


Polyethylene Fractures in Mobile-Bearing Total Ankle Arthroplasty: Report of 2 Cases

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Introduction

Total ankle arthroplasty is a widely accepted option treatment for ankle osteoarthritis.

The percentage of ankle arthroplasties' annual failure is around 1.2% (with a 95% CI from 0.7 to 1.6),¹² with survival rates varying between 70.7% and 84% at 10 years, according to some authors.^{3,6} Although decreasing, a wide range of complications have been reported for TAR. One of these complications, which has been infrequently described for the HINTEGRA TAA model (Newdeal SA), is fracture of the polyethylene mobile bearing.

In this report, we discuss 2 cases of polyethylene fracture at 8 and 9 years after their implantation, without any traumatic causes, from our series of 35 patients with HINTEGRA TAA replacements.

Cases Report

Case 1

A 53-year-old male patient underwent a TAA in 2011, owing to posttraumatic tibiotalar osteoarthritis, as a consequence of a fracture that took place 3 years earlier. As an early complication, he suffered a surgical wound dehiscence that healed completely 1 month later.

One year after surgery, the patient developed a continuous pain in the medial ankle. The clinical examination revealed a slight varus in the hindfoot (Figure 1), although the radiographic appearance was correct (Figure 2) and no misalignment of the implants was observed. Given the persistence of pain despite conservative treatment, we decided

to perform a percutaneous Achilles lengthening and a Dwyer osteotomy of the calcaneus in order to get some hindfoot valgus (Figure 3). The patient had an unremarkable postoperative course, the pain disappeared, and the ankle and foot alignment improved. Seven years later, he reported a recurrence of the symptoms in the medial side of the ankle and, consequently, in 2018 we decided to perform an arthroscopic debridement leading to the improvement of the symptoms, and where the polyethylene was seen as normal and without attrition.

In 2019, 8 years after the arthroplasty, the patient reported severe pain in the anterior part of the ankle, associated with some neuropathic pain in the area of the superficial peroneal nerve. This pain appeared suddenly, without previous trauma, and without having performed any type of unusual activity. During the physical examination, no significant findings were revealed with the exception of pain, because the gait was not affected. We could not detect any pathology in conventional radiographic studies; therefore, a computed tomographic (CT) scan was performed. In the CT scan, a rupture of the insert was suspected by observing an anterior

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displacement of its metallic marker, and a direct contact between the metallic surfaces of the tibial and talar components (Figure 4).

One month after the CT scan, in a radiographic study, the anterior displacement of the polyethylene's metal marker and a varus tilt of the ankle joint were clearly appreciated (Figure 5). A revision surgery was performed and a polyethylene fracture was seen in a coronal plane (Figure 6A). The polyethylene was replaced by another

one with the same thickness (6 mm), obtaining an excellent clinical and radiologic postoperative course.

It is worth noting the great difficulty in extracting the posterior fragment of the fractured polyethylene, being essential for us the maneuver of placing it in a sagittal plane before the extraction (Figure 6A). For this procedure, we used a pin-based distractor and laminar spreader simultaneously, which were helpful in achieving some space between the metallic components to be able to rotate the fragment and to extract it.

CASE 2

A 46-year-old man with posttraumatic ankle arthrosis, who suffered a rupture of the posterior tibial tendon, and presented a valgus deformity of the hindfoot. In 2009, owing to his hindfoot deformity, the patient underwent a reinforcement of the spring ligament and a transfer of the *flexor digitorum longus* tendon to the scaphoid. Owing to the progression of the hindfoot valgus deformity, 1 year later he underwent an arthrodesis of the Chopart joint and a medializing calcaneus osteotomy. In 2011, the patient showed an important arthritis of the ankle joint; therefore, a TAA was implanted. The postoperative course was favorable.

In 2019, 8 years after surgery, the patient reported an acute pain in the anterior and lateral sides of the ankle, associated with some neurologic symptoms in the area of the superficial peroneal nerve, without previous trauma. The radiographic study was normal (Figure 7). Therefore, a CT scan was performed, but no significant findings were observed in the subtalar joint (Figure 8). A sympathetic dystrophy was suspected, and we decided to continue with observation and periodic control by a pain specialized team.

