CASE REPORT

Endoprosthetic reconstruction for giant cell tumors of the distal tibia: A short term review

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Abstract

Custom-made endoprosthetic reconstruction for distal tibia tumors is a viable option of treatment in carefully selected patients. It maintains satisfactory function and provides good pain relief. We report four cases of giant cell tumors of the distal tibia successfully treated by endoprosthetic reconstruction. This is a feasible option in cases of this nature and offers a better function than the other available options.

Key words: pathology, sarcoma, surgical oncology.

INTRODUCTION

A giant cell tumor (GCT) of bone is a benign and locally aggressive lesion. It usually involves the metaphyseal-epiphyseal region of long bones. It is a relatively rare at the ankle but is known to behave unpredictably when situated at that location. It comprises less than 4% of GCT cases. The usual mode of treatment for these tumors is extended curettage but for recurrence of the tumor, below-knee amputation has been the treatment of choice because complete excision of tumors in this region is difficult to achieve and reconstruction options usually give poor functional results. This is due to the tumor’s subcutaneous location and the proximity of the distal tibia to the neurovascular bundle and tendons. However, limb salvage has replaced amputation as the mainstay of surgical treatment in tumors in the other regions such as the proximal femur, the distal femur and the proximal tibia, principally because of improvements in surgical technique and in the design and production of the implant.

An endoprosthetic replacement enables the early restoration of function as the patients can bear weight early. The prosthesis that we use is custom-made from Eagle Osteon Technologies, Chennai, India. Figure 1 shows the stretch by the engineers, which is made based on measured roentgenograms and the length of resection, which is determined by the surgeons. The prosthesis is made from titanium alloy and consists of two components that are locked together by the three screws and a central peg (Fig. 2a). The distal component has a saddle joint that sits on the dome of the talus and is stabilized by four screws into the talus (Fig. 2b). The saddle joint consists of a bar lined with a polyethylene liner that articulates with an oblong hole at the superior aspect of the talus end of the prosthesis. The proximal component has a cylindrical stem that is cemented intramedullary to the proximal end of the tibia. The articular surfaces are lined by ultra-high molecular-weight polyethylene. The movement at the ankle is not a hinge movement, rather a saddle joint movement to better mimic the mechanics of a normal ankle joint.

Operative technique

The anterior lateral approach was used for all patients. The biopsy tract is excised in all patients. The tumor is dissected with wide margins. The proximal bone cuts were made 3 cm from the distal margin of the tumor. The cartilage over the talar dome is shaved off and the head of talus is fashioned to fit the cup end of the implant.
prosthesis. This component is cemented onto the talus and secured with four fully threaded 4-mm cancellous screws (Fig. 3a). The proximal end of the bone is reamed to 2 mm bigger than the stem diameter and the stem is cemented in without a cement spacer. The two components are reduced and locked together by the peg and secured by three screws (Fig. 3b). The final implant in situ is shown in Figure 4.

To date there are only three publications on the endoprosthetic replacement of the distal tibia.1–5 We report our series of four cases of recurrent GCT of the distal tibia that were successfully treated with wide resection and endoprosthetic reconstruction. We believe that distal tibial endoprosthetic replacement is a viable option that enables patients to maintain their limbs and function.
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Patient 1
This is a 25-year old man who presented with a right ankle swelling 8 years prior to presentation. A diagnosis of GCT of the distal tibia was made by radiography (Fig. 5a) and confirmed by a needle biopsy. He underwent an extended curettage and bone grafting. No adjuvant treatment was given. In August 2007 he presented again with recurrence of pain over the ankle for over 6 months. The pain had been getting progressively worse and a roentgenogram showed a recurrent expansile lesion over the distal tibia, suggestive of a recurrence, Campanacci grade 2 (Fig. 5b). The diagnosis was reconfirmed with a needle biopsy. A wide resection of the distal tibia with endoprosthesis replacement was done on September 2007. The patient was allowed full weight bearing 3 days after the surgery and started walking unaided 2 weeks afterwards. The latest radiograph taken 30 months after the surgery is shown in Figure 6. There is no evidence of loosening. His latest Musculoskeletal Tumor Society (MSTS) score is 86.7%.

