

Custom 3D Printed Trabecular Metal Endoprosthesis for Limb Salvage and Reconstruction of Large Tibial Defects Following Osteosarcoma Resection



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Statement of Purpose

- This case study presents a unique approach for reconstruction of a large distal tibial defect following resection of an osteosarcoma.
- The technique utilizes a custom endoprosthetic talar fusion device and a custom segmental implant, associated with a positive long-term functional outcome for the patient.

Literature Review

- Distal tibia osteosarcoma is a rarely encountered malignant tumor.
- Traditionally, below-knee amputation was considered the primary choice for treating distal tibial osteosarcomas and was believed to yield a safe margin with a predictable outcome.
- However, with the recent advances in surgical techniques and chemotherapy, limb salvage is now widely applied to the treatment of distal tibial osteosarcoma.
- Recent literature suggests limb salvage can produce better functional outcomes for patients with a similar rate of complications, survival, and local recurrence when compared to proximal amputations.
- Limb Salvage for these cases typically consists of two procedures including “en bloc” resection of the tumor followed by reconstruction of the remaining tibial defect.
- The large remaining defect in the distal tibia presents a surgical dilemma, with many surgical treatment options described in the literature including custom made endoprostheses, autografts, allografts and tibiotalar arthrodesis.
- However, despite various surgical options for reconstruction, many of these treatments still result in medium-term morbidity, as well as deterioration of function with time.
- This has led to a lack of consensus amongst surgeons when faced with determining definitive treatment in this patient population.

Case Study

- We present a case study of a 17-yr-old male patient with no significant past medical history that presented with an aggressive bony lesion of the distal tibia on MRI, which was confirmed via bone biopsy as an osteosarcoma
- A bone scan was also completed at this time, which was negative except showing increased uptake at the site of the primary tumor.
- Upon the patient’s initial presentation and diagnosis, treatment consisted of several rounds of chemotherapy.

Case Study Continued

- Three months later the patient had surgery, including wide en bloc resection of the tumor with an outside surgeon that resulted in a 19 cm deficit of the tibia and fibula with pathology revealing a tumor free proximal margin.
- In order to address this deficit, the patient underwent an attempted tibiotalar fusion utilizing a combination of allograft and iliac crest autograft placed in the tibial defect.
- Fixation consisted of a humeral blade plate and intramedullary tibial nail as seen in *Image #1* below.
- Unfortunately, the allograft became infected with associated dehiscence of the surgical site.
- Over the course of one year, the patient underwent multiple attempts of surgical debridement and use of antibiotics beads, but the hardware eventually become exposed and had to be removed.

Image #1



Image #2



- Afterwards, the patient was treated with a 6 week antibiotic course, and was found to completely heal at the surgical site without clinical evidence of recurrent infection.
- After being offered a proximal amputation as treatment from the outside surgeon, the patient presented to Dr. Wodajo for a final attempt at limb salvage.
- Initial surgical management included washout and debridement of the surgical site with temporary insertion of an antibiotic infused cement spacer as noted in *Image #2* above.
- Six months later, definitive surgical treatment included a 2-part procedure including:
 - Removal of the cement spacer
 - Complex Reconstruction of left distal tibia with segmental implants and custom endoprosthetic trabecular metal tibiotalar fusion device



Implant description: straight fluted tibial stem 190 x 12.5 mm, custom endoprosthetic trabecular metal cone against talus with a single 6.5-mm cannulated cancellous screw in the calcaneus

Results

- Post-operatively, the patient was kept non-weight-bearing in a posterior splint and CAM boot until fusion was confirmed on a CT scan at 3 months post-operatively.
- Afterwards, the patient was transitioned to full weight-bearing with the use of a custom ankle foot orthosis at this time to assist with foot clearance during gait.
- The patient was noted to be pain free with ambulation, and was able to participate in recreational sporting activities with friends, including pick-up basketball games.



Results Continued

- There were no further surgical interventions necessary, and the patient continued to follow up in the clinic for over 9 years while remaining pain free with ambulation with the assistance of an ankle foot orthosis.
- The tibiotalar fusion maintained stable anatomical alignment, and provided a stable plantigrade foot demonstrated on yearly CT and radiographic scans following the definitive procedure.



Analysis & Discussion

- Following resection of osteosarcoma of the distal tibia there is often a large residual defect with many reconstructive techniques described in the literature yielding medium-term morbidity, as well as deterioration of function with time due to construct failure.
- To our knowledge, no cases have been described in the literature for fixation of distal tibial defects utilizing a custom endoprosthetic, talar fusion device, as well as a custom segmental implant for reconstruction of a large defect without deterioration of functional outcome over a long follow up period.
- This case study demonstrates the use of a custom made, 3D printed endoprosthetic trabecular metal tibiotalar fusion device for definitive treatment of distal tibia osteosarcoma without medium-term morbidity or deterioration of function due to construct failure over time.
- This case can serve as an example of why limb salvage with utilization of custom made hardware should be considered as an alternative to below-knee amputations in patients with distal tibial osteosarcomas.

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