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Management of big osteochondral defects of the knee using osteochondral allografts with the MEGA-OATS technique

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Abstract

Treatment of osteochondral defects in weight-bearing areas of the knee, especially when they are sizeable and involve considerable subchondral bone loss, is a challenging problem. We report our experience on the use of osteochondral allografts with the MEGA-OATS technique in the management of large osteochondral defects of the knee in young patients.

Five patients (3 male and 2 female) were included in this study; their age ranged from 22 to 41 years and the mean size of the defect covered was 30×30 mm. They were followed for a minimum of 2.5 years (mean: 32.8 months, range 30–36). An age- and size-matched fresh frozen, non-irradiated distal femoral allograft was used to obtain the donor plug, which was then inserted in the recipient area in a press-fit fashion.

Patients' Lysholm knee score increased from 37.8 pre-operatively to 73.8 post-operatively. Tegner activity score increased in all five patients; it improved from a mean of 2 pre-operatively (range 1–3) to 4 post-operatively (range 2–7). Four out of five patients returned to work and three went back to sporting activities.

With this technique one can cover sizeable osteochondral defects, and compensate for significant subchondral bone loss, while accurate reconstruction of the curvature of the femoral condyle is allowed. We believe that it is a viable salvage option in young patients with big osteochondral defects of the knee. It offers very satisfactory functional results and does not compromise patients' future options.

Keywords: Osteochondral defect; Allograft; Knee

1. Introduction

The fact that the repairing capacity of articular cartilage is very limited renders the prognosis of osteochondral defects, especially when they occur after skeletal maturity, fairly poor [1–3]. This is even more profound when the defect is sizeable and considerable subchondral bone loss is added in the equation.

Osteochondral autograft transplantation with the mosaicplasty, DBCS, or OATS technique is successful in covering relatively small defects, but has considerable technical limitations and has been related with increased donor site morbidity for defects larger than 2×2 cm [4,5]. Therefore the use of osteochondral allografts has been proposed in the management of such large osteochondral defects [6–8].

We report our experience on the use of osteochondral allografts with the MEGA-OATS technique in the management of large osteochondral defects of the knee in young patients.

2. Materials and methods

Between March and December 2001 five patients received osteochondral allografts with the MEGA-OATS technique for the management of sizeable osteochondral defects of the knee. Three patients were male and two were female and their age ranged from 22 to 41 years (average:

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Table 1
Results

Patient	Age	Gender	Cause	Site	Size (mm)	Side	FU	Lysholm score		Tegner score	
								Pre	Post	Pre	Post
1	34	F	OCD	MFC	30×30	R	30	31	34	1	2
2	41	F	OCD	MFC	30×30	L	36	37	85	2	4
3	25	M	OCD	LFC	25×25	R	36	39	80	2	4
4	22	M	OCD	MFC	35×35	L	30	35	71	2	3
5	27	M	AVN	Trochlea	30×30	R	32	47	99	3	7

29.8). The size of the defect covered ranged from 25×25 mm to 35×35 mm (mean 30×30 mm) and it was situated in the medial femoral condyle in three cases and in the lateral femoral condyle and trochlea in one case respectively. In four cases the cause of the osteochondral defect was OCD, while in one the cause was avascular necrosis (AVN) (Table 1). The size and severity of the defect was assessed arthroscopically in all cases prior to this procedure. Previous surgery included arthroscopic debridement, removal of loose bodies as well as failed chondrocyte transplantation in one case.

The operation was performed with the patient supine; a tourniquet was applied and the knee was exposed through a midline skin incision. The site of the osteochondral defect was subsequently approached, carefully measured and marked (Fig. 1). The recipient site was then prepared using a K-wire inserted perpendicular to the cartilage surface as a guide; the appropriate sized hollow chisel and mill (MEGA-OATS system, Arthrex, Naples, USA) were then used to millcut the cartilage and subchondral bone of the defect (Fig. 2). The milling depth was determined by the millimetre scale the mill is equipped with and a special depth gauge.

An age- and size-matched fresh frozen, non-irradiated distal femoral allograft was used to obtain the donor plug. All allografts were obtained from the Leicester bone bank and period from harvesting to implantation was no longer than 1–2 months. Donors were screened for malignancies, autoimmune disorders and infectious diseases, while donors and recipients were blood type and Rhesus matched.

The distal femoral allograft was inserted in the specially designed workstation (MEGA-OATS system, Arthrex, Naples, USA) and the donor plug was prepared with a hollow mill whose diametre is approximately 0.3 mm larger than the mill used for the recipient site, in order to allow for press-fit implantation (Fig. 3). The donor plug depth was appropriately shaped surpassing the milling depth in the recipient area by 1–2 mm, in order to allow for cancellous bone impaction (Fig. 4). Finally the donor plug was inserted into the recipient site in a press fit fashion by means of a special tappet (Figs. 5 and 6). In the patient who underwent MEGA-OATS grafting due to a 30×30 mm osteochondral defect of his trochlea resulting from AVN, a concomitant lateral release and Elmslie-Trillat tibial tubercle transfer were also performed to protect the graft, as this patient also had a laterally subluxating patella.

The wound was closed in layers over a drain and three doses of intravenous antibiotics were administered perioperatively. Aspirin thromboprophylaxis was initiated immediately post-operatively and was continued for a period of 6 weeks. Range of movement as well as muscle strengthening exercises were commenced as soon as the pain allowed. Only touch-toe weight bearing was allowed for the first 6 weeks, followed by a further three-month period of partial weight bearing.

Patients were followed for a minimum of 2.5 years (mean: 32.8 months, range 30–36). Their functional out-

Fig. 1. Recipient area. 30×30 mm osteochondral defect with subchondral bone loss.

Fig. 2. Recipient area prepared to receive allograft.

