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CASE REPORT

A Frugal Method of Reconstruction Following Resection of Osteosarcomas Around the Knee Joint.

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ABSTRACT

Osteosarcoma is the commonest primary malignant bone tumour which has a bimodal age distribution and presents mostly around the knee joint. With advances in chemotherapy, medical imaging, surgical techniques and implants, limb salvage surgery (LSS) has become a norm. However, prompt referral to specialist units and multidisciplinary (MDT) approach remains the key that has led to an increase in the survivorship of these patients over the last few decades. Reconstruction around the knee joint following resection of osteosarcoma remains a challenge due to multiple reasons and options including biological and non-biological techniques. In lower-lower-middle-income countries (LMIC), this challenge becomes further compounded because of financial limitations. We report 2 cases where a frugal method of reconstruction following resection around a knee joint was used for LSS and arthrodesis was achieved with intramedullary nails and bone cement (PMMA) and both patients were mobilized full weight bearing immediately after surgery.

Keywords: Osteosarcoma, Limb salvage, Intramedullary nailing, Bone cement, Arthrodesis.

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INTRODUCTION

Osteosarcoma has predilection for meta-epiphyseal region of long bones, with femur being the commonest bone (42% incidence) of which 75% cases are in the distal femur[1]. Its overall incidence is 4.7 cases per million population annually with a bimodal age distribution. The first peak is typically between 13-16 years and constitutes 10% of all pediatric cancers whereas the second peak occurs in adults over 60 years[1,2].

Delayed presentation leading to metastasis and tumor size at presentation are important prognosticating factors. Surgical options include amputation or Limb-salvage surgery (LSS), with no difference in overall survivorship, where amputation can lead to both physical and psychological disabilities[3,4]. Reconstruction options after tumor extirpation can be broadly classified into biological and non-biological methods (Table 1). Although megaprosthesis provides immediate restoration of function but along with its long-term complications, it carries a big price tag[5]. Therefore, in LMIC group, cost effective treatment options are sought after which mostly includes biological techniques and variety of frugal technique, one of which is described in this case report where limb reconstruction was achieved with intramedullary nails (IMN's) and PMMA to bridge the defect. To, our knowledge this procedure had been rarely described in literature[6]. This is a cost effective and reproducible procedure and spares the patient from ablative surgery.

CASE REPORT

Written informed consent was obtained from the patients (or patient's legal guardian) for the publication of this case report and any related images.

The patients were informed that any identifying information would be kept confidential.

We report 2 cases of conventional osteosarcoma in the distal femur in 2 females, (Patient 1:8 years, presented on 15th May 2024 and Patient 2 :22 years, presented on 28th April 2024) who had received multi agent neoadjuvant chemotherapy and had isolated disease on restaging studies. They both underwent LSS under general anesthesia and prophylactic antibiotic cover without tourniquet, where in patient 2 we performed extra articular resection due to joint involvement.

Table 1: Reconstruction options around knee joint.

Biological	Hybrid	Non-biological
1. Autograft: i. Vascularized and non-vascularized.	Allograft prosthetic composite.	1. Custom endoprosthesis.
2. Allograft: a. Osteoarticular allograft. b. Structural/Intercalary.		2. Modular endoprosthesis.
3. Recycled bone. a. Radiation. b. Autoclaving. c. Liquid nitrogen. d. Pasteurization.		3 Arthrodesis nail

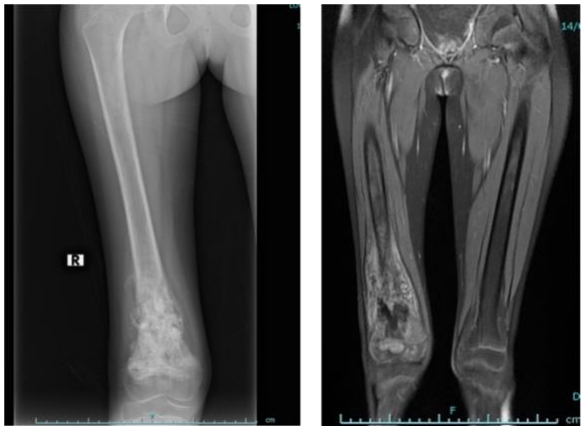

Figure 1: Pre-op X-ray and MRI of patient 1 showing distal femur malignant lesion with pathological fracture and soft tissue mass

Figure 2: Pre op MRI of patient 2 showing proximal tibia malignant neoplastic lesion with soft tissue component

Figure 3: Post-op X-ray of patient 1 showing nail cement spacer covering the distal femur bone gap; arthrodesing the knee joint, reinforced with plate and screws

Figure 4: Post-op X-ray of patient 2 showing nail cement spacer covering the proximal tibia and distal femur bone gap; arthrodesing the knee joint.

Following tumour extirpation, they underwent reconstruction with cemented Intra-medullary nails (IMNs) which were joined at the center initially with cerclage wires and the resultant defect filled with Polymethyl methacrylate (PMMA) bone cement. Care was taken to achieve correct alignment, length and rotation in relation to the contralateral leg. In patient 1, an additional Dynamic Compression Plate (DCP) was added to augment rotational stability. Surgical drains were used in both cases and standard fashion wound closure was achieved with occlusive wound dressings. Both patients were mobilized full weight bearing the next day with no immediate complications. Histology showed R0 margins in both cases and based on Huvos grading of chemotherapy response, they both had adjuvant chemotherapy after discussion in the surgical oncology MDT. Both patients remain disease free at last follow up and independently mobile with no reported complications in the short term.

