Palliative limb salvage using a retrograde nail-cement composite after intercalary resection of a distal femoral osteosarcoma: a case report

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ABSTRACT

Malignant lower-limb metaphyseal and diaphyseal bone tumours that have not yet invaded the epiphysis can usually be managed with limb-sparing surgery. Reconstructions using intercalary allografts, autoclaved autografts, extracorporeally irradiated autografts, vascularised autografts, and distraction osteogenesis have all achieved favourable results. In patients with metastatic disease and a short life expectancy, reconstruction using allografts or autografts should be carefully considered because a long recovery period is needed. An intercalary endoprosthesis provides immediate stability, a short recovery period and a low implant failure rate. Nonetheless, it may be expensive when there is inadequate space for stem insertion, necessitating a custom-made endoprosthesis. We present a 12-year-old boy with stage-III osteosarcoma of the metaphysis and diaphysis of the femur who underwent knee joint salvage and reconstruction with a retrograde, locked, intramedullary nail surrounded with methylmethacrylate. At the one-month follow-up, the patient could walk unassisted. At the 2-year follow-up, his Musculoskeletal Tumor Society score was 83%. The patient died from lung metastases at 31 months. He had not experienced any complications with the reconstruction.

Key words: fracture fixation, intramedullary; limb salvage; methylmethacrylate; osteosarcoma

INTRODUCTION

The distal femoral metaphysis is the most common site for primary malignant bone tumours in children. For tumours close to, but not invading, the epiphyseal area, part of the epiphysis should be salvaged to maximise knee function and minimise leg length discrepancy. Such limb-sparing procedures include reconstruction with intercalary allografts, autoclaved autografts, extracorporeally irradiated autografts, vascularised autografts, distraction osteogenesis, and an intercalary endoprosthesis. In patients with metastatic disease and a short life expectancy, reconstruction using allografts or autografts should be carefully considered because...
these require a long recovery period. An intercalary endoprosthesis provides immediate stability with a short recovery period and a low implant failure rate. Nonetheless, these can be expensive when there is inadequate space for stem insertion, necessitating a custom-made endoprosthesis.\(^{12}\) We present a 12-year-old boy with an osteosarcoma of the distal femur who underwent knee joint salvage and reconstruction with a retrograde, locked, intramedullary nail surrounded with methylmethacrylate. Excellent stability and a full range of knee motion were achieved immediately after the surgery.

**CASE REPORT**

In July 2005, a 12-year-old boy presented with a 5-month history of painful swelling in his left distal thigh after a minor injury while playing football. He also complained of pain at night and at rest. A physical examination revealed a 10x10 cm firm, tender, soft-tissue mass in the anterolateral aspect of his distal thigh, with intact overlying skin. Pain restricted his knee range of motion to 0º to 90º of flexion. His neurovascular examination was normal.

Radiographs revealed a mixed osteolytic and osteoblastic lesion in the distal metaphysis with a periosteal reaction showing a ‘sunray’ appearance (Fig. 1). Magnetic resonance imaging revealed that the lesion was invading the lateral side of the vastus intermedius. The lesion measured 5x6x18 cm, including superior marrow extension and a soft-tissue component (more on the lateral side) [Fig. 2]. The neurovascular structures were not involved. The lesion was heterogeneous and hypo-intense in T1-weighted images, and hyper-intense in T2-weighted images. Technetium-99 methylene-diphosphonate bone scintigraphy showed increased uptake in the distal femur only. Computed tomography of the chest revealed 6 nodules scattered through both lungs, varying from 0.4 to 0.8 cm in size. No metastases were found in his abdomen and pelvis.

Examination of tissues extracted during an open biopsy confirmed the diagnosis of stage-III osteosarcoma. He was commenced on neoadjuvant chemotherapy consisting of adriamycin and cisplatin. After 3 cycles of chemotherapy, the size and number of the lesions were not reduced. Amputation was not performed to achieve local control, because the tumour had not invaded the epiphyseal area and its anatomical location permitted a wide resection. To maximise his knee function and limit any leg-length discrepancy, a wide resection salvaging part of the epiphysis and a reconstruction using a retrograde intramedullary nail surrounded with methylmethacrylate was selected. This enabled early weight bearing and demanded a shorter recovery period, something very important for a patient with a short life expectancy owing to multiple pulmonary metastases. Adjuvant chemotherapy and a pulmonary metastasectomy were also planned.

