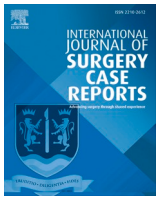
International Journal of Surgery Case Reports 125 (2024) 110519

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.elsevier.com/locate/ijscr



Case report

Isolated posterior malleolus fracture: A case report and review of the literature

Joeffroy Otayek, Joe Ghanimeh, Anthony El Alam, Joseph Mouawad *, Alfred Khoury

Orthopedic Surgery, Lebanese American University Medical Center-Rizk Hospital, LAU Gilbert and Rose-Marie Chaghoury School of Medicine, Beirut, Lebanon

ARTICLE INFO

Keywords:
Ankle fracture
Isolated posterior malleolus fracture
Case report
Posteroanterior cannulated screws

ABSTRACT

Introduction: Fractures involving the ankle joint typically manifest as bimalleolar or trimalleolar fractures, with isolated posterior malleolus fractures (IPMF) representing a rare subset, comprising 0.5–4 % of cases. Due to its rarity and subtle clinical presentation, IPMF poses unique diagnostic and management challenges. This case report presents the diagnosis and treatment of a 50-year-old woman with an IPMF following a fall, alongside a review of relevant literature.

Case presentation: A 50-year-old woman presented with severe right ankle pain and inability to bear weight after a backward fall. Physical examination showed swelling, tenderness in the medial retromalleolar region, and pain with passive dorsiflexion. Imaging through X-rays and CT scans revealed an isolated posterior malleolus fracture involving 40 % of the tibiotalar articular surface. The patient underwent surgical fixation using two posteroanterior cannulated screws via a posterolateral approach. Post-operative X-rays confirmed adequate reduction and fixation. She remained non-weight-bearing for six weeks, followed by physical therapy.

Discussion: IPMFs are challenging to diagnose due to subtle signs and limitations of standard radiographs. Advanced imaging, particularly CT with 3D reconstruction, is crucial for accurate diagnosis. Classification systems, such as Haraguchi and Mason, guide treatment. Surgical fixation is often necessary for fractures involving significant joint surfaces, displacement, or instability. Posteroanterior cannulated screws offer a minimally invasive and effective stabilization method, as demonstrated in this case.

Conclusion: Early recognition and proper surgical management of IPMF are essential to prevent complications. Increased awareness and further research are needed to improve outcomes for this rare ankle injury.

1. Introduction

Fractures involving the ankle joint are common, often resulting from traumatic events.

Ankle fractures most commonly involve the lateral malleolus, the medial malleolus, or both (bimalleolar). In some cases, trimalleolar fractures occur when the posterior malleolus is also affected. However, isolated posterior malleolus fractures (IPMF), representing a distinct subset of 0.5–4 % of all ankle fractures, are relatively rare and pose unique diagnostic and management challenges [1,2]. Despite being less prevalent compared to other ankle fractures, IPMF require careful attention and consideration due to their potential impact on the stability and function of the ankle joint. The posterior malleolus is essential for ankle stability by facilitating load transfer through the tibiotalar joint. Its damage can cause posterior talus subluxation, potentially leading to a debilitating injury [3]. The characteristic mechanism of injury for these fractures involves hyper-plantar flexion accompanied by an axial compressive force from the posterior fragment of the talus on the posterior tibia, often resulting from slipping and falling [4]. The rarity of IPMF poses significant challenges leading to delayed diagnosis. This is associated with longer incapacity and more severe sequelae including osteoarthritis, cracking sensations, chronic instability, pain, and stiffness [5]. In this paper, we present the clinical course of a patient with an isolated posterior malleolus fracture post. The diagnosis was done using multiple imaging modalities and the patient was treated with surgical treatment using PA cannulated screws.

This case report aims to present an intriguing and informative clinical scenario involving an isolated posterior malleolus fracture along with a literature review on the diagnosis and treatment. All work has been reported in line with the SCARE criteria [6]. The clinical course of

Abbreviations: CT, Computed Tomography; AP, Anteroposterior; PA, Posteroanterior; IPMF, Isolated Posterior Malleolus Fractures.

* Corresponding author.
E-mail address: joeamouawad@gmail.com (J. Mouawad).

https://doi.org/10.1016/j.ijscr.2024.110519
Received 7 September 2024; Received in revised form 21 October 2024; Accepted 23 October 2024
Available online 24 October 2024

this patient is summarized in the outline (Table 1).

