Medical Science

pISSN 2321–7359; eISSN 2321–7367

The pattern of pilon fractures in King Saud Medical City

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To Cite:
Alshammari AO. The pattern of pilon fractures in King Saud Medical City. Medical Science 2022; 26: ms527e2631.
doi: https://doi.org/10.54905/disssi/v26i130/ms527e2631

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Peer-Review History
Received: 27 November 2022
Reviewed & Revised: 01/December/2022 to 12/December/2022
Accepted: 13 December 2022
Published: 14 December 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Background: The pilon fracture is a fracture notable by the fact that it varies greatly in its intricacy. Despite being uncommon, pilon fractures are of interest to orthopedic surgeons because of the awkwardness of their treatment. For correct grading, classification and preoperative preparation, necessary radiographic images must always be undertaken. *Aim:* The study was designed to determine clinical as well as radiographic patterns of pilon fractures at our facility. *Methods*: The study included patients with tibial pilon fractures who presented to King Saud Medical City (September 2019 – August 2022). Fractures were categorized based on the AO classification method and Gustilo–Anderson classification. *Results:* Tibial pilon fractures occurred in 21 individuals, among them 23.8% of fractures were open, 14.2% of the individuals had Gustilo type II and the predominance (47.6%) belonged to AO type 43-B. Fracture grade and its relationship to fibula fracture both substantially impacted the AOFAS scoring rate (P=0.025 and P=0.019, respectively). *Conclusion:* When compared to other musculoskeletal injuries, tibial pilon fractures are still quite rare, but it is rising in incidence. Hence, specific orthopedic surgery units in Saudi Arabia dealing with lower tibial fractures are needed to cover a wider geographic area to categorize patients aiming to tailor appropriate management strategies that may positively affect its outcome.

Keywords: AO classification, distal tibia fracture, Gustilo–Anderson classification, intra-articular ankle fractures, Pilon fracture, Plafond fracture.

1. INTRODUCTION

Pilon fractures were first termed in 1911 by Destot, a French radiologist. They affect the distal tibia's articular weight-bearing surface. The word "pilon" is a derivative of the French tongue, denoting pestle, when a distal tibial metaphysis is parallel to the distal tibia, it is similar to a pharmacist's pestle. It was then called a 'plafond,' which is French for 'ceiling', where the distal tibial articular surface is referred to as the ankle joint ceiling (Saad et al., 2019). It was estimated less than 10% of all lower limb fractures are caused by such fractures (Ballal et al., 2016; Busel et al., 2017; Ibrahim et al., 2021). Its incidence in men ranges from 57% to 65%, so it is commoner in males when in comparison to females. It has bimodal age distribution, being most frequently encountered in 25 and 50-year-old (Mauffrey et al., 2011). Pilon fractures occur most frequently between the ages of 25 and 50, according to bimodal age distribution. These fractures are usually characterized by fragmented bones

and severe soft tissue damage (Cole et al., 2013; Ballal et al., 2016). Its occurrence is progressively increasing as a consequence of the expansion of industries across the globe, the popularity of athletic pursuits, the fall from altitude and the spike in traffic accidents (Gülabi et al., 2012).

Several technical progressions have resulted from a finer comprehension of soft tissues' role in fracture healing. Along with the fracture pattern and the surgeon's desire, assessing the soft tissue envelope turn out to be one of the key factors in deciding on an operation strategy (Busel et al., 2017). Orthopedic surgeons are faced with the intriguing management dilemma of repairing pilon fractures. While there are many potential causes for it though, none is as difficult to deal with as the accompanying soft tissue damage (Gao et al., 2019). These fractures had been categorized using a variety of approaches. The Arbeitsge-meinschaftfur Osteosynthesefragen (AO) classification system in accordance with the level of joint input and comminution on x-rays, was the most extensively used (Mair et al., 2021; Moncman et al., 2022). As identifying and documenting the pattern of pilon fractures and associated soft tissue injuries is essential for the treating surgeon, a group of patients at our center were evaluated in the present study for radiologic and objective patterns of pilon fractures. Herein authors are unaware of any analogous research that has been done in Saudi Arabia.

2. MATERIAL AND METHODS

Study design and population

During the period between September 2019 and August 2022 in King Saud Medical City, the whole mature patients with pilon fractures who comply with the inclusion standards were included voluntarily in a prospective manner. The study proposal was approved by the institutional review board, King Saud Medical City (No. H1RI-19-Aug-19-01).

Inclusion criteria

A patient with a fractured tibial pilon with or in the absence of a fractured fibula was considered qualified for inclusion if he or she presented to our institute during the chosen period.

Exclusion criteria

A patient with fractures other than tibial pilon fractures was omitted from the study.

