikal vida, posterior malleol kırığı, cerrahi prosedürler

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INTRODUCTION

Ankle fractures frequently include PMF. The form of these fractures varies; they might range from minor posterolateral avulsion injuries to major displaced fracture fragments (1). PMF can occur in conjunction with lateral and medial malleolar fractures or in isolation following ankle rotational traumas; they account for 7 to 40% of all ankle fractures (2–5). The fracture patterns of PMF are widely variable (6,7). Haraguchi et al. Suggested a classification system based on computed tomography (CT) to accurately assess the percentage of fragmentation (8).

The posterior inferior tibiofibular ligament (PITFL) provides syndesmosis-based rotatory support to the ankle joint, and it attaches to the posterior malleolus (9). The distal tibiofibular syndesmosis is essential for joint stability and mortise congruency. If the syndesmosis is not reduced, the joint is more likely to develop long-term problems, including pain, ankle instability, and arthritis (10).

Which type of fractures should be treated surgically is a matter of debate today. It is widely accepted by many surgeons that surgical treatment is necessary for fractures involving more than one-third of the articular surface and in which fragments are displaced more than 2 mm (11,12). In addition, some biomechanical studies suggest no fixation for fragments of 25% and smaller (13). However, Langenhuijsen et al. suggested that anatomical reduction of the posterior fragment with internal fixation should be performed in fractures involving 10% or more of the tibial articular surface (14). Both percutaneous and open surgical methods can be used in the treatment of PMF (15). The body of literature reveals very few studies on the effect of different fixation methods on clinical outcomes.

The purpose of this study was to evaluate the effect of screw and plate fixation techniques on the clinical and radiological outcomes of PMF treated surgically. The hypothesis was that fixation with screws alone would be sufficient for satisfactory clinical results.

MATERIALS and METHOD

Study design

The study was conducted retrospectively in keeping with the ethical standards of the Clinical Research Ethics Committee of the SBU Haseki Training and Research Hospital. All patients included in the study gave informed consent and the study was approved by a local ethics committee (Date:26.04.2023, No:84-2023). 82 patients with PMF who had received surgical treatment between December 2016 and February 2018 were reviewed retrospectively. Institutional trauma registries were screened. Bimalleolus and trimalleolus fractures with posterior malleolus subtype fractures were included in the analysis, and all ankle fractures were radiographically confirmed. The Haraguchi classification was used to classify the PMF. Inclusion criteria were Haraguchi types 1 and 2 PMF and a minimum follow-up of 24 months. Exclusion criteria were patients younger than 18 years of age, open and pathological fractures, history of previous lower extremity fractures, additional injury, <12 (12 or 24) months follow-up, and missing data. The medical records were used to collect patient demographic, perioperative, and postoperative characteristics. Following the exclusion of 20 patients according to the exclusion criteria, the remaining patients were divided into two groups regarding the fixation material. An anti-glide plate was used for osteosynthesis in 32 patients and screws alone were used in 30 patients.

Surgical technique

A senior orthopedic surgeon who is an expert in foot and ankle surgery performed all surgeries under general or epidural anesthesia. Patients were positioned in the prone position and a tourniquet was applied to the upper thigh. We utilized a posterolateral technique. Between the Achilles tendon and the fibula, a longitudinal incision was made. Careful dissection along the lateral border of the Achilles tendon was performed to prevent damage to the sural nerve. Under direct view, the pieces were reduced by traction of the foot and dorsiflexion of the ankle, and then secured with a sharp reduction clamp. In the screw group, after the fixation of the fragments temporarily by Kirschner wires, one or two 3.5 mm lag screws were administered from the posterior to the anterior direction (Figure 1). In the plate group, a buttress plate was used to attach the posterior malleolus to the tibia's posterior surface (Figure 2).

