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Original Article

Early complications associated with the posterolateral surgical approach in posterior malleolar fractures

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Abstract

Objective: Determine the complication rates following the posterolateral surgical approach in posterior malleolar fractures and evaluate possible associations with comorbidities.

Method: Twenty-six adult cases of ankle fractures involving the posterior malleolus were treated with a posterolateral surgical approach. All cases were classified according to Lauge-Hansen, Haragushi, and Bartoníček classifications. Data analysis sought the relative frequency of complications, the statistical association between comorbidities, corticosteroid use, external fixators, previous skin lesions, and smoking.

Results: The incidence of postoperative complications was 38.4%. No statistically significant association was found between the development of postoperative complications and comorbidities, smoking, or corticosteroid use. In 50% of the cases, the fractures occurred during stage 3 supination external rotation, according to the Lauge-Hansen classification. Additionally, 3% of patients developed flexor hallucis longus adhesion, and 11% developed equinus deformity.

Conclusion: Overall complication rates after the posterolateral surgical approach in posterior malleolar fractures were 38.4%. No association was found between comorbidities or previous skin lesions and wound dehiscences. Additionally, 11% had postoperative Achilles tendon shortening.

Level of evidence: IV; Therapeutic studies; Case series.

Keywords: Ankle; Ankle fractures; Fracture fixation; Surgical wound dehiscence.

Introduction

Isolated lateral malleolar fracture accounts for 66% of ankle fractures; 25% present as bimalleolar fractures, and 7% as trimalleolar fractures[1-3]. The presence of a posterior malleolar fracture is related to a worse prognosis due to higher rates of subsequent osteoarthritis[4,5]. The posterolateral approach for internal fixation has been gaining popularity in recent years; however, there is a lack of studies detailing its complications and potential disadvantages.

Trimalleolar fractures are highly complex in terms of diagnosis, treatment planning, surgical management, and the risk of complications. The presence of a Volkmann's fragment, representing a posterior malleolar fracture, adds further complexity and increases the risk of postoperative complications[6,7]. In this context, identifying the most appropriate surgical approach, considering both the timing of intervention and potential postoperative complications, is essential[1].

Study performed at the Hospital Municipal Odilon Behrens, Belo Horizonte, MG, Brazil.

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Open reduction and internal fixation (ORIF) of the lateral and medial malleolus is routinely performed in ankle fractures; however, the management of posterior malleolar fractures remains controversial—particularly regarding the fragment size that requires fixation and the preferred surgical approach when intervention is indicated[3,4,6,8].

The posterolateral surgical approach provides effective access to anatomical reduction and stable fixation for posterior malleolar fractures, including large and small fragments, as well as non-displaced fragments, which can be fixed with ORIF or percutaneously with minimally invasive techniques[9,10]. This approach offers access to the fibula and tibia laterally, allowing fixation of the posterior fragment by the same incision using plate and/or screws, allowing better coverage of soft tissues when compared to the anteromedial approach[1,10-12]. Despite the advantages of the posterolateral surgical approach, early complications can affect the surgical wound healing[13,14]. It is important to note that one of the few limitations of this approach is the technical challenge it presents when the fracture involves anterior comminution of the joint.

With an individualized approach based on fracture morphology assessed through preoperative computed tomography (CT), the historically poor outcomes associated with trimalleolar ankle fractures could be significantly improved[15]. However, despite advancements in surgical indications and refinements in reduction and fixation techniques, controversy remains regarding the optimal individualized approach, and concerns have been raised about potential complications associated with the increased use of posterior approaches[16-19].

The most prevalent complications of the posterolateral approach are related to the surgical wound, occurring in approximately 11% of cases, according to the literature[19].

The objective of this study is to present clinical and radiographic data on complications following the posterolateral surgical approach in posterior malleolar fractures and evaluate possible associations with comorbidities.

Methods

The study was approved by the Institutional Review Board. Adult patients, of both sexes, submitted to surgery between 2019 and 2022 and agreed to participate in this study, were included. Patients diagnosed with isolated or associated posterior malleolar fractures through radiographs, surgically treated with the posterolateral surgical approach, were analyzed. Cases that presented inconsistencies in the medical record that led to the impossibility of data analysis were excluded.

A damage control approach was implemented when necessary, in accordance with the institution's protocol (e.g., open fractures, fracture-dislocations, high-energy trauma). All patients underwent preoperative ankle computed tomography (CT) and were submitted to definitive surgical treatment through the posterolateral approach. The criteria for surgical fixation included: displacement involving more than 30% of the articular surface, displacement greater than 1 mm, syndesmosis lesion, or impaction of the articular surface.

Data from medical records and imaging exams were evaluated retrospectively. Based on the trauma mechanism, the fractures were classified according to the Lauge-Hansen, Haraguchi, and Bartoníček classifications using CT. All classifications were performed by the same examiner, blinded to patient data. Additionally, data extracted from medical records included whether external fixation was used in the acute setting, skin condition at presentation, pre-existing comorbidities, smoking status, use of steroids and/or corticosteroids, and the occurrence of acute complications related to the posterolateral approach during posterior malleolus osteosynthesis.

