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Review

The use of unicondylar osteoarticular allografts in reconstructions around the knee

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ABSTRACT

Unicondylar osteoarticular allografts (UOA) of the knee are mainly used after bone tumour resections for benign aggressive tumours or small malignant tumours with clearly defined margins. They are also used less often in large posttraumatic condylar defects. Between 1989 and 2004, 12 deep-frozen UOA reconstructions (in 11 patients) were performed at our Institute. The diagnosis was chondrosarcoma in four cases, giant cell tumour in three, osteosarcoma in three, posttraumatic defect in one, and one failed UOA. The involved site was the medial femoral condyle in six cases, the lateral femoral condyle in three, the medial side of the tibial plateau in two, and the lateral in one case. One allograft was removed after 29 months because of an intra-articular displaced fracture, and substituted with a new UOA. One patient died of metastatic disease at 24 months. We report the functional and radiographical outcome of the remaining 10 UOAs with a minimum follow-up of 4 years (average 11 years). Two of the 10 patients had excellent results, five were good and three were fair. Radiographically, five patients had "mild" and five had "severe" degenerative changes. One patient with severe degenerative changes had pain and stiffness, therefore the UOA was converted into a prosthesis allograft composite, using a conventional total knee prosthesis. In selected cases of distal femoral and proximal tibial tumours, UOA reconstructions give good functional outcomes with relatively few major complications.

Contents

1. Introduction

Unicondylar osteoarticular allografts (UOAs) are used to reconstruct the distal femur or proximal tibia, either after tumour resections or in cases of large posttraumatic or osteonecrotic bone defects [1].

The distal femur and proximal tibia are the most commonly affected sites for primary bone tumours. Benign tumours are usually managed by curettage with or without adjuvants. However, in aggressive benign lesions with extracompartmental extension (stage 3), curettage is often complicated by recurrence, articular fractures, stiffness, or damage at the joint surface. A condylar resection reduces the risk of local recurrence and a UOA reconstruction is thought to significantly delay mechanical problems [2].

Malignant bone tumours require wide surgical margins. For malignant bone tumours around the knee, this usually results in large segmental resections with extensive bone sacrifice, followed by reconstruction with a megaprosthetic implant or total osteoarticular allograft. However, these reconstruction techniques are associated with frequent complications. Infection is the most serious complication after large segmental reconstruction, especially in the proximal tibia, where failure rates at 10 years have been reported as up to 41% [3]. A frequent complication of megaprosthetic implants is aseptic loosening. This can occur especially after short distal femur resections, as the prosthetic femoral stem is difficult to fit in the distal metaphyseal femur, causing poor primary stability and a risk of early stem "sinking" and loosening. Finally, frequent mechanical complications can occur with total osteoarticular allografts in the longer term. Failure rates at 10 years have been reported as up to 29%, usually due to fracture, joint laxity or early degenerative changes [4]. When malignant tumours involve only one half of the distal femur or proximal tibia, and show clearly defined margins, a single condyle resection can offer wide margins and a UOA reconstruction is thought to reduce the risk of complications associated with megaprosthetic

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and total osteoarticular reconstructions. Another important advantage of UOA reconstructions is the bone stock preservation. Thus allowing for easier salvage procedures with a conventional total knee prosthesis in cases of allograft subchondral collapse.

In the past, single condyle resections have been reconstructed with a patellar autograft. This technique was first proposed by Campanacci et al. in 1985 [5]. They reported that in a study of 19 patients with a 2–9 year follow-up, both graft fusion and good stability was achieved in all cases. Encouraging results were also achieved by Farooque [6] with the same technique applied on seven patients with 3–6 years of follow-up. In more recent years, the use of deep-frozen allografts has replaced autografts, thus avoiding any harvest morbidity. The aim of this study was to describe our experience with UOAs and to assess the clinical and radiographical outcome after a minimum follow-up of 4 years.

2. Materials and methods

We reviewed demographic, clinical, and surgical details of 12 UOAs (11 patients) treated at our hospital from 1989 to 2004. Eight of the reconstructions were performed in female patients and four in males. The average age was 33 years (range: 16–63). Preoperative diagnoses were: chondrosarcoma in four cases, giant cell tumour in three, osteosarcoma in three, posttraumatic osteochondral defect in one, and one hemi-osteoarticular allograft failure. The distal femur was affected in nine cases (six medial and three lateral condyles) and the proximal tibia in three (two medial and one lateral condyle). Nine left and three right knees were reconstructed.

For giant cell tumours, the resection margins were at least marginal, whereas wide margins were achieved in all malignant tumours. In all cases the segments were reconstructed with a size-matched deep-frozen osteoarticular allograft, obtained from the bone bank at our Institute. The allografts were harvested in sterile conditions and stored at minus 80 °C. Allografts and donors were tested for viral and bacterial infections. In the operating room, aerobic and anaerobic swabs were obtained before thawing the graft in warm saline and antibiotic solution. During fixation, great care was applied to restore the anatomical congruency of both the patellar–femoral and tibial–femoral joint, to avoid joint profile alteration.