2. Case presentation

We are presenting the case of a 50-year-old female who presented to the emergency department after falling backward on the stairs with complaints of right ankle pain and inability to bear weight. On physical examination, she had tenderness over the posterior aspect of the medial malleolus and swelling around the ankle. Neurovascular examination was normal showing normal peripheral pulses with no motor or sensory deficits. The fibular head was palpated to check for Maisonneuve injuries and showed no tenderness. Ankle pain was elicited with passive dorsiflexion. X-rays showed an obliquely oriented minimally displaced posterior malleolus fracture (Fig. 1).

A CT scan was ordered to look for associated fractures and evaluate the size of the fractured fragment and articular step-off. It revealed that the fracture involved 40 % of the tibiotalar articular surface, and there were no associated fractures of the tibia or fibula (Figs. 2, 3, 4).

The diagnosis of an isolated posterior malleolus fracture was made.

The patient was admitted to the orthopedic surgery department, and surgical fixation was planned due to the extent of articular surface involvement. Through a posterolateral minimally invasive approach, an open reduction and internal fixation (ORIF) with two posteroanterior cannulated screws (4.5 mm) with washers was performed successfully. A posterior short-leg splint was applied postoperatively and switched to a short-leg cast three days later when edema and pain improved. Postoperative X-rays showed adequate reduction and fixation (Fig. 5).

After the procedure, the patient was advised to ambulate with non-weight bearing with crutches for six weeks and to follow up with physical therapy to regain the full range of motion of the ankle. At the six-month follow-up, the patient returned to her pre-injury level of activity with full ankle range of motion and no remaining pain.

3. Discussion

IPMF, also known as Paratrooper fracture, Volkmann's fracture, or Earle's fracture, is a rare and complicated type of ankle fracture that poses challenges in both diagnosis and treatment [7]. It presents with atypical clinical symptoms and is difficult to visualize on standard X-rays, making timely and accurate diagnosis crucial. Delayed diagnosis and treatment can lead to chronic instability and osteoarthritis, especially due to the poorly vascularized bone fragments and the considerable stress placed on the tibial plafond [8]. In a study conducted by Comat et al., it was found that over half of the cases exhibited only a few symptoms during the initial clinical examination, and the examination's specificity was deemed inadequate [8]. This finding aligns with the results reported by Boggs [1]in 1986 and Nugent and Gale [9] in 1990, who also identified partial functional impotence as a common and non-specific clinical presentation. However, these previous researchers emphasized a specific functional sign, namely the medial retromalleolar tenderness [8]. The latter was present among the clinical picture of the patient presented in this case report.

Table 1
Timeline of the case report.

5/2/2023	Patient presented to the ER post fall with right ankle pain and inability to ambulate.
5/2/2023	Isolated posterior malleolus fracture was seen on Xray and CT scan
6/2/2023	Open reduction internal fixation was done using posteroanterior cannulated screws with postoperative leg posterior splint.
10/2/2023	Short leg cast applied after edema decreased.
22/3/2023	6 weeks postoperative x-ray revealed fracture healing.
10/8/2023	6 months follow-up showed full range of motion with no remaining pain

This injury results from axial compression causing an impaction of the talus on the posterior edge of the distal tibia while in plantar flexion [10]. Our patient, while falling backward, exhibited a plantar flexion of her ankle with an axial force while landing in keeping with the described mechanism for IPMF. Based on the Ottawa criteria, standard ankle radiographs are typically the first imaging method used to assess ankle injuries [2]. In Comat et al.'s study mentioned earlier, only 9 of 12 patients met the Ottawa criteria, while 3 did not initially match them. Consequently, there was a 25 % risk of overlooking fractures when applying the Ottawa Ankle Rules alone [8]. Three radiological signs on X-ray can indicate a posterior malleolus fracture include: the Misty Mountains sign (hazy overlapping bone fragments on AP radiographs), the Double Contour sign (double line showing fragment displacement on lateral radiographs), and the Spur sign (bony prominence suggesting significant displacement) [11].Ozler et al. found that small fragments from an isolated posterior malleolus fracture can only be seen on 50° external rotation lateral ankle radiograph [10]. Therefore performing an additional Xray of the ankle in 50 degrees of external rotation can be an asset in the initial imaging work-up when in doubt of IPMF. An X-ray of the leg, including the knee should be considered in the radiographic evaluation to exclude a Maisonneuve fracture, especially in pronation eversion injuries [5].