Case 2
The second patient is a 16-year-old girl who presented with a 6-month history of aching pain and swelling of the right ankle when she was first seen, by our oncology unit in 2004. The patient had no systemic symptoms or problems related to the joint. On examination, the patient walked normally and had slight tenderness to palpation of the distal part of the tibia. Radiographs revealed a lytic expansile lesion in the distal metaphysis of the right tibia. The diagnosis of a GCT of the bone was established with a biopsy. The lesion was curetted, the distal end of fibular was excised together with the lesion and the cavity was filled with corticocancellous bone graft from the iliac crest and the middle portion of fibula was used to reconstruct the ankle joint. The

Figure 3 (a) The distal component cemented onto the talar dome and secured in with four screws, (b) the proximal and distal components are reduced and locked together with the peg and three screws.

Figure 4 Intraoperative image of the implant in situ. Proximally the implant is cemented into the proximal tibia and distally it is cemented into the dome of talus, augmented with screw fixation (two screws anteriorly and two screws posteriorly).
Figure 5  (a) Roentgenograms of the right distal tibia showing an expansile lesion in the right distal tibia located at the metaphysis extending into the epiphysis, (b) the repeat roentgenograms after 8 years, showing recurrence of the expansile lesion of the distal tibia with multiple areas of cavitation.

Figure 6  The latest radiograph for patient 1. There is no evidence of loosening and there is bone growth over the proximal attachment of prosthesis.
postoperative patient resumed full weight-bearing within 3 months.

She remained asymptomatic for 3 years. In December 2007 she noted progressively worsening pain with activity and the recurrent swelling of the right ankle. Radiographs revealed a recurrence of the lytic lesion in the distal part of the right tibia, as shown in Figure 7a. A study of a specimen obtained by means of a needle biopsy revealed the diagnosis of recurrent GCT of the bone. A wide resection of distal tibia with endoprosthesis reconstruction was done in February 2008. Postoperatively, she recovered well and went back to college. About 2 years after the surgery, she developed over the shin a sinus discharging pus and complained of occasional mechanical pain over the region. The radiographs taken show septic loosening over the proximal end of the implant (Fig. 7b). The wound cultures grew a methicillin-resistant staphylococcus infection. She refused two-stage revision and is currently on chronic antibiotic suppression. Her latest MSTS score is 73.3%.

Case 3

The third patient is a 27-year-old man who presented with a 9-month history of increasing pain and decreasing motion in the right ankle when our unit first saw him in March 2004. Radiographs revealed a lytic expansile lesion in the distal part of the right tibia. After a biopsy confirmation, an extended curettage and autologous bone grafting was carried out from the iliac crest. In September 2007 the patient had recurrence of disease. He went to another institution and an amputation was planned but he defaulted.

In February 2008, when he came to see us, he was walking with non-weight bearing crutches. Radiographs show the expansion and thinning of the distal tibia cortex, suggestive of a recurrence of the tumor, Campanacci grade 3 (Fig. 8a). After a biopsy confirmation, a wide resection and endoprosthetic replacement was done. He was back to function within 2 weeks. On follow up, it was noted that his ankle was in 15 degrees valgus and the follow-up radiograph showed talar collapse (Fig. 8b) but the implant was still stable and he is able to bear his full weight without any pain. His latest MSTS score is 80%.

Case 4

This is a 26-year-old man who presented with a 6-month history of right distal tibia swelling and a 2-month history of pain. The radiographs and magnetic
resonance imaging at presentation are shown in Figure 9a. We opted for an endoprosthesis replacement as the lesion was extensive and involved almost the entire distal tibia. He underwent the surgery in July 2009. The resected specimen and the endoprosthesis are shown in Figure 9b. He was bearing weight on day 2 postoperatively and was able to walk without assistance after 2 weeks. His latest MSTS score is 90%.

Figure 8 (a) Expansile lesion over the right distal tibia (Campanacci grade 3), (b) talar collapse with backing out of screws but the implant appears stable.