Fixation of the grafts was achieved with plate and screws in three cases (one femoral and two tibial), and with screws alone in nine cases (eight femoral and one tibial).

In both distal femur and proximal tibia condyle grafts, the host capsule, meniscus, and posterior and anterior cruciate and collateral ligaments were preserved as much as possible and reattached with non-absorbable sutures to the graft, in order to obtain joint stability. Joint stability and motion were tested after wound closure and soft tissue "over-tightening" was avoided in order to reduce overload on the graft or on the contralateral joint compartment. Table 1 shows the demographic data and tumour characteristics.

Patients were given intravenous amikacin (500 mg, 2 doses) on the day of surgery and teicoplanin (200 mg, 1 daily dose) throughout their postoperative hospital stay, followed by 3 months of oral antibiotic therapy.

Postoperatively the knee was immobilised in a cast for 1–3 months (mean 1.3 months) allowing flexion and extension of the knee 1 month after surgery. Then patients were allowed only partial weight bearing until the osteotomy line was completely healed according to radiographical appearance (mean 11 months, range: 6–14).

All patients were recently seen in our Institute, by one of the authors, for radiographical studies and functional assessment. The functional evaluation was assessed according to the system proposed by the Musculoskeletal Tumour Society (MSTS) [7]. Joint degeneration was assessed by plain radiographs and was considered mild when more than 50% of the joint space was maintained, and neither subchondral sclerosis nor osteophytes were present. Degenerative changes were classified as moderate when collapse of the joint space was greater than 75%, and mild when there was subchondral sclerosis or one or two osteophytes. Severe degenerative changes were scored when there was complete loss of joint space, subchondral sclerosis and multiple osteophytes [8].

Table 1
Demographic data and tumour characteristics for all 12 cases

Category	Value	No. of patients	%
Mean age (years) (range)	33 (16–63)		
Gender			
Male		4	33
Female		8	67
Site			
Distal femur		9	75
Proximal tibia		3	25
Compartment			
Medial		8	67
Lateral		4	33
Fixation			
Screws		9	75
Plate		3	25
Diagnosis			
Chondrosarcoma		4	34
Osteosarcoma		3	25
Giant cell tumour		3	25
Posttraumatic		1	8
Graft failure		1	8

Two patients, one who died of metastatic disease 2 years after surgery and another who had early graft failure (2 years), were excluded from functional and radiographical analysis because of the short follow-up period. The average follow-up time of the remaining 10 cases was 10 years (range: 4–18) with an average follow-up of 9 and 12 years for the distal femur and proximal tibia respectively.

3. Results

There were no cases of infection, wound complication, graft non-union or local recurrence. One graft was removed after 29 months because of subchondral collapse with an intra-articular displaced fracture (early failure), and replaced by a second osteochondral allograft. At the time of graft removal, functional outcome was "good" and joint degenerative changes "mild". At the last follow-up (16 years after revision) functional outcome was "fair" with "severe" joint degenerative changes. Consequently the patient underwent a total knee arthroplasty (TKA) (Fig. 1).

Three patients had a subsequent surgical procedure without graft removal: one patient (femoral medial condyle) underwent an early open surgical debridement and gained significant improvement in knee motion; one patient (femoral lateral condyle) underwent late arthroscopic debridement because of painful joint degenerative changes and was pain free at last follow-up. The third patient (tibial medial condyle), underwent the removal of a protruding screw causing a painful bursitis and was also pain free at the last follow-up. The final functional outcome of the three patients who underwent a surgical procedure was "good" at 4, 10, and 14 years of follow-up.

The functional outcome was "excellent" in two patients, "good" in five and "fair" in three. Both patients with "excellent" results underwent UOA of the distal femur lateral condyle with normal knee alignment (Fig. 2). All four patients who scored "fair" in the functional evaluation of this study had an UOA of the medial compartment (three of the femur and one of the tibial plateau) (Fig. 3). In these four patients, two had normal knee alignment and the other two knees were in varus. One patient required a posterior stabilised TKA because of continuous pain; the other three patients returned to their previous daily activities and had acceptable pain control, requiring occasional use of oral analgesics after knee overload; all three had acceptable active knee motion with a minimum flexion of 90°. One patient had an extension lag of 15° with 110° of flexion.

Meticulous soft tissue reconstruction was always performed; posterior and anterior cruciate ligaments were reattached in four and two cases respectively and lateral and medial collateral ligaments in three and five cases. However, the lack of homogeneity and small patient number did not permit any significant evaluation of the clinical role of the reconstructed ligaments or their effect on knee kinematics and joint degenerative changes.

Joint stability was assessed clinically and was normal in three cases, while five had less than 10° of valgus laxity and two had less than 10° of varus laxity. Knee alignment on long leg films was normal in five cases, however four of the cases were in varus and one in valgus.

Radiographical changes were assessed, excluding the two cases with less then 4 years of follow-up. All patients showed healing of the osteotomy line. Half of the