Revolutionary PEKK Total Talus/Navicular Custom Resurfacing Prosthesis – First Case Report

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Figure 1: *Highly polished PEKK total talus/navicular bone prosthesis. Shown with 3 size options.*

This past week I had the opportunity to perform the first ever implantation of a highly polished 3-D printed custom PEKK implant by Oxford Performance Materials (OPM). While PEKK (poly-ether-ketone-ketone) has been used extensively in maxillofacial surgery over the last several years, it is just now becoming available to orthopedic applications to address segmental bone loss. It has several advantages when compared to the currently available metallic constructs which includes hypoallergenic properties, radiolucency, superior biological whickering, bone-like mechanics (similar modulus), thermoplastic stability, and intraoperative flexibility with the ability to modify the implant to optimize both fit and fixation. To say that this material is revolutionary is an understatement.

This was a 57 y/o female patient who presented with debilitating proximal foot pain around the talonavicular joint. She had a history of autoimmune disorder and has been on long-term steroid use. Radiographically, there was significant degenerative changes and dysplastic deformation of talar head and neck and collapse of the navicular bone. MRI and CT scans demonstrated significant subchondral cyst formation and evidence of avascular necrosis and collapse of the navicular bone and distal 1/3 of the talus. Traditionally, (prior to 3D printing availability) I would have attempted a resection of the non-viable bone and bridged a TN/NC fusion with STJ fusion with a large allograft bone bridge to fill the defect. I have done this in the past but found that the results were more often less than desirable. I was concerned about the patient's ability to heal in an area that already an AVN which becomes more challenging with her chronic steroid use. In more recent years, I have relied on custom printed titanium constructs to address this sort of problem. We are now seeing more and more cases of total bone replacement (talus) and resurfacing using metal. What we don't know is what are the long-term implications of highly polished metal against bone/cartilage. What we do know is that metal is unforgiving and does not mimic the bone modulus. I have personally seen cases where patients reject the metal interface, and the opposite bone seemingly melts/disintegrates around the metal. We also know that metal constructs do not allow intraoperative flexibility when it comes to fixation.

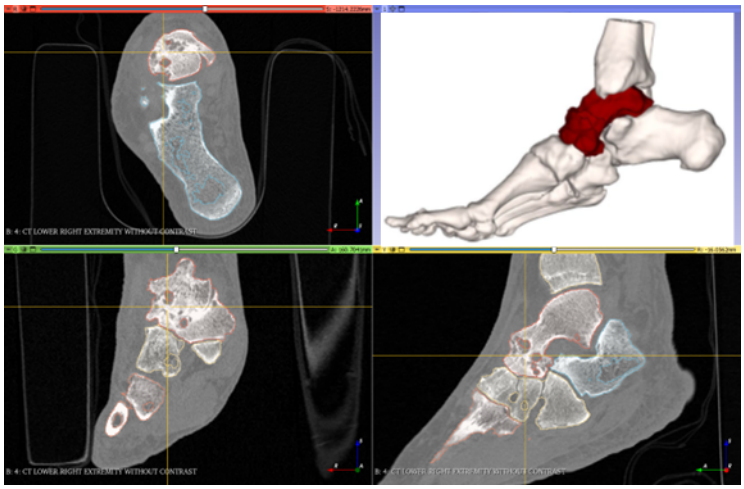


Figure 2: *CT scan and 3D modeling of right foot demonstrating severe cystic formation of the distal talus and navicular bone with suspected pathological fracture of the talar neck.*

In this case I chose to use a highly polished PEKK construct to take the place of both the navicular and talus in a fused status. This would eliminate the patients need to fuse through poorly vascularized region and would allow for articulations at the ankle, subtalar, and naviculocuneiform joints. While I thought about having a fusion interface to the calcaneus for stability purposes, I ultimately elected to resurface there instead as it allows for easy conversion to a hybrid total ankle joint in the future without the need to disrupt a fusion site.

