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EDITORIAL

Osteoarthritis after an ankle fracture: we can't really avoid it

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Introduction

Ankle fractures are common and highly prevalent injuries [1]. As a matter of fact, malleolar fractures represent from 9 to 18% of all fractures in the emergency department [2–4].

Ankle fractures can present a variety of clinical features [5]: fibula only, tibia only, bimalleolar, trimalleolar, and other possible associated lesions.

Usually, except for particular cases (elderly patients with decompensated diabetes, chronic inflammatory diseases in active phase, severe oedema, obesity, and peripherals vasculopathies) or some non-displaced extra-articular fractures, the treatment of ankle fractures is surgical.

The management of these lesions is often demanding, and the results are not always comparable to what expected [6]. The fracture complexity, an unsatisfactory reduction, or the loss of reduction after surgery can lead to malunions, which may alter joint axis, articular congruency, and physiological load distribution [6]. These conditions, if not treated, inevitably predispose to post-traumatic ankle osteoarthritis (PTAO).

However, PTAO does not occur only after ineffective treatments or complications.

Even with the evolution in management principles and although optimal surgery with an anatomical and stable fracture reduction is performed, the estimated risk of PTAO over time is extremely high, being from 20 to 40% [7].

End-stage PTAO is a disabling condition that affects about 1% of the general population. Some authors estimate an incidence of 30 cases per 100,000 population and this represents a share of 2–4% of all patients with OA [8, 9].

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PTAO incidence is increasing over time, with relevant high social and economic costs since typically tends to affect younger individuals compared to other joints [10–12].

The aim of the editorial is to highlight the incidence PTAO after a fracture, and to describe the prognostic factors related to PTAO development.

It is the author hope to further raise awareness of this frequent condition, in particular to young surgeons, and to improve the physician–patient relationship by better clarifying long-term expectations after an ankle fracture.

Incidence of PTAO after an ankle fracture

PTAO cannot really be ruled out, even after a simple fracture.

According to a recent systematic review published in 2022 [13], the incidence of PTAO, defined as a radiographic joint space narrowing, was 25% (95% CI 18–32), regardless of the fracture type. For more complex fractures, the incidence was higher: 34% (95% CI 23–45).

In brief, one in four ankle fractures seems to be followed by radiological PTAO, and after more severe fractures even one in three.

When the results are sorted by follow-up time, both studies with a short and long follow-up showed a high incidence of PTAO [13].

However, the period within which PTAO develops or becomes symptomatic with an indication for treatment cannot be specified, since the literature reports contradictory results.

As reported by Shih et al. [14] an early joint space narrowing is common (58% of cases) and occurs 12 months after a surgically treated malleolar fracture.

Regardless of the fracture type, Foy & Fagg reported that PTAO may become visible within 2 years after the trauma [15].

Papa and Meyerson reported a mean time between trauma and PTAO requiring an ankle fusion of 6 years (range: 1–24 years) [16].

Horisberger et al. found a more variable and latent period between trauma and PTAO requiring further surgeries (fusion or Total Ankle Arthroplasty (TAA)): this period was 21 years on average, ranging from 1 to 52 years [17].

Prognostic factors related to PTAO development after an ankle fracture

There are predictable and unpredictable factors related to PTAO development after an ankle fracture.

The severity of the trauma represents one of the most important predictable factors for the development of PTAO.

Although the occurrence of PTAO after an ankle fracture seems to be high, regardless of the fracture pattern, some fractures are thought to be more at risk than others.

Ankle fractures associated with exposure or dislocations are associated with higher rate of early PTAO [18]. The vast majority of these are lateral shear fracture dislocations (about 50%), followed for incidence by posterior and posterolateral dislocations. The dislocation, together with the high-energy trauma that caused it, strongly contributes to increase cartilage damage.

A higher risk of PTAO development was reported in association with trimalleolar fractures presenting a posterior fragment larger than 5% of the articular surface, and with isolated medial malleolar fractures [19].

Weber types B and C and fractures involving the posterior malleolus are other well-known PTAO predisposing factor [7, 20, 21].

A recent systematic review article [13] tried to perform separate subgroup analyses for different fracture patterns according to Weber classification, but there were insufficient data. However, subgroup analyses indicated that the incidence of PTAO for Weber BC was higher compared to Weber ABC without posterior malleolus involvement. Conversely, a regression analysis did not confirm a statistically significant relationship ($\beta = 0.18$; 95% CI − 0.06 to 0.42; $P = 0.14$).

According to other authors, additional prognostic factors can be associated with a higher incidence PTAO: age 30 years or more at the time of injury, [22] female sex [23], overweight and obesity [22].

The most important unpredictable factor related to PTAO development after an ankle fracture is represented by high-energy traumas which may cause associated lesions as vascular or cartilage damage, osteochondral lesions (OCLs) and ligament injuries.

Stufkens et al. highlighted the importance of OCL such as can occur also in simple Weber A fracture [24]. According to a recent review article [25], OCLs are frequently observed in patients with ankle fractures when assessed both directly after and at least 12 months after initial trauma (45 and 47%, respectively). Rotational type fractures seem to show a higher incidence of OCLs.

OCL may significantly vary in terms of morphology, and may include cartilage layers blistering, in-bone cystic lesions or bone layers, and cartilage fractures. However, OCLs are usually not evident on standard radiographs; therefore, they can be frequently misdiagnosed at first [24].

OCL treatment is ideally operative depending on the nature, size, and location of the lesions [26]. Considering the high incidence of OCL and the premature PTAO that the articular cartilage damage can cause, surgeons should be aware of these treatable concomitant injuries. This may improve the clinical outcomes when directly addressed during the first surgery.

As well as OCL, misdiagnosed ligament injuries, in particular of the syndesmotic complex [18] or the deltoid ligament [27] may predispose to PTAO. A non-anatomical healing of these structures can result in persistent pain and ankle instability, with high risk of early PTAO [28].

The described conditions represent the main pre-operative prognostic factors related to PTAO development after an ankle fracture, regardless of the good fracture reduction obtained with surgery.

With these premises, it is simple to imagine that in the face of such high percentages of PTAO risk, if the fracture reduction is not satisfactory due to technique errors or post-operative complications, the risk of developing PTAO further increases. This can happen in case of a distal tibia or/and fibula fractures malunion [6], or due to an insufficient posterior malleolus reposition [29].

Conclusions

PTAO after a fracture is an extremely common condition, even after a perfectly executed surgery.

The most important predictable factors for PTAO are: exposed fractures, fractures associated with lateral share dislocations, trimalleolar fractures, Weber types B, Weber types C, and fractures involving the posterior malleolus.

On the other hand, main unpredictable factors for PTAO are high-energy traumas which may cause several different associated lesions whose evolution cannot be precisely forecast.

Despite many efforts, orthopaedic surgeons can try to decrease but not avoid the risk of PTAO.

Through careful pre-operative study, it is possible to determine which patients may be at higher risk, in order to perform additional diagnostic investigations to exclude associated lesions.

Prior to surgery, it is important to discuss with the patient, and to explain the possibility of PTAO, irrespective of the success of the surgical procedure.

The patient should be also informed about possible therapeutic options in case of PTAO. In case of OCL or mild to moderate arthritis, regenerative treatments can be applied [26, 30], together with osteophytes removal when needed. In case of end-stage PTAO, ankle fusion [31], or TAA with innovative solutions [32–34], represents the treatment of choice.

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