DISCUSSION

Osteosarcoma in the distal femur or proximal tibia is common and challenging to treat due to the high functional demands on the knee joint[1]. Surgical options include amputation and LSS. Amputation is often considered as one of the procedures, but its physical and psychological morbidity is usually underestimated with no reported benefit in overall survivorship over limb salvage surgery (LSS) and hence limb salvage surgery is preferred where appropriate[3,4]. Megaprosthetic reconstruction around the knee joint offers a formidable option following tumor extirpation and has its own unique complications but the major concern in LMIC group is its cost and availability[5]. Therefore, in the economically constrained health care systems, surgeons have to consider other options for reconstruction including autografts, allografts and recycled bone techniques with all of them having their unique pros and cons[7,8]. In some of these instances an articulating reconstruction can be achieved utilizing osetoarticular allografts, but its main disadvantage is its lack of availability. Arthrodesis usually provides a more robust reconstruction but at the expense of motion at the knee joint and may not be acceptable to every patient and family. Traditionally bone grafts have been used to achieve arthrodesis around the knee joint, but their use again is limited due to availability of allograft and deficiency of size of autograft to bridge the gap in larger resections.

In challenged situations experienced by most LMIC group, an arthrodesis can be achieved following tumour resection with IMN's and PMMA used as a spacer to bridge the defect. This can be used as a temporary measure later converted to megaprosthesis or a permanent measure as in our reported case[6,9,10]. One large case series has reported satisfactory outcomes at medium to long term follow up with this technique[10]. This reconstruction method is easily reproducible and is overall more cost-effective than other arthrodesis techniques and offers several benefits including reduced surgery time, no requirement for microvascular surgeon, no need for bone bank and no donor site morbidity as is the case with autografts. These PMMA spacers are unaffected by adjuvant chemotherapy and patients can ambulate full weight bearing immediately[9,10].

One of the disadvantages of our described technique is the resultant limb length discrepancy, especially in paediatric age group, which may be overcome by contralateral epiphysiodesis or limb lengthening of the ipsilateral side at a later stage after disease cure. This complication, however, is inherent to all arthrodesis techniques described in the literature and can be overcome with growing endoprosthesis which can be either invasive or noninvasive[7]. However, these are extremely costly implants and expensive for most LMIC group patients.

Patients undergoing this frugal surgical technique have reported less pain, faster recovery, and lower infection rates, thus reducing long-term costs and the need for multiple surgeries[10].

CONCLUSION

This frugal technique can be used in selective cases for reconstruction following tumor resection around the knee and long terms results are to be monitored with focused research on development of indigenous megaprosthesis which can cater for the population in LMIC group.

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REFERENCES

1. Ottaviani G, Jaffe N. The epidemiology of osteosarcoma. Cancer Treat Res. 2009;152:3-13.
2. Stitzlein RN, Wojcik J, Sebro RA, Balamuth NJ, Weber KL. Team Approach: Osteosarcoma of the Distal Part of the Femur in Adolescents. JBJS Rev. 2017;5(12):e5.
3. Roșca AC, Baciu CC, Burtăverde V, Mateizer A. Psychological Consequences in Patients With Amputation of a Limb. An Interpretative-Phenomenological Analysis. Front Psychol. 2021;12:537493.
4. Li X, Zhang Y, Wan S, Li H, Li D, Xia J, et al. A comparative study between limb-salvage and amputation for treating osteosarcoma. J Bone Oncol. 2016;5(1):15-21.
5. Myers GJ, Abudu AT, Carter SR, Tillman RM, Grimer RJ. The long-term results of endoprosthetic replacement of the proximal tibia for bone tumours. J Bone Joint Surg Br. 2007;89(12):1632-7.
6. Prejbeanu R, Vlad Daliborca C, Dumitrascu V, Vermesan D, Mioc M, Abbinante A, et al. Application of acrylic spacers for long bone defects after tumoral resections. Eur Rev Med Pharmacol Sci. 2013;17(17):2366-71.
7. Temple HT. Allograft Reconstruction of the Knee-Methods and Outcomes. J Knee Surg. 2019;32(4):315-21.
8. Ibrahim M, Shah SA, Ahmed I, Khan MA, Khan Z. Is there an ideal method of reconstruction for proximal humerus osteosarcoma? A review of different reconstruction techniques. J Pak Med Assoc. 2023;73(5):1069-75.
9. Donati D, Giacomini S, Gozzi E, Sorin E, Borz S, Mercuri M, et al. Knee arthrodesis with a temporary spacer performed in malignant tumor around the knee. Arch Orthop Trauma Surg. 2002;122(2):123-8.
10. Puri A, Gulia A, Pruthi M, Koushik S. Primary cement spacers: a cost-effective, durable limb salvage option for knee tumors. Knee. 2012;19(4):320-3.