One year later, the patient continued reporting pain with a similar pattern to the first case patient. Definitive diagnosis was confirmed with a new CT scan (Figure 4B), performed in 2020. We could appreciate similar findings with



Figure 1. Clinical appearance after left total ankle arthroplasty in case 1.



Figure 2. Case 1. Anteroposterior and lateral loading radiographs.



Figure 3. Case 1. Radiographic appearance after Dwyer osteotomy in anteroposterior and lateral views.



Figure 4. Computed tomographic scan where the anterior displacement of the polyethylene's metallic marker and the contact between the tibial and talar components can be seen in case 1.

case 1: an anterior displacement of the metallic polyethylene marker and a decrease in the space between the tibial and talar components. Consequently, the patient underwent surgery to replace the polyethylene for another with the same thickness (5 mm). Surgery showed the same pattern of insert fracture (in the coronal plane), and we had the same difficulty to extract the posterior fragment, requiring the maneuver described in the first case.

Discussion

HINTEGRA TAA model is made up of a smooth metallic tibial component, a mobile-bearing ultrahigh-density

polyethylene and a metallic talar component, all of them available in different sizes. Metallic components are manufactured with cobalt-chromium (CoCr), adding 2 layers of coating at the bone-prosthesis interface: titanium (Ti) with a porosity of 20% and hydroxyapatite (HA). Polyethylene insert is mobile, it has the same size as the talar component, and is available in 5- to 9-mm thicknesses.

This model of TAA entails different complications based on several reports, including, but not limited to, aseptic loosening of components, loss of mobility, subsidence, delayed wound healing, malleolar fractures, or polyethylene attrition. Nevertheless, polyethylene fracture is a rare complication described for the HINTEGRA TAA model. In one of the longest series published, Barg et al² reviewed 722 total ankle arthroplasties, with a follow-up mean of 6.3 years, concluding that 68 of them required revision surgery, a TAA replacement was necessary in 61 cases (27 of them needed both components to be replaced, 13 cases only needed the tibial component replacement, and finally, in 14 cases only the talar component was replaced), and a conversion to arthrodesis was needed in 7 cases; but they did not describe any case of polyethylene fracture.

In another series of 128 patients, Valderrabano et al⁹ describe the case of a TAA revision due to an early dislocation of the polyethylene insert (6 weeks postoperatively), but without its fracture. In this case, an evident varus tilt was observed in radiographs, most likely causing the polyethylene dislocation, and also generating a lack of stability of the talar component, which had to be replaced too. Yang et al¹⁰ in their 210-patient series with the HINTEGRA TAA model describe an isolated case of polyethylene dislocation, caused by a technical mistake; and Zafar et al¹¹ describe only 1 case of polyethylene fracture in their review of HINTEGRA TAA with a 12-year follow-up average.

In our aforementioned case 1, a slight varus tilt of the hindfoot was seen after the arthroplasty, which may have contributed to polyethylene fracture.



Figure 5. Lateral radiograph where the anterior displacement of the polyethylene's metallic marker can be seen and anteroposterior radiograph where we can see an ankle joint varus tilt.