The procedure

The process started with a skin and neurovascular examination of the individuals who had pilon fractures. The affected ankle was then subjected to a conventional X-ray, including lateral and anteroposterior (AP) images, as well as a CT scan. Following that, the AO classification system was used to classify the fractures, which allocated them into three main types: Extra-articular (43-A), partial ((43-B) and Total articular Fractures (43-C) (Tomás-Hernández, 2017). Relying on the Gustilo-Anderson categorization system, soft tissue damages were divided into various groups. Open fractures having a wound of fewer than 1 cm that was clear and devoid of soft tissue damage were referred to as Type I fractures. Wounds sized more than 10 mm with slight soft tissue damage characterize type II fractures. Numerous fracture fragments, pervasive soft tissue destruction, embracing vascular impairment, amputations and higher levels of contamination were all characteristics of Type III fractures (Elniel and Giannoudis, 2018). Comparative x-rays of the undamaged contralateral foot were used as a reference to get insight into the normal alignment of the fractured side.

Data collection

Expert orthopedic surgeons and radiologists scrutinized the patient files, the roentgen rays, and indeed the CT scans. According to a formerly developed questionnaire, the data was collected on gender, age, manner of trauma, escorted traumas and the finding according to AO & Gustilo classification systems.

Data analysis

Utilizing SPSS 23.0, the retrieved data were analyzed and assessed at a 95% CI. Comparatively to categorical data, which was studied using mean and standard deviation, numerical data were explored as percentages. Shapiro-Wilk test was used to determine whether frequencies were normal. Levene's test was applied to determine if variances for a variable were equal across groups. The Chi-square test was used to analyze the relationships between groups. To determine how characteristics differed from one another, ANOVA tests were utilized. A 5% significant threshold had been employed (p fewer than or equivalent to 0.05).

3. RESULTS

Table 1 displays information about patients' attributes and statistics as percentages and frequencies. The study's criterion was satisfied by twenty-one patients suffering from a specific tibia pilon fracture (18 males and three females), which has a 6:1 male-to-female ratio. Their age ranged from 21 to 60 years, with a mean of 35.3±11.2 years.

Table 1 Attributes of patients with distal tibia pilon fractures (n=21)

Patients' characteristics	
Variable	Frequency (%)
Gender	
Male	18 (85.7%)
Female	03 (14.3%)
Site of tibial pilon fracture	
Right	12 (57.1%)
Left	09 (42.9%)
Associated fibular fracture	
Yes	05 (23.8%)
No	16 (76.2%)

Right-side injuries impacted 12 individuals (57.1%), whereas left side afflicted 9 patients (42.9%). By analyzing the etiologies of the trauma, the bulk of the fractures was brought on by MVA in 14 cases (66.7%) and the remainder was due to falls 7 (33.3%) (falls from high altitude in 3 (14.3%) and 4 (19.1%) due to slips) (Figure 1). While five of the patients (23.8%) experienced an open fracture, 16 (76.2%) of the participants exhibited a closed fracture (Figure 2). Conforming to the Gustilo-Anderson categorization, Class II open fractures were evident in the majority of patients (14.2%) (Table 2).

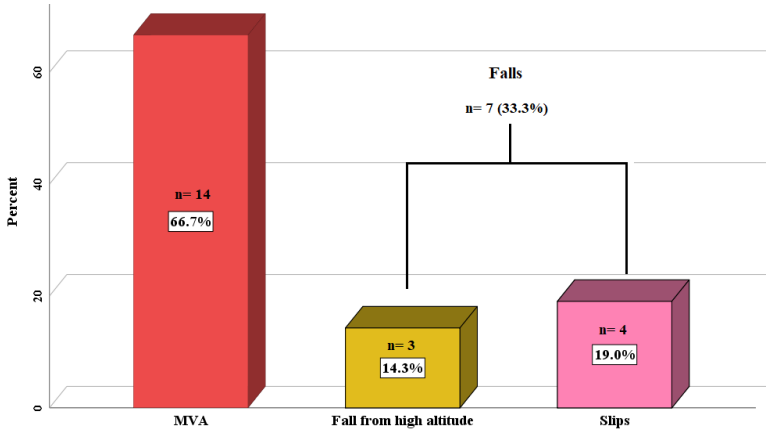

Figure 1 Mode of trauma in the study group (n=21)

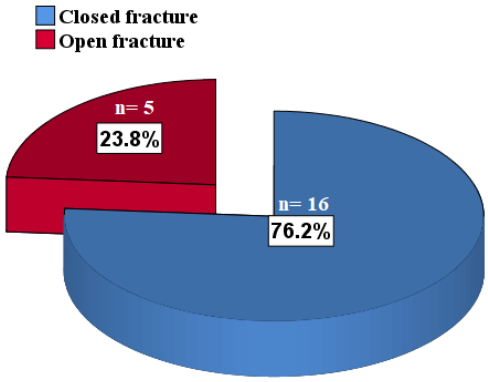

Figure 2 Mode of fractures in the study group (n=21)

Table 2 Gustilo-Anderson classification of pilon fracture among study group (n=21)

Gustilo-Anderson classification	Frequency	Percentage (%)
Type I	1	4.8
Type II	3	14.2
Type III	1	4.8
Total	5	23.8

An accompanying lower fibular fracture was observed in five individuals (23.8%), while 14 (66.7%) experienced another injury. As per the categorization system used by AO, 2 (9.5%) fractures belonged to pattern 43-A, 10 (47.5%) to 43-B, and 9 (42.9%) were to the property of pattern 43-C (Table 3). The two-stage approach, which involves initial external immobilization and final restoration after soft-tissue recovery, was used to repair fractures in all patients (Figures 3 & 4).

