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Modular megaprosthesis for distal femoral tumors

Accepted: 26 June 2001 / Published online: 13 September 2001
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Abstract We treated 48 patients with distal femoral tumors by resection and limb salvage with an uncemented megaprosthesis (Howmedica Modular Replacement System). Diagnoses included: 32 osteosarcomas, five chondrosarcomas, six giant cell tumors of the bone, three fibrosarcomas, and two Ewing's sarcomas. The mean follow-up was 5.6 years (2–10 years). The overall complication rate was 39%. Seven patients died of their disease, but none from complications related to the surgery. Five patients were revised to arthrodesis, and one required amputation because of complications. The mean postoperative Musculoskeletal Tumor Society score (MSTS) score was 21 (6–28) for the remaining 35 patients. The most frequent complications were infection (14.6%) and aseptic loosening (4.8%). Ten-year survival of the prosthesis was 65%.

Résumé Les auteurs ont traité 48 patients atteints de tumeurs du fémur distal par résection et reconstruction avec une prothèse non-cimentée (HMRS). Les diagnostics étaient : ostéosarcome 32, chondrosarcome 5, tumeur à cellules géantes 6, fibrosarcome 3, et sarcome d'Ewing 2. Le suivi moyen fut de 5.6 ans (2–10 ans). Le taux de complications global fut de 39%. Sept malades sont morts de la maladie tumorale, mais aucun de complications de la chirurgie. Cinq patients ont dû avoir une reprise pour arthrodesis et un patient a subi une amputation à cause de complications. Le score MSTS (musculoskeletal tumor society) moyen fut 21 pour les autres. Les complications les plus fréquentes étaient l'infection (14.5%) et le descellement (4.8%). Le taux de survie de la prothèse à 10 ans était de 65%.

Introduction

Limb salvage surgery is now the preferred treatment for distal femoral tumors in most centers. Our preferred option following resection of the tumor is the use of a modular prosthesis, i.e., standard-sized components with varying lengths according to the amount of bone resected. This procedure has produced consistently better results for distal femoral tumors than for proximal tibial tumors for several reasons [7, 10, 13]. The prosthesis can be used either with or without cement [3, 9, 11], and results have been almost the same in both cases at midterm follow-up. Mechanical failure and infection are the two major factors in the poor functional results [9, 14, 15]. We reported excellent results for noncemented Kotz prosthesis in distal femoral tumors in the short term [13] and have used this implant for more than 10 years. The purpose of this article is to report the mid- to long-term results of these types of prostheses and compare our results to other studies using the same type of prosthesis. We also identified factors that could possibly increase the longevity of the prostheses.

Materials and methods

Patients

Between March 1991 and March 1999, 48 patients had intraarticular resection of distal femoral tumor and implantation with a modular hinged megaprosthesis, the Howmedica modular resection system (HMRS) (Figs. 1, 2). There were 30 males and 18 females. The mean age at the time of surgery was 24 years (12–60 years). The diagnosis was osteosarcoma in 32 patients, giant cell tumor (GCT) in six patients, chondrosarcoma in five patients, fibrosarcoma in three patients, and Ewing's sarcoma in two patients. Clinical assessment was done using the Musculoskeletal Tumor Society score (MSTS) [6]. All patients had a complete tumor work-up prior to the surgery. This included routine blood work, X-ray of the femur, chest and bone scan, computed tomography (CT) of the chest, and magnetic resonance imaging (MRI) of the femur.

Operative technique

An extensile midline incision was made over the knee. A subfacial dissection was performed, leaving at least a 2-cm margin of normal

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Fig. 1a,b Preoperative radiographs showing osteosarcoma of distal femur



Fig. 2a,b Postoperative radiographs of uncemented HMRs

tissue. The mean femoral resection was 18.72 cm (12–35 cm). In all 48 cases, an intraarticular wide resection was done. The Kotz (HMRs) modular prosthesis was used in these cases. Intraoperative monitoring for the neurovascular bundle was routinely done using pulse oximetry. Standard radiographs were assessed for follow-up radiolucency, subsidence, or migration of prosthesis. Prosthetic survival was estimated by the Kaplan Meier method [8].

Results

The patients were followed for a mean of 5.6 (2–10) years. At the time of the last follow-up, seven patients had died of their malignancy but had been functioning well until their death. This left 41 patients available for clinical and radiological review.

Complications

There were two aseptic loosening, four deep prosthetic infections, two superficial infections, two sciatic nerve

palsies, two peroneal palsies, and one vascular compromise leading to amputation. There was one femoral stem fracture at 3 years following surgery, one periprosthetic fracture at 9 years following surgery (successfully treated nonoperatively), and one local tumor recurrence within 2 years of surgery. Five patients had successful arthrodesis – four for deep infection and one for femoral stem fracture. One patient had an above-knee amputation secondary to popliteal artery thrombosis.