Surgical technique

To perform the ankle posterolateral approach, the patient must be in prone position with a pad placed under the ipsilateral leg. A longitudinal posterolateral incision of approximately 8 cm is made between the Achilles tendon and the fibula. The sural nerve and the small saphenous vein are identified and carefully protected. The septum of the deep posterior compartment of the leg is then opened, and the flexor hallucis longus tendon is identified and retracted medially. This provides access to the posterior malleolus and is an anatomical reference to protect the neurovascular bundle.

All osteosyntheses of posterior malleolar fractures were performed using plates and screws under fluoroscopic guidance. After fracture reduction and fixation, wound closure was performed using Vicryl® 2.0 for the fascia and subcutaneous tissue, and Nylon® 3.0 for the skin.

For the postoperative period, patients were immobilized with a plaster cast for four weeks, followed by a removable boot and initiation of range of motion exercises from the fourth week, with no weight-bearing until the sixth week. Starting from week six, progressive weight-bearing was introduced alongside physiotherapy focused on improving range of motion, muscle strengthening, and gait training.

Statistical analysis

Statistical analysis was performed using SPSS software for Windows, version 26 (SPSS Inc., Chicago, Illinois, USA). The means, standard deviations, minimum, maximum, median and frequencies of the collected data were calculated. Significance analysis was conducted using the chi-square test, Mann-Whitney U test and Kruskal-Wallis test for non-parametric data. In addition, the odds ratio and the confidence interval were calculated. Multivariate analysis was employed to identify independent risk factors for complications. The significance level adopted was $p < 0.05$.

Results

Thirty-one patients were included in the study, but five did not meet the inclusion criteria due to incomplete data in

the medical record, so 26 were analyzed. Among the cases included, 46.1% (12) were male and 53.8% (14) were female. The mean postoperative follow-up time was 12 weeks.

The most frequently injured mechanisms, according to Lauge-Hansen classification, were stage 3 supination external rotation in 50% (13) of cases, stage 4 pronation external rotation in 34.6% (9), and 15.4% (4) with stage 4 supination external rotation (Table 1).

At the time of initial evaluation, 69.2% (18) of patients presented with no skin lesions, and only 3.8% (1) involved an open fracture. Due to the need for damage control—such as in cases of open fractures, fracture-dislocations, or high-energy trauma—38.5% (10) of patients underwent initial external fixation: 1 for an open fracture, 3 for fracture-dislocations, and 6 for high-energy fractures. Definitive surgical treatment in these cases was performed after a median interval of 9.4 days.

Regarding medical history, 84.6% (22) of individuals were healthy, while 11.4% (4) had comorbidities such as anxiety, hypertension, dyslipidemia, depression, or hypothyroidism. Steroid use before the injury was reported in 3.8% (1) of cases. Additionally, 15.4% (4) had a history of smoking, and 3.8% (1) were chronic corticosteroid users.

The CT scans showed that of the 15 fractures classified as Haraguchi type 1, 10 were classified as Haraguchi type 2. Finally, one patient was classified as Haraguchi type 3.

The overall complication rate was 38.4%. Among these, 3% of cases developed shortening of the flexor hallucis longus, identified by difficulty in achieving full hallux extension, although the tendon showed no adhesions. Additionally, 11% of patients experienced Achilles tendon shortening, with maximum dorsiflexion limited to 90° on the Silfverskiöld test.

In total, 26.9% (7) of cases developed superficial wound edge necrosis that did not require additional surgical intervention. There was no statistically significant association between the presence of phlyctenae before surgery and the occurrence of postoperative complications (p = 0.289). No procedures were postponed due to the presence of phlyctenae. The median time for skin healing in patients with superficial skin lesions was 10 weeks.

There was no statistically significant association between the development of postoperative complications and the use of external fixators (p = 0.683), comorbidities (p = 0.625), smoking (p = 0.264), steroid use (p = 0.615), or chronic corticosteroid use (p = 0.385).

Regarding the frequencies observed based on the Haraguchi classification, 57.7% of cases were classified as type 1, 38.5% as type 2, and 3.8% as type 3 (Table 2).

According to the Bartoníček classification, no cases were classified as type 1; 50.0% were type 2, 19.2% were type 3, and 30.8% were type 4 (Table 3).

Discussion

Trimalleolar fractures are highly complex due to factors such as the trauma mechanism, force vectors, diagnostic challenges, treatment planning, surgical intervention, and potential complications. The involvement of the posterior malleolus—characterized by the presence of the Volkmann fragment—further increases the complexity and the risk of postoperative complications associated with ankle fractures[20-22]. Given its relatively low frequency, accounting for approximately 7% of ankle fractures, there is a limited number of studies in the literature addressing complications specifically related to the posterolateral approach in its management[21-23]. It remains unclear whether these complications stem from the surgical approach itself or the inherent nature of the fracture, highlighting the need for comparative studies evaluating different surgical approaches for the same fracture type to provide clearer guidance.