If there is uncertainty regarding a diagnosis, we find it reasonable to use CT scans to accurately evaluate the length and displacement of fractures. Some researchers have highlighted that in IPMF, the fragment is often underestimated when using standard lateral X-rays due to the angle of the fracture line [12]. Thus, the recommended imaging modality for diagnosing and assessing a posterior malleolar fracture should be a 3D reconstruction CT scan [3].

IPMF are classified according to Haragushi et al. as three types: the posterolateral-oblique type (type 1), the medial-extension type (type 2), or the small-shell type (type 3). Type 2 fracture typically consists of two fragments. Certain fragments may encompass nearly the entire medial malleolus [13]. Another classification was described by Mason et al. who also divided IPMF into 3 types. Type 1 fractures consist of a small primary bone fragment located outside the joint, Type 2 fractures involve a primary fragment located in the posterolateral triangle of the tibia, (Volkmann area), while type 3 fractures are characterized by a coronal plane fracture line that affects the entire posterior plafond [14]. The present case is categorized as a Haragushi type 1 and Mason type 3 fracture. In cases of type 3 posterior malleolar fractures, the majority of fibular fractures observed were either high or long oblique fractures [15]. Therefore, the presented case is considered a rare occurrence, as it involves a type 3 fracture without any accompanying fibular fracture.

The need for fixing posterior malleolus fractures remains a subject of debate. The existing criteria for fixation are diverse and continually evolving. They include fractures that affect >25 % to 33 % of the joint surface, those with a displacement of >2 mm, cases of ankle instability with associated syndesmotic injury, and persistent backward misalignment of the talus [16]. Some surgeons assert that fixing all posterior malleolus fractures is necessary, as they believe this approach will result in improved posterior syndesmotic stability [2].In addition, the influence of fragment size and joint congruency on osteoarthritis in the long-term has only been demonstrated radiographically but not clinically [17]. A new perspective challenges the prevailing belief regarding the treatment of IPMF involving 25–33 % of the tibial plafond. Instead of focusing solely on the size of the fracture fragments, this fresh approach suggests that the outcome may be determined more by the pattern and shape of the posterior malleolar fracture itself [18].

The primary methods used to fix posterior malleolus fractures (PMF) are the anteroposterior (AP) or posteroanterior (PA) interfragmentary cannulated screws, or the posterior buttress plate [19]. To assign a treatment modality, recent studies have divided PMFs into two groups based on fragment size, namely, those with fragments >15 % and those with fragments <15 %. Wang et al. conducted a study that concluded that when dealing with PMFs with a fragment size of <15 %, using PA