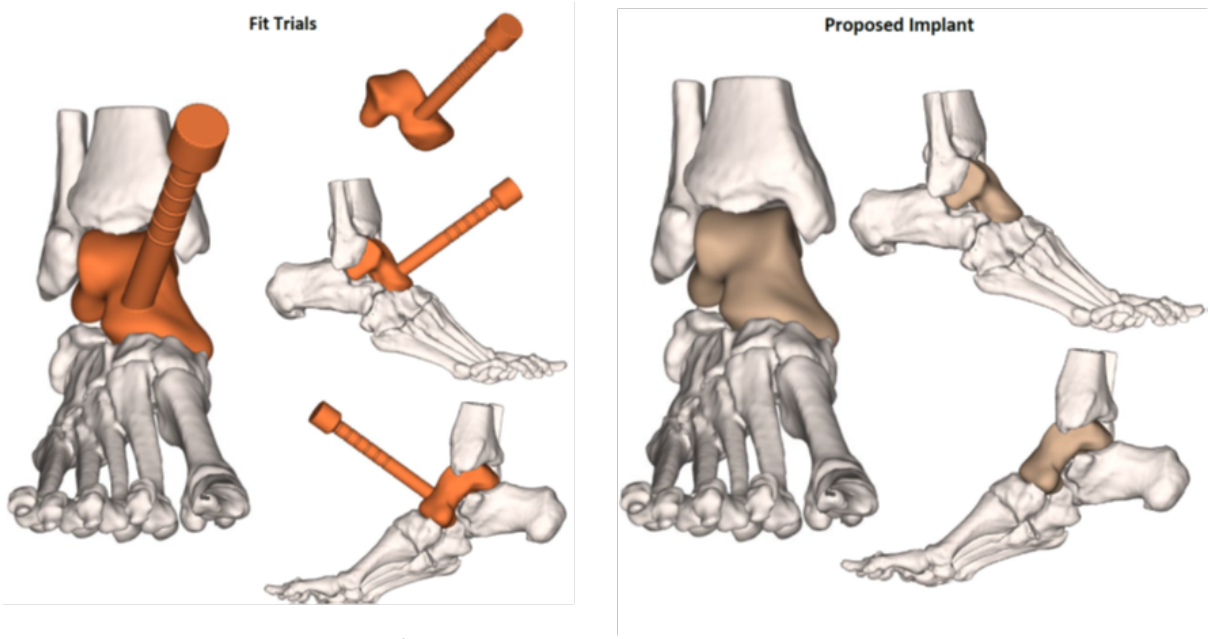


***Figure 3**: 3D rendering of the total talus/navicular prosthesis with the trial and actual implants.*

The surgery was performed with a midline incision between the EHL and Anterior Tibial tendons to expose the talus and navicular bones. A talectomy and an excision of the navicular bone was done leaving the tuberosity intact with the Tibialis Posterior tendon attachment. Trial sizers were then used to check size, fit, and stability of the implant. In this case we opted for the nominal size.

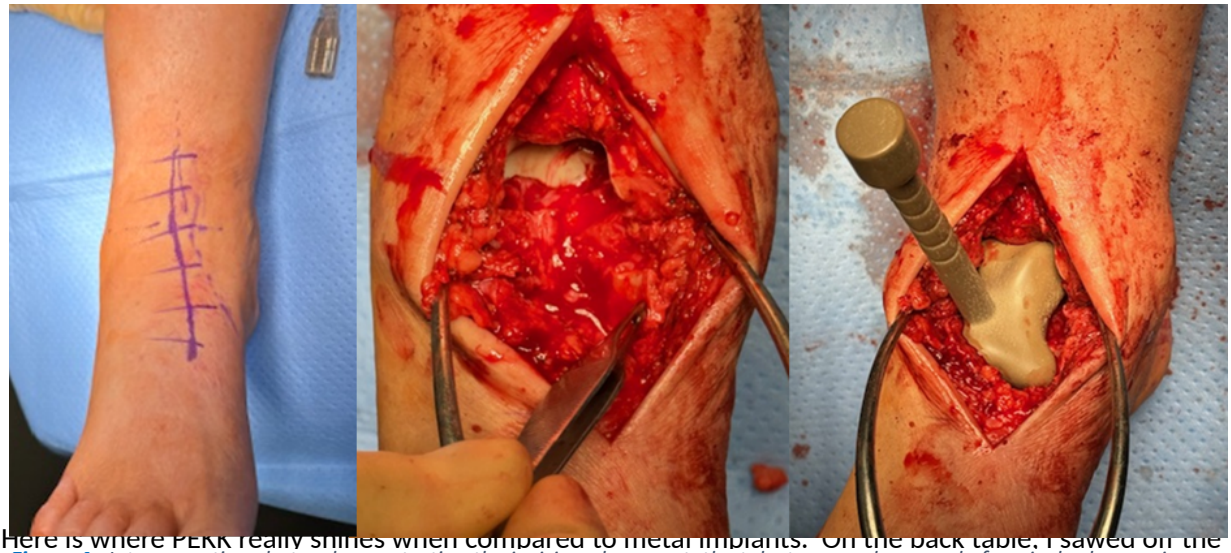
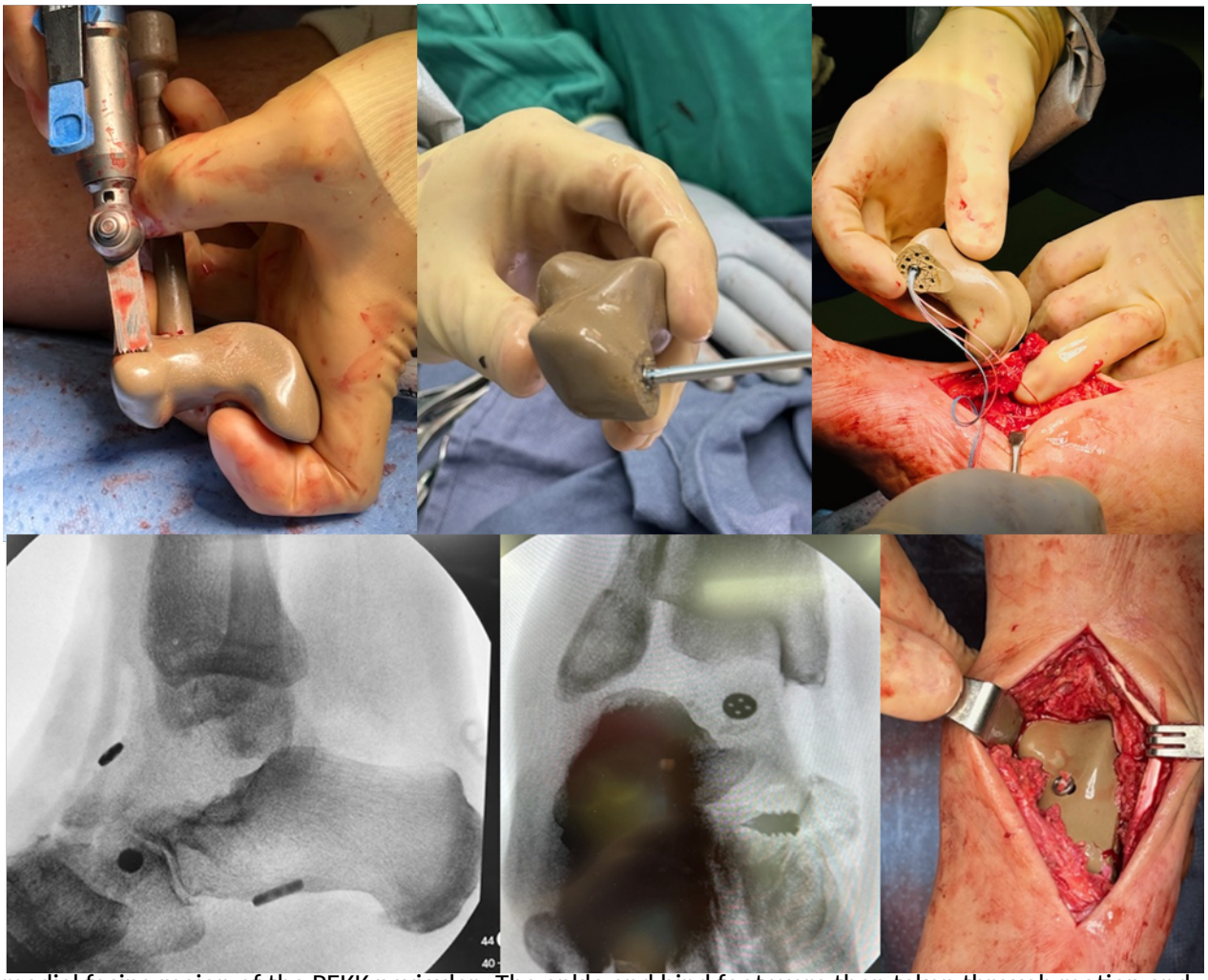