A summary of all the four patients is given in Table 1. The details of the MSTS score are shown in Table 2. The average MSTS score 82.5%.

DISCUSSION

GCT generally occurs in those with mature skeletons with a peak incidence in the third decade of life. GCT of
the foot and ankle are very rare and occur commonly in young adults with an average age of 28.8 years.

Various forms of treatment for GCT of the distal tibia have been proposed, including extended intra-lesional curettage, with the use of phenol, cryotherapy and burr and bone grafting, cryotherapy, cementation, limb salvage and even amputation. Traditionally, transtibial amputation has been the treatment of choice for treating local bone tumors involving the distal tibia and fibula. A wide margin of resection and a satisfactory functional result with an appropriate below-knee prosthesis can be achieved with amputation. However, amputation is associated with significant psychological, physical, social and financial cost to patients.

As the surgery of limb salvage has developed, reconstruction of ankle joint has been attempted using autografts, allografts and endoprosthesis. Among the many options of reconstruction, arthrodesis was regarded as the best option. It provided excellent stability of the ankle joint and avoided problems relating to prosthetic implantation. A study by Casadei et al. reported a good functional outcome in patients with distal tibia tumor treated by resection and autogenous bone graft arthrodesis. However, arthrodesis of the ankle has several limitations, including the loss of joint movement, a long period of recovery, the need for multiple operations to achieve arthrodesis and the possibility of non-union. This was overcome by the use of vascularized free fibular graft, which gave better union rates but still a stiff ankle. Shalaby et al. reported a series of six cases of osteosarcoma of the distal tibia treated with fibular grafts (vascularized and non-vascularized) stabilized with an Ilizarov external fixator. It took an average of 13.2 months to achieve union and he reported that the vascularized grafts gave a better union than non-vascularized grafts. Their average MSTS score was 70%. Jeon et al. reported a series of nine patients where the reconstruction was done with pasteurized autograft. In his series, six patients had post-operative complications such as a superficial wound infection, non-union and fracture.

In our series of four cases, patients were allowed to bear weight 2 to 3 days after surgery and after 2 weeks were back to full function. The average MSTS score in this series is 82.5%. We did not encounter soft tissue problems, as all four cases were GCT and the resections were done close to the bone, preserving the soft tissue envelope. Thus, limb salvage operations using distal end endoprosthesis have potential advantages compared to biological alternatives. These include early stability, early mobilization and weight bearing, and a better appearance and psychological acceptance. All the patients in our series showed excellent stability of their ankles at the latest follow up. All the patients had an excellent oncology outcome. One had a talar collapse without loosening of the implant or compromising his function. Another patient developed deep infection with methicillin-resistant staphylococcus but still maintained the endoprosthesis with chronic antibiotic suppression. The remaining two patients are functioning well. Abudu
et al. concluded in their series of five patients that endoprosthesis replacement of the distal tibia has a significant medium-term morbidity and functional deterioration. Shekkeris et al. in his series of six patients, reported deep infection in two cases that eventually lead to amputation. The average MSTS score for the remaining four patients in his series was 70%. He concluded that endoprosthetic replacement is a viable option providing that patients understand the risk of uncontrolled infection, which may lead to amputation.

The prosthesis that we use is custom made by Eagle Osteon Technologies, Chennai, India. It has a semi-constrained joint at the ankle portion. Our design does not have an osseous integration collar proximally for long-term bone in growth and stability. We foresee loosening as one of the problems that we might face in the long term due to the high torsional forces that are transmitted through the bone-implant junction. We have highlighted this potential problem to the manufacturers and have advised them to incorporate it in their future designs. So far, in our follow up, there have been no cases of loosening.

We believe that distal endoprosthetic replacement is a feasible option in cases of extensive distal tibia tumors (especially locally aggressive tumors) that would otherwise require amputation. It enables us to maintain a functional ankle joint and an almost full function of the limb. However, it is still early to predict the long-term survival of this implant in our series of patients.

REFERENCES