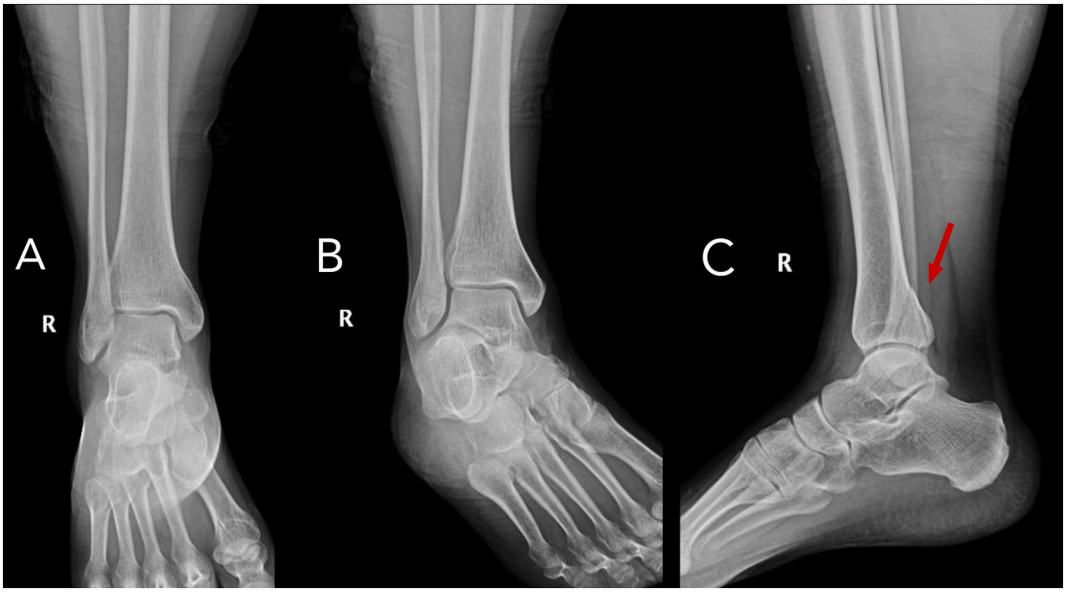


Fig. 1. Anteroposterior (A), lateral (B), and oblique (C) X-ray views showing a right obliquely oriented minimally displaced posterior malleolus fracture (red arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

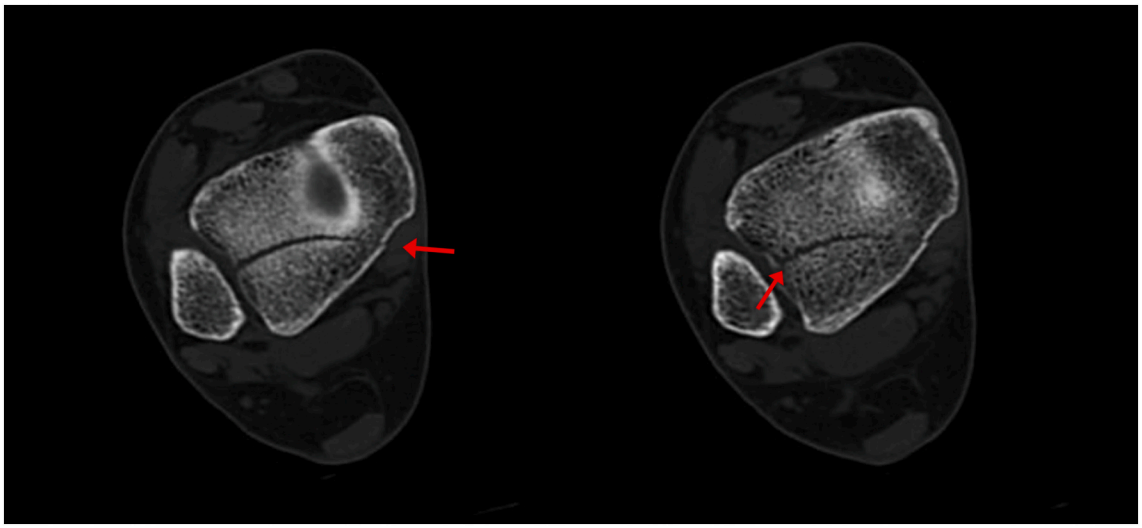


Fig. 2. Axial Ct scan cuts showing the posterior malleolus fracture line.

screw or AP screw fixation might be more effective than using PA plate fixation [20]. The reason for this may be that, in such cases, the plate must be placed distally to achieve proper fixation, which makes it susceptible to protrusion since it cannot be countersunk like a screw. As a consequence, this protrusion can irritate the flexor hallucis longus, leading to significant adhesions, and impacting the outcomes after surgery [21]. When treating PMFs with a fragment size of 15 % or more, larger fragments allow the plate to be placed slightly more proximally to the tibia, reducing the risk of distal protrusion [20]. Wang et al. finally concluded that if the fragment size is above 15 %, using cannulated screws or a buttress plate had no significant difference in outcomes [20].

In light of these findings, we opted for 2 PA cannulated screws in the present case where the fracture was involving 40 % of the articular surface. A minimally invasive approach with 2 well-placed PA cannulated screws enabled adequate reduction and stability after fixation.

Our case highlights the importance of early recognition of an isolated posterior malleolus fracture and appropriate management to ensure the best possible outcome for the patient.

As a case report, it is essential to recognize the inherent limitations, such as the singular nature of the case, which may restrict the broader applicability of the findings.

4. Patient perspective

The patient was very satisfied, pain-free and has returned to daily activities.

5. Conclusion

In conclusion, this case report emphasizes the paramount importance of early recognition of IPMF and the need for appropriate management to optimize patient outcomes. Prompt and proper treatment is essential in preventing long-term complications and facilitating the successful recovery and restoration of ankle function. Surgical fixation is often necessary to minimize the risk of chronic instability and post-traumatic arthritis.