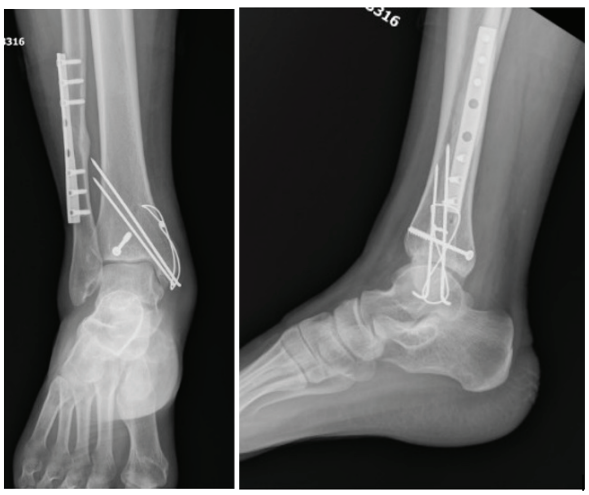

Figure 1: Radiographs AP and lateral with posterior Malleolar Screw fixation

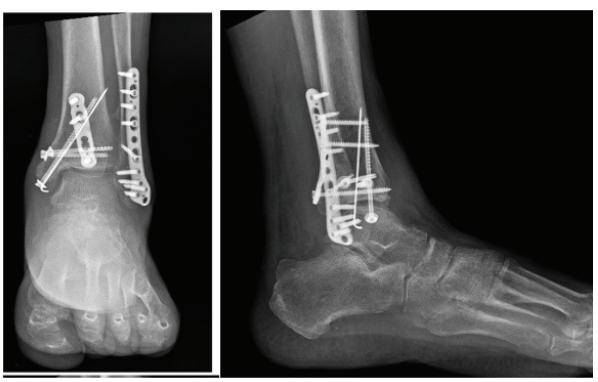

Figure 2: Radiographs AP and lateral PMF fixation with plate osteosynthesis.

Clinical evaluation

All patients were evaluated on the 3rd, 6th, and 12th months, as well as every 6 months throughout the second year. After two weeks of immobilization with a splint, both active and passive movements were initiated. By the fourth week, partial weight-bearing was encouraged, followed by full weight-bearing in the sixth week, allowing patients to be mobilized. Two independent observers assessed clinical results based on the AOFAS score. According to the AOFAS score, 90-100 points define excellent, 80-89 defines good, 70-79 defines moderate, and <70 defines poor results. At the final follow-up, we examined the ankle's range of motion and compared it to the unaffected side.

Radiological evaluation

Before surgery, AP, lateral, and mortise X-rays and 3D CT scans of the injured ankle were performed for all patients (Figure 3). Based on x-rays during the most recent follow-up, the Bargon reference criteria were utilized to determine the severity of posttraumatic arthritis (16).

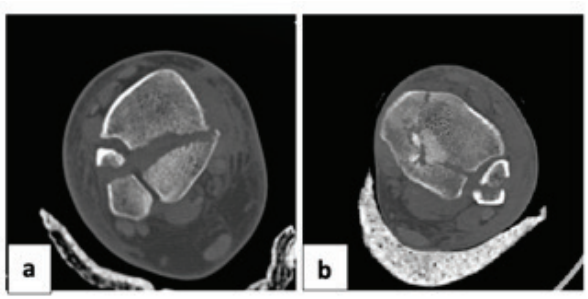

Figure 3: Preoperative axial section computed tomography images of patients. a) Radiographs type 1 Haraguchi posterior malleolus fracture, b) Radiographs type 2 Haraguchi posterior malleolus fracture

Statistical analysis

The statistical analysis was conducted using SPSS 15.0. Numbers and percentages were provided for categorical variables, while the mean, standard deviation, minimum, and maximum were provided for numerical variables. The Mann-Whitney U test was used to compare numerical data between two independent groups because the normal distribution assumption was not met. The Chi-Square Test was utilized to examine the ratio disparity and risk effect between the groups. The significance level for alpha was accepted as $p<0.05$.

RESULTS

There was a total of 60 patients who participated in this study: 27 (45%) women and 33 (55%) men. The mean age was 42.90 (range, 26-54). Thirty-three patients were treated with plate osteosynthesis and the remaining 27 patients were treated with screw osteosynthesis. Both groups consisted of similar demographic and clinical characteristics (Table 1). All patients were followed for at least 24 months (mean 36.2±4.6 months; range, 24–44 months). The rate of clinical and radiological outcomes and complications is detailed in Table 2. According to the AOFAS scoring system, the results were similar between the two groups (p=0.593). Complication rates were also similar between the two groups. (p=0.560). There was no significant difference between groups in terms of active range of motion (Table 3).

Table 1: Demographic and clinical characteristics of patients in both groups

	Plate (n= 33)	Screw (n= 27)	P value
Age (Years)[a]	41.9±7.2 (26-54)	44.1±6.0 (32-52)	0.232*
Sex			
Female (%)	17 (51.5)	10 (37.0)	0.262**
Male (%)	16 (48.5)	17 (63.0)	
Type of fracture			
Bimalleolar (%)	28 (84.8)	24 (88.9)	0.719**
Trimalleolar (%)	5 (15.2)	3 (11.1)	
Haraguchi classification			
Type 1 (%)	18 (54.5)	14 (51.9)	0.835**
Type 2 (%)	15 (45.5)	13 (48.1)	
Time from injury to surgery (days)[a]	1.2±0.5 (1-3)	1.3±0.6 (1-3)	0.291*
Follow-up (months)[a]	35.6±5.3 (24-44)	37.0±3.5 (30-42)	0.367*

Mean±standard deviation, *Independent samples t-test, **Pearson's chi-square test