***Figure 4:** Intraoperative photos demonstrating the incision placement, the talectomy and removal of navicular bone minus the tuberosity and the trial prothesis.*

Here is where PEKK really shines when compared to metal implants. On the back table, I sawed off the t a suture anchor. The PEKK construct was then implanted, and the sutures were brought through drill holes in the navicular tuberosity and used to anchor the tuberosity with the tibialis posterior tendon to the

***Figure 5:** **A**. Intraoperative modification of the PEKK total talus/navicular prothesis. **B.** Insertion of the bone anchor which was optimally placed during the surgery and did not require preoperative planning. **C**. Sutures passed through the navicular tuberosity to anchor the tibialis posterior tendon to the prothesis. Notice the rough texture that was created intraoperatively to allow for tissue ingrowth. **D/E.** Intraoperative imaging demonstrating the placement of the dynamic suture button to mimic the cervical ligament. This also demonstrates the improved visibility of the surrounding joints/anatomy when compared to the opaque nature of metallic protheses. **F.** Final implantation. Range of motion was smooth and there was no visible instability noted to the prothesis at all articulations.*



medial facing region of the PEKK navicular. The ankle and hind foot were then taken through motion and vasus and valgus stressing and found to be stable. I decided to augment the stability of the construct, especially with the pull of the Tibialis Posterior, so I drilled through the implant at the talar neck region to the calcaneus and placed a suture button there to mimic the cervical ligament. This intraoperative flexibility was something that I have not experienced with metal constructs and makes me really excited about the potential of custom printed PEKK in complex reconstruction cases of the foot and ankle.

It should be noted that no tourniquet was used during this surgery and the patient only took Tylenol and Advil post-operatively and did not need to utilize narcotics during the first week of recovery. Also, a PICO negative pressure incisional vacuum was placed with an automated icing sleeve built into the posterior splint. The patient was converted to a boot at post-operative week one and has started non weight bearing range of motion exercises and will start weight-bearing at postoperative week 4 in a boot for an additional 2-3 weeks. I will then have her transition to a regular shoe with a Tayco Ankle Brace which she will eventually wear during strenuous activities.

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