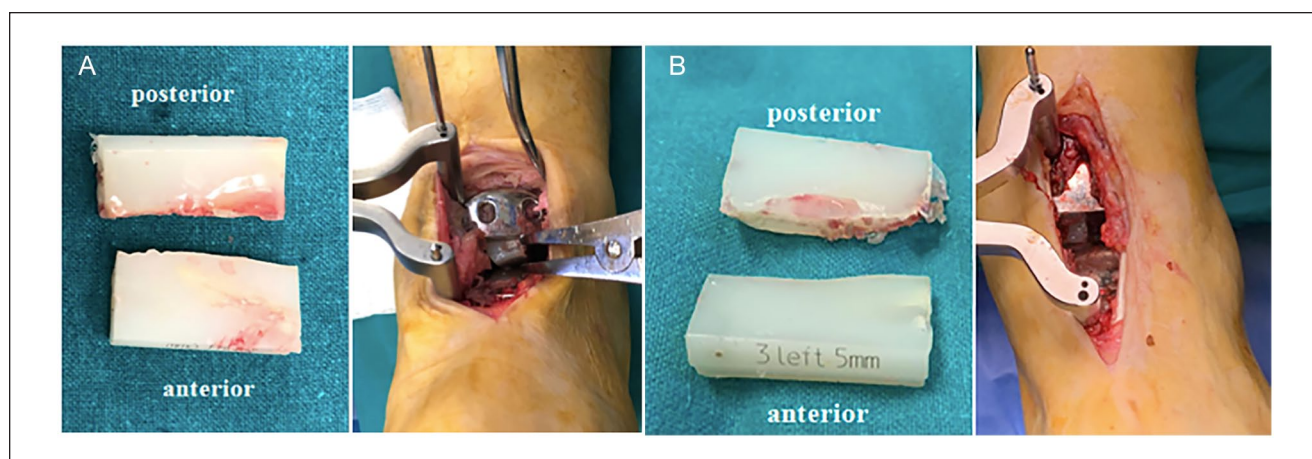


Figure 6. Fractured polyethylene and maneuver of placing the posterior fragment in the sagittal direction in (A) case 1 and (B) case 2.

According to Scott et al,⁸ it is reasonable to assume that misalignments in the coronal plane would produce polyethylene fractures in the sagittal plane, and misalignments in the sagittal plane would produce polyethylene fractures in the coronal plane. They describe it in their 3-cases article of polyethylene fractures in STAR (Scandinavian Total Ankle Replacement; Waldemar Link) TAA model, which also has a mobile-bearing polyethylene. In another review by Christensen et al,⁴ of 156 STAR ankle arthroplasties, 5 polyethylene fractures were reported; 4 of them were in the coronal plane and 1 of them presented a corner break.

Finally, in the case described by Assal et al,¹ it is also shown how misalignment in the coronal plane conditioned a sagittal plane rupture of the polyethylene in TAA.

In our 2 analyzed cases, we observed that a fracture in the coronal plane led to the displacement of the anterior fragment, causing some neurologic symptoms because of pressure in the area of the superficial peroneal nerve, which disappeared after the polyethylene replacement.

The initial diagnosis of polyethylene fracture is not easy but it can be predicted if the displacement of the metallic marker is appreciated in simple radiographs. The diagnosis can be confirmed by CT scan, where we can see 2 key images: a displacement of the metallic marker and a close contact between the tibial and talar components (Figure 4). In fact, Dahabreh et al⁵ present a case of another TAA model with mobile-bearing polyethylene, the Ankle Evolution System (Biomet Merck), where a displacement of the posterior metallic mark of the polyethylene insert is observed, in an arthroplasty that presents some varus misalignment.

Regarding the thickness of the polyethylene, Galeote et al⁷ affirm that the minimum thickness of polyethylene insert should be 5 mm, although other authors, such as Scott et al,⁸ recommend a polyethylene thickness greater than 7 mm. Christensen et al,⁴ in their article regarding STAR TAA model tears, described that the thickness of the fractured inserts was 6 mm in 3 cases and 7 mm in the other two.