Magnetic resonance imaging was performed to evaluate the extent of the tumour and to rule out any skip lesions. The resection lines were marked above the knee joint (the epiphyseal plate) 10 cm on the lateral side (to achieve a 4-cm margin), 5 cm on the medial side (because marrow oedema was more distal

![Anteroposterior and lateral radiographs showing an osteosarcoma in the metadiaphyseal area of the femur.](image)
Osteotomies were performed using an oscillating saw. All tumour margins were grossly clear and covered entirely by the vastus intermedius muscle. Both proximal and distal marrow and the tumour specimen were sent for pathological examination. A bone defect of about 25 cm was created.

A retrograde intramedullary femoral nail (11x360 mm, M/DN; Zimmer, Warsaw [IN], USA) was used and surrounded with methylmethacrylate. The entry point was created using a sharp awl 4 mm anterior to the posterior cruciate ligament insertion. After a guide wire was placed, the femur was reamed to 12.5 mm for insertion of an 11-mm nail. The intercalary defect was kept equal with the length of the resection. The nail was locked with 2 screws proximally and 3 screws distally to provide rotational stability. Four bags of Simplex methylmethacrylate bone cement (Stryker, Howmedica, Osteonics, Allendale [NJ], USA) were moulded around the nail to shape the resected ends of the femur using a freehand technique. After the cement hardenened, the excess cement was removed with a rongeur and high-speed burr. Good stability and a full range of motion in both the knee and the hip were achieved. The operating time was 3.5 hours, approximately 2 hours for the resection and 1.5 hours for the reconstruction. The estimated blood loss was 400 ml. Postoperative radiographs revealed an acceptable alignment of the nail but an uneven bone cement surface (Fig. 3).

One week postoperatively, the patient could bear weight partially with the aid of 2 crutches. One month postoperatively, he could walk unassisted, but was advised to use one crutch for walking. Only 20% of the resected specimen showed tumour necrosis. Ifosfamide was added to his adjuvant chemotherapy, but the patient’s parents refused to allow a pulmonary metastasectomy. The patient returned to school 3 months later. His functional score was 83% according to the Musculoskeletal Tumor Society (MSTS) scoring system. During his 2-year follow-up, a 1.5-cm limb length discrepancy was noted. The metastatic lesions in his lungs progressed gradually and he died 31 months after surgery. He could ambulate fully until his last admission and had no local recurrence or complications.

DISCUSSION

Osteosarcoma is the most common malignant bone tumour seen in children and young adults. Over the past 3 decades, more effective chemotherapy regimens and surgical techniques have improved the prognosis for patients with localised osteosarcoma.
considerably. In most cases, limb-sparing procedures achieve superior mechanical results and adequate disease control. Nonetheless, the prognosis for patients with metastatic osteosarcoma remains unfavourable.

Limb-sparing surgery usually involves intra-articular resection of the distal femur with a variable amount of the surrounding soft tissues to achieve an adequate tumour-free margin. When the epiphysial area has not been invaded by tumour, part or all of the epiphysis may be salvaged, because no joint replacement (prosthetic or allograft) can function as well as the normal knee. Distal femoral resection and replacement with an endoprosthesis is a good option but has less favourable functional results than knee-salvage procedures. An intercalary allograft with intramedullary cement reduces the fracture rate and improves the survival of the allograft, but the protected weight-bearing period must continue until allograft incorporation, and in some countries the supply of allograft is limited. A retrograde, locked, intramedullary nail surrounded by methylmethacrylate can salvage the knee joint and achieve immediate stability, with less blood loss and a shorter operating time.

Methylmethacrylate provides immediate and long-term stability for the construction, support for a segmental defect, and can be moulded into different shapes. This technique has been used for pathological fractures of the femur and tibia, achieving good stability and range of motion, and early weight bearing. Nevertheless, the freehand technique used to mould the cement results in an uneven cement surface.

Although our patient did not survive long enough to provide evidence of the durability and complication rate of this type of construction, he had a good functional outcome and no complications for at least 2.5 years. This construction is useful for palliative treatment in patients with metastases and a relatively limited life expectancy. Long-term follow-up studies are needed to determine the potential complication rates and durability of this construction.

REFERENCES