The score for pain and function was 75%, for support and walking ability 68% each, gait 70%, and emotional acceptance 64% of the normal. The mean flexion was 90° (30°–110°). The mean extensor lag in five patients was 15° (5°–30°). The prosthetic survival at 10 years was 65%.

Discussion

Limb salvage surgery is now a standard treatment in most centers around the world. Treatment options after resection are arthrodesis, megaprosthesis, and reconstruction using osteochondral allograft. With the development of modern chemotherapy the prognosis for malignant tumors has improved greatly and encouraged surgeons to consider limb salvage surgery in most cases [1]. The site of tumor is an important factor, however, as many studies have shown poor results in the treatment of proximal tibial tumors compared to distal femoral tumors [7, 10, 13]. The trend, therefore, may be shifting towards the use of prosthesis in limb salvage, particularly for distal femoral tumors. This site has good soft tissue coverage and the extensor mechanism is less vulnerable than in proximal tibial tumors.

Resection arthrodesis provides a stable limb but at the cost of knee motion [2, 12]. However, many patients undergoing this procedure are young, and this option is probably preferable over other options when considering long-term stress. Allografts tend to restore anatomy and bone stock but have a tendency to pathologic fracture and collapse, with an infection rate comparable to that of prosthetic reconstruction [5]. With regard to hinged megaprosthesis, one major problem has been aseptic loosening [9, 14, 15]. Therefore, prosthesis with rotating ability has been the focus of recent attention, and results in the early period have been encouraging [4, 10]. Theoretically, the rotating prosthesis decreases shear stresses at the tibial plate bone interface, resulting in decreased incidence of aseptic loosening of the implant. However, it is also likely that the motion between the components may lead to more wear debris that can lead to future osteolysis. Long-term results are not yet available.

In our study, the modular hinged noncemented megaprosthesis produced good results for distal femoral tumors. The aseptic loosening was only 4.8% and clinical assessment revealed an average score of 70%. However, infection remained a grave concern, with an unacceptable rate of approximately 15%. All four deep infections in our study required removal of the implant and arthrodesis.

It is difficult to compare results of our study with those of other studies, as different prostheses were used

Table 1 Comparative series (*na* not available)

Study	Type of prosthesis	Use of cement	Infection rate (%)	Aseptic failure (%)	Overall complication rate (%)	5-year survivor analysis (%)	10-year survivor analysis (%)
Kawai 1999 et al. 10	Rotating	Yes	na	4.0	na	88.0	na
Kawai 1998 et al. 9	Hinged	Yes	10.0	40.0	125.0	67.0	48.0
Unwin 1996 et al. 15	Hinged	Yes	8.4	9.9	100.0	na	67.4
Choong 1996 et al. 4	Rotating	Yes	na	6.6	23.3	90.0	na
Capanna 1994 et al. 3	Hinged	No	5.0	0	55.0	na	na
Roberts 199111	Hinged	Yes	6.8	6.0	na	72.0	na
This study	Hinged	No	14.6	4.8	39.0	94.0	65.0

and operative management and factors for prosthetic survival also differed. (Table 1). Capanna et al [3] reported uncemented Kotz modular prosthesis in 95 distal femoral tumors with a very high failure rate of the polyethylene bushes (42% of cases). We did not encounter this complication, maybe because our study had a smaller number or because, in most of our cases, the new design of Kotz prosthesis was used. Also, we used only two or three screws for femoral stem fixation when required. In most cases, no screws were used at all. We did, however, rely on a larger diameter femoral stem with press-fit.

Kawai et al [9] reported on 40 patients with hinged megaprosthesis. There was a high rate of aseptic loosening (40%) and prosthetic survival was only 48% at 10 years. In our study, the incidence of loosening was 4.8% and prosthetic survival at 10 years was 65%. Kawai et al also concluded that major disruption of quadriceps mechanism could lead to increased incidence of aseptic loosening. We did not use cement, and all patients had intraarticular resection rather than extraarticular resection. Kawai et al did report, however, that 20 patients would not undergo extraarticular resection or have an MRI and were not available for follow-up during the study period.

Kawai also recently reported on the use of rotating megaprosthesis after resection of distal femoral and proximal tibial tumors at a follow-up of 2–7 years [10]. The results were encouraging, with 5-year prosthesis survival for distal femoral tumors of 88%. The mean score for pain was 88%, function 72%, emotional acceptance 86%, and gait 76% of the normal for distal femoral tumors. Our results were similar, with prosthetic survival at 5 years of 90%, function 75%, and gait 70% of the normal. However, the mean score for pain was 75% and emotional acceptance only 64% of the normal. Results were encouraging for all categories except emotional acceptance. For cultural and religious reasons, our patients like to sit on the floor cross-legged, which they are unable to do after surgery. This was accepted with great reluctance by most patients.

We feel that an intraarticular resection of distal femoral tumors and reconstruction with an uncemented hinged megaprosthesis is a good treatment option that produces results comparable to the rotating megaprosthesis in the midterm. However, long-term results are needed to determine which type of prosthesis is preferable.

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