Table 2: Clinical and radiological results of patients in both groups

	Plate (n= 33)	Screw (n= 27)	P value
AOFAS score	92.4±7.4 (70-100)	92.3±8.1 (70-100)	0.810*
Bargon classification			
Stage 0 (%)	5 (18.5)	7 (25.9)	0.560**
Stage 1 (%)	1 (3.7)	17 (63.0)	
Stage 2 (%)	1 (3.7)	2 (7.4)	
Stage 3 (%)	0 (0.0)	1 (3.7)	
Complication			
Infection (%)	3 (9.1)	5 (18.5)	0.593**
Nonunion (%)	2 (6.1)	1 (3.7)	
Malunion (%)	0 (0.0)	1 (3.7)	
Neurovasculardeficiency (%)	1 (3.0)	0 (0.0)	

Mean±standard deviation, AOFAS: The American Orthopaedic Foot&Ankle Society, *Independent samples t-test, **Pearson's chi-square test

Table 3: Results of joint range of motion measurements of patients in both groups

	Plate (n=33)	Screw (n=27)	P value
Fractured side dorsiflexion	14.1±1.8 (10-18) (14)	14.0±1.6 (12-18) (14)	0.988*
Non-injured side dorsiflexion	17.9±2.0 (14-22) (18)	18.4±2.0 (15-22) (18)	0.413*
Fractured side plantar flexion	36.6±1.9 (30-40) (36)	36.9±2.0 (34-42) (36)	0.932*
Non-injured side plantar flexion	41.5±2.5 (36-46) (42)	40.6±2.7 (36-45) (40)	0.178*
Fractured side inversion	17.0±1.6 (14-20) (17)	17.4±1.4 (14-20) (18)	0.327*
Non-injured side inversion	23.1±1.9 (20-26) (24)	22.2±2.7 (16-26) (22)	0.225*
Fractured side eversion	15.3±1.8 (10-18) (16)	15.5±1.9 (10-19) (16)	0.554*
	17.8±1.6 (15-22) (18)	17.6±1.2 (15-20) (18)	0.523*

Mean±standard deviation, *Independent samples t-test.

DISCUSSION

We discovered that screw fixation alone gives comparable stability to anti-glide plate fixation for PMF. This finding is significant in light of the present amount of literature on the subject. However, it should be noted that our study contributes novel information as it specifically focuses on the comparison of different fixation materials used for stabilizing posterior malleolar fractures. This aspect of our study adds to the existing knowledge and supports the growing body of evidence in favor of screw-only osteosynthesis for Haraguchi type 1 and 2 PMF.

The findings are comparable with those of earlier research evaluating various surgical procedures for treating PMF. Miller et al. compared the outcomes of unstable ankle fractures treated with open posterior malleolar fixation versus locked syndesmotic screws in the absence of a PMF. Fixation of unstable ankle fractures, such as PMF fragments with intact PITFL, was observed to be more stable than trans-syndesmotic screws (17). Similarly, this study supports the importance of direct reduction and screw fixation of the posterior malleolus in achieving stability and positive clinical outcomes.

Fu et al., in their review article, highlighted the lack of consensus regarding the size of the PMF that would lead to ankle instability and affect prognosis. They recommended the use of CT scans for accurate assessment of fragment morphology and supported direct posterior malleolus fixation to stabilize syndesmotic injuries (18). While their conclusions lean towards buttress plate osteosynthesis, our findings demonstrate that direct reduction and screw-only fixation of the posterior malleolar fragment yield comparable stability and clinical outcomes, as evidenced by similar AOFAS scores and radiological evaluation.

Regarding the impact on the existing knowledge, our findings are in line with previous studies that have also reported positive outcomes with screw fixation (18). This consistency across studies reinforces the effectiveness of screw-only fixation and supports its consideration as a preferred treatment option for Haraguchi type 1 and 2 PMF.

It is important to note that while our findings align with the current body of literature, there may still be varying opinions and approaches in the field. Some studies have advocated for buttress plate osteosynthesis (18). However, our results demonstrate that direct reduction and screw-only fixation yield comparable stability and clinical outcomes without the need for additional soft tissue dissection and more complex surgery. This contributes to the ongoing discussion and adds valuable insights to the decision-making process when it comes to posterior malleolar stabilization.

One of the strengths of our study is that it contributes to the limited body of literature comparing different fixation materials used for the stabilization of PMF. However, our study has some limitations as well. First, as a retrospective analysis, inherent selection bias and confounding variables may have influenced the results. Furthermore, it should be noted that factors that could potentially impact patients' clinical outcomes, notably osteoporosis, diabetes, and smoking habits, have not been extensively addressed within our study. The effects of osteoporosis on bone health and healing, the potential influences of diabetes on fracture recovery, and the adverse impact of smoking on bone health are well-documented in the scientific literature. The lack of comprehensive exploration of these factors in our fundamental study could limit the generalizability and interpretation of our findings.

CONCLUSION

Screw fixation alone offers the advantages of smaller incisions and less soft tissue dissection while providing stability similar to plate fixation in PMF. These results add to the growing

literature on the management of PMF and provide valuable information for clinical decision-making.

Ethics Committee Approval: This study was approved by Clinical Research Ethics Committee of Haseki Training and Research Hospital (Date:26.04.2023, No:84-2023).

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