In this context, the goal is to identify the most appropriate surgical approach for treating this type of fracture, considering the potential postoperative complications. This study evaluated the postoperative complications associated with posterior malleolus fractures treated through the posterolateral approach.

In this study, 26 posterior malleolus fractures were retrospectively evaluated following surgical treatment using

Table 1. Relative frequency of the trauma mechanism according to Lauge-Hansen classification

		Frequency	%	Valid %	Cumulative %
Stages	3 - SER	13	50.0	50.0	50.0
	4 - SER	4	15.4	15.4	65.4
	4 - PER	9	34.6	34.6	100.0
	Total	26	100.0	100.0	

SER: Supination external rotation; PER: Pronation external rotation.

Table 2. Relative frequency of cases using Haraguchi classification

		Frequency	%	Valid %	Cumulative %
Types	1	15	57.7	57.7	57.7
	2	10	38.5	38.5	96.2
	3	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Table 3. Relative frequency of cases using Bartoníček classification

		Frequency	%	Valid %	Cumulative %
Types	2	13	50.0	50.0	50.0
	3	5	19.2	19.2	69.2
	4	8	30.8	30.8	100.0
	Total	26	100.0	100.0	

the posterolateral approach. The findings were consistent with the literature, showing a predominance of cases resulting from a supination external rotation mechanism. However, there was a slight predominance of female patients, contrasting with the current literature.

The overall complication rate in our study was 38.4%, slightly lower than that reported in the literature, which indicates a global incidence of skin complications of 44.2%[13].

At the time of initial care, 69.2% (18) of patients presented with no skin lesions, and only 3.8% (1) involved an open fracture. Due to the need for damage control, 38.5% (10) of the cases underwent initial external fixation. No statistically significant association was found between open fractures (3.8%) or external fixators (38.46%) and the development of postoperative complications (p = 0.683). Although the literature indicates that open fractures are a significant risk factor for infection[2,11-13,18,24], this discrepancy may be attributed to the sample size of our study.

Regarding skin complications, 26.9% (7) of cases developed superficial wound edge necrosis that did not require further surgical intervention. No statistically significant association was found between the presence of phlyctenae before surgery and the occurrence of postoperative complications (p = 0.289). Although the frequency of skin complications associated with the posterolateral approach is numerically relevant in several previously published studies, Abdelgawad et al.[6] argue that wound dehiscence following the posterolateral approach is generally less severe than that seen with anterior, lateral, or medial approaches, as implants are placed deeper and benefit from greater soft tissue coverage[8,14,22].

Regarding the data collected on the medical records, 84.61% (22) of individuals were healthy, while 11.39% (4) had comorbidities such as anxiety, hypertension, dyslipidemia, depression, or hypothyroidism. Steroid use before the injury was reported in 3.8% (1) of individuals, 15.38% (4) had a history of smoking, and 3.8% (1) were chronic corticosteroid users. No statistically significant association was found between the development of postoperative complications and the presence of comorbidities (p = 0.625), smoking (p = 0.264), steroid use (p = 0.615), or chronic corticosteroid use (p = 0.385), which is consistent with the findings of Tavares et al.[13].

Among the other complications observed, 3% of patients presented with shortening of the flexor hallucis longus, consistent with previous findings by Mertens et al.[25], who reported hallux flexion deficits in 30% of 50 patients treated via the posterolateral approach. No cases of sural nerve injury were identified in our sample. Additionally, 11% of patients developed Achilles tendon shortening—a complication not widely reported in the literature. This condition may result from temporary equinus immobilization or potentially be associated with the posterior surgical approach itself. It can often be reversed through an intensive postoperative physiotherapy program, and surgeons should address it proactively to prevent progression to a permanent equinus deformity.

Conclusion

Overall complication rates after the posterolateral surgical approach in posterior malleolar fractures were 38.4%. No association was found between comorbidities or previous skin lesions and wound dehiscences. Additionally, 11% had postoperative Achilles tendon shortening, and 3% of patients presented with shortening of the flexor hallucis longus. Further studies with larger sample sizes are needed to identify and prevent additional factors that may be associated with these complications.

Authors' contributions: Each author contributed individually and significantly to the development of this article: LAG *(https://orcid.org/0000-0003-0656-7270) Carried out the bibliographic review, organization of the collected data, interpreted the results of the study, formatting of the article, wrote the article, participated in the review process and approved the final version; YCA *(https://orcid.org/0009-0004-1275-5539) Interpreted the results of the study, statistical analysis, wrote the article, participated in the review process and approved the final version; GDH *(https://orcid.org/0000-0002-1830-450X) Performed the surgeries, data collection and approved the final version; ACO *(https://orcid.org/0000 0002 3477 830x) Interpreted the results of the study, participated in the review process and approved the final version; ACM *(https://orcid.org/0000 0003 2469 0424) Interpreted the results of the study, participated in the review process and approved the final version; SIK *(https://orcid.org/0000 0002 9079 6940) Conceived and planned the activities that led to the study, wrote the article, approved the final version. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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