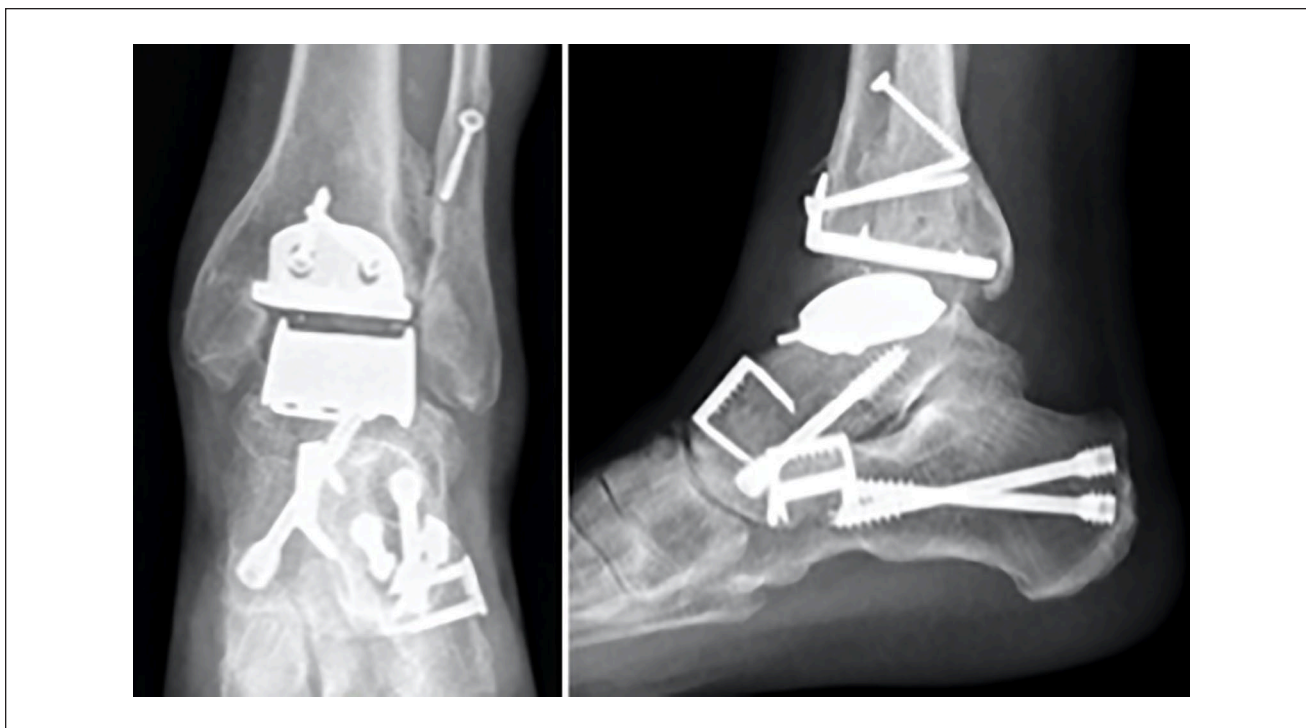


Figure 7. Case 2. Anteroposterior and lateral radiographs when pain started. It can be seen how the polyethylene metallic marker is not displaced.

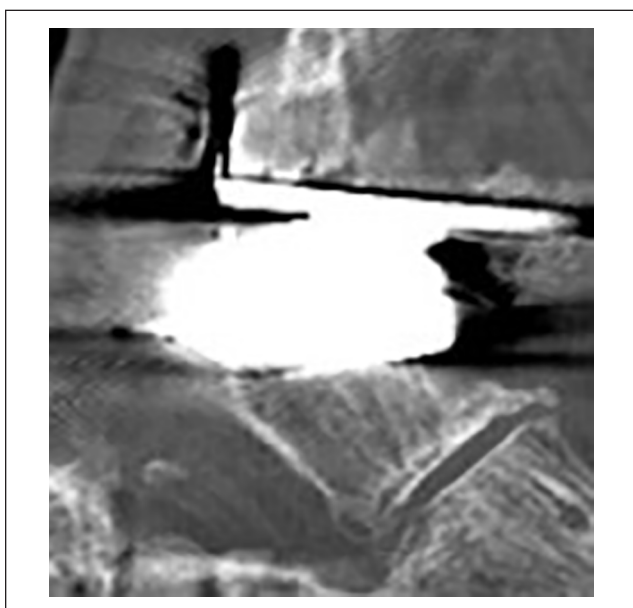


Figure 8. Computed tomographic scan where the anterior displacement of the polyethylene metallic marker can be seen, in case 2. The subtalar joint was not degenerated.

Therefore, it is reasonable to assume that the polyethylene thickness correlates with its resistance and performance, despite the fact that a greater bone resection will be required.

We also consider that the time after surgery must be taken into account, because our 2 cases occurred over 8 years postoperatively.

Concerning the surgical technique, we want to highlight the importance of the orientation in the sagittal plane of the posterior part of the fractured polyethylene in order to facilitate its extraction. The use of a distractor was also important, as can be seen in Figure 6.

Conclusions

Polyethylene fracture is an infrequent complication described in the HINTEGRA TAA model. Misalignment in the coronal or sagittal planes of the TAA components may be a risk factor for polyethylene fracture. Another possible risk factor for polyethylene fracture is an insufficient thickness of the mobile-bearing insert. In our cases, we believe that both polyethylene inserts' thicknesses, (6 mm in case 1 and 5 mm in case 2) may have been contributory.

Informed consent

Written informed consent was obtained from the patients for publication of this case report and any accompanying images.

Ethical Approval

Ethical approval was not sought for the present study because it consists of a description of clinical cases, but patients included in it did not participate actively.

Declaration of Conflicting Interests

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