Table 3 AO classification of pilon fracture among study group (n=21)

AO classification of pilon fracture		
Class	Frequency	Percentage (%)
43-A	02	09.5
43-B	10	47.6
43-C	09	42.9

Figure 3 Patient with closed fracture, *A*; Pilon fracture type 43-C treated via posterior slab in the initial stage. *B*; ORIF in the final stage

Figure 4 Patient with open/compound distal tibial and fibular fractures, *A*; Type 43-C pilon fracture. *B*; External fixator used in the initial stage. *C*; ORIF in the final stage

Relying on the AOFAS grading method for the functional consequence assessed during follow-up, patients' scores ranged between 60 to 100 with a mean combined score of 86.9±11.52 points. When the AO fracture type increased as well as the presence of fibular fractures, the score was observed to drop to fewer than 85 points (p = 0.025 and 0.019, respectively). The AO fracture type has an impact on reduction quality, thus lower-grade fractures displayed the best quality (P=0.003) (Table 4).

Table 4 The Radiological outcome of the reduction concerning AO Fracture type

AO Fracture type	The radiological outcome of reduction			P value
	Anatomical	Fair	Poor	
43 A	2 (100%)	—	—	
43 B	7 (70%)	3 (30%)	—	0.003*

43 C	6 (66.7%)	2 (22.2%)	1 (11.1%)	

4. DISCUSSION

Even though multiple research projects concerning tibial pilon fractures had previously been published in international literature, there hasn't been researched to determine the pattern of these fractures among the Saudi population. The purpose of the current study was to determine the pilon fracture patterns in patients who received care at King Saud Medical City. Such injuries seem to affect males slightly more frequently than they do females and most of these fractures occur in people around the age of 45 (Mair et al., 2021). In the earlier publications, there were variations in patient ages and the causation of the injury. It has been found in this study that young adults have a higher incidence of pilon fractures and it is most noticeable in the male gender. The most common cause of pilon fractures is high-energy trauma involving strong axial loads that ultimately induce tibial plafond to explode on top of the talus, such trauma generally results from falls, high-altitude leaps, or automobile accidents (Mair et al., 2021; Saad et al., 2019). Occasionally it results from relatively low-energy rotational stresses, such as those that occur in skiing injuries, however, these fractures often have less substantial comminution (Bartonícek et al., 2012; Mair et al., 2021).

The average age of the individuals in the existing study was 35.3 years and the greatest cause of their fractures was automobile accidents. Sports stressful events represented the vast majority of reasons for pilon fracture in the study by Etter and Ganz, (1991), and patients' average age was 41.9 years. In contrast, the report by Gülabi et al., (2012), noticed that the commonest causes of such fractures were falling from high altitudes, then minimal falls and lastly automobile accidents, when the average age of the sufferers was 46 years old. Since road traffic accidents made up the bulk of the casualties in this research, so they were younger in an age when compared to the other studies. Various fracture categories were reported in different studies utilizing the Gustilo-Anderson classification, compared to Biz et al., (2018), with grade III being exceedingly popular and Gülabi et al., (2012), where grade II was the utmost prevalent, to a greater extent grade II fractures were recognized to the greatest extent in the present research.

In terms of AO categorization, 47.6% of fractures were type 43 B, followed by 42.9% for type 43 C fractures, which is comparable to Juto et al., (2018), where type 43 B fractures were the greatest prevalent. Similarly, Wang et al., (2022), found that the 43-B type was the commonest among his patients. Whereas it was in contradiction to the results obtained by Youssef, (2019) where type 43 C was the commonest among the other types. According to a different interpretation of the study, in comparison to Type 43 A, 43 B, Type 43 C had a worse functional outcome, which was in accordance with the data provided by Korkmaz et al., (2013).

5. CONCLUSION

Patients with polytrauma frequently suffer from tibial pilon fractures. The majority of type B fractures as a result of traumatizing torsion mechanisms, such as slips and falls, while the majority of type C fractures are produced by high-energy compressive mechanisms, the most common example is automobile accidents. When analyzing the fracture pattern, it's also important to take into account the presence and the degree of soft tissue damage. Establishing the necessary strategies to tackle each pattern independently requires a rigorous and methodical strategic approach to understanding the patterns linked with it. To properly classify tibial pilon fractures and deal with factors that might adversely influence management outcomes, many orthopedic surgical facilities dealing specifically with such fractures must be established in Saudi Arabia. The obtained results ought to be confirmed by thorough prospective and quantitative research.

Acknowledgment

This study would not have been possible without participants, no matter how hard I tried. The participants in this study deserve my sincere thanks.

Ethical considerations

The institutional revision panel of King Saud Medical City granted its approval to this project (No. H1RI-19-Aug-19-01). A thorough explanation of the benefits of participating in the research was given to every patient who volunteered for the project. They subsequently accepted the informed consent for utilizing their details both verbally and in writing. The research was organized in conformance with the ethical guidelines indicated in the 2000 update of the Helsinki Declaration.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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