Fig. 3. Coronal Ct scan cuts showing the posterior malleolus fracture line.

Fig. 4. Sagittal Ct scan cuts showing the posterior malleolus fracture line with the posterior fragment being 40 % of the articular surface.

To improve patient outcomes and quality of life, it is imperative to enhance awareness among healthcare professionals regarding IPMF. We highlighted specific radiographic views and signs for diagnosis and discussed multiple treatment modalities with their outcomes. By fostering further research and encouraging collaboration among clinicians, we can develop refined guidelines for diagnosing and managing this rare ankle fracture, ultimately benefiting both patients and healthcare providers.

Guarantor

Joeffroy Otayek

Consent

Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is

Fig. 5. Anteroposterior (A), oblique (B), and lateral (C) Xrays views post-op showing adequate reduction of the fracture with 2 PA cannulated screws and washers.

available for review by the Editor-in-Chief of this journal on request.

CRediT authorship contribution statement

1. Joeffroy Otayek: Principal Investigator and Lead Author, tasked with the primary responsibility of drafting and revising the manuscript.
2. Joe Ghanimeh: Literature Review Specialist and Co-Author, responsible for conducting a comprehensive literature review to ensure the case report is contextualized within current medical knowledge.
3. Anthony El Alam: Manuscript Editor and Literature Review Co-Author, involved in reviewing and refining the manuscript and contributing to the literature review, ensuring the manuscript meets high academic standards.
4. Joseph Mouawad: Co-Author with a Focus on Data Analysis and Discussion, specializes in analyzing the case's outcomes and its contributions to or divergences from established knowledge. Also serves as the main point of contact with the journal during the submission and review process.
5. Alfred Khoury: Senior Specialist Author and Clinical Advisor, who performed the surgical technique and diagnosed the patient, contributing expert insight into the clinical aspects of the case. Provides detailed descriptions of the surgical procedure, diagnostic process, and overall clinical management of the patient. Supervises the manuscript's development, offering critical revisions to ensure the report accurately reflects the case.

Ethical approval and consent

Informed consent to the publication of clinical information and imaging was obtained from the patient presented in this case report.

No Institutional Review Board (IRB) approval was required for this case report, as it is solely focused on a descriptive analysis of an individual case, without any modifications to the standard clinical management or additional risk to the patient.

Funding

The authors of this study declare that there are no funding sources.

Declaration of competing interest

No conflicts of interest.

Acknowledgments

We would like to express our gratitude to the patient for her willingness to participate in this case report. Her cooperation and openness throughout the process have been invaluable in our understanding of this medical condition.

We also thank the healthcare professionals who were involved in the patient's care. Finally, we extend our appreciation to our colleagues for their feedback and support in the preparation of this report. No conflicts of interest.

References

[1] L.R. Boggs, Isolated posterior malleolar fractures, Am. J. Emerg. Med. 4 (4) (1986) 334–336, https://doi.org/10.1016/0735-6757(86)90304-9.
[2] S. Serbest, U. Tiftikçi, H.B. Tosun, E. Kesgin, M. Karataş, Isolated posterior malleolus fracture: a rare injury mechanism, Pan Afr. Med. J. 20 (123) (2015) 1–5, https://doi.org/10.11604/PAMJ.2015.20.123.6046.
[3] L. Tomar, G. Govil, P. Dhawan, Isolated posterior malleolar fracture: a case report of a rare presentation with narrative review of literature, Cureus 14 (1) (2022), https://doi.org/10.7759/CUREUS.21658.
[4] E. Neumaier Probst, R. Maas, N.M. Meenen, Isolated fracture of the posterolateral tibial lip (Volkmann's triangle), Acta Radiol. 38 (3) (1997) 359–362, https://doi.org/10.1080/02841859709172083.
[5] D.P.J. Smeeing, R.M. Houwert, M.C. Kruyt, F. Hietbrink, The isolated posterior malleolar fracture and syndesmotic instability: a case report and review of the literature, Int. J. Surg. Case Rep. 41 (2017) 360–365, https://doi.org/10.1016/J.IJSCR.2017.10.062.
[6] C. Sohrabi, G. Mathew, N. Maria, A. Kerwan, T. Franchi, R.A. Agha, The SCARE 2023 guideline: updating consensus surgical CAse REport (SCARE) guidelines, Int. J. Surg. 109 (5) (2023) 1136–1140, https://doi.org/10.1097/JS9.0000000000000373.
[7] J. Bartoníček, Avulsed posterior edge of the tibia. Earle's or Volkmann's triangle? J. Bone Joint Surg. Br. 86 (5) (2004) 746–750, https://doi.org/10.1302/0301-620X.86B5.13896.
[8] G. Comat, O. Barbier, D. Ollat, The posterior malleolar fracture: a parachute injury not to be overlooked, Orthop. Traumatol. Surg. Res. 100 (4) (2014) 419–422, https://doi.org/10.1016/J.OTSR.2014.02.008.
[9] J.F. Nugent, B.D. Gale, Isolated posterior malleolar ankle fractures, J. Foot Surg. 29 (1) (1990) 80–83. Accessed July 21, 2023, https://europepmc.org/article/med/2319104.
[10] T. Özler, M. Güven, A. Önal, Ç. Uluçay, T. Beyzadeoğlu, F. Altintaş, Missed isolated posterior malleolar fractures, Acta Orthop. Traumatol. Turc. 48 (3) (2014) 249–252, https://doi.org/10.3944/AOTT.2014.14.0033.

[11] J. Feger, Posterior malleolus fracture, In: *Radiopaedia.Org*. Radiopaedia.org (2020), https://doi.org/10.53347/rID-82232.
[12] M.P.J. Van den Bekerom, D. Haverkamp, P. Kloen, Biomechanical and clinical evaluation of posterior malleolar fractures. A systematic review of the literature, J. Trauma 66 (1) (2009) 279–284, https://doi.org/10.1097/TA.0B013E318187EB16.
[13] N. Haraguchi, H. Haruyama, H. Toga, F. Kato, Pathoanatomy of posterior malleolar fractures of the ankle, J. Bone Joint Surg. 88 (5) (2006) 1085–1092, https://doi.org/10.2106/JBJS.E.00856.
[14] C. Bergman, M. Morin, K. Lawson, Anatomy, classification, and Management of Ankle Fractures Involving the posterior malleolar fragment: a literature review, Foot Ankle Orthop. 4 (4) (2019), https://doi.org/10.1177/2473011419887724.
[15] L.W. Mason, W.J. Marlow, J. Widnall, A.P. Molloy, Pathoanatomy and associated injuries of posterior malleolus fracture of the ankle, Foot Ankle Int. 38 (11) (2017) 1229–1235, https://doi.org/10.1177/1071100717719533.
[16] X. Duan, A.R. Kadakia, Operative treatment of posterior malleolar fractures, Open Orthop. J. 11 (1) (2017) 732–742, https://doi.org/10.2174/1874325001711010732.
[17] C.C.D. Van Hooff, S.M. Verhage, J.M. Hoogendoorn, Influence of fragment size and postoperative joint congruency on long-term outcome of posterior malleolar fractures, Foot Ankle Int. 36 (6) (2015) 673–678, https://doi.org/10.1177/1071100715570895.
[18] R.P. Blom, D.T. Meijer, R.J.O. de Muinck Keizer, et al., Posterior malleolar fracture morphology determines outcome in rotational type ankle fractures, Injury 50 (7) (2019) 1392–1397, https://doi.org/10.1016/J.INJURY.2019.06.003.
[19] Q. Zhou, H. Lu, Z. Wang, S. Yu, H. Zhang, Posterolateral approach with buttress plates and cannulated screw fixation for large posterior malleolus fractures, J. Foot Ankle Surg. 56 (6) (2017) 1173–1179, https://doi.org/10.1053/J.JFAS.2017.05.028.
[20] Z. Wang, J. Sun, J. Yan, et al., Comparison of the efficacy of posterior-anterior screws, anterior-posterior screws and a posterior-anterior plate in the fixation of posterior malleolar fractures with a fragment size of $\geq$15 and $<$15, BMC Musculoskelet. Disord. 21 (1) (2020), https://doi.org/10.1186/S12891-020-03594-7.
[21] A. Anwar, Z. Zhang, D. Lv, et al., Biomechanical efficacy of AP, PA lag screws and posterior plating for fixation of posterior malleolar fractures: a three dimensional finite element study, BMC Musculoskelet. Disord. 19 (1) (2018), https://doi.org/10.1186/S12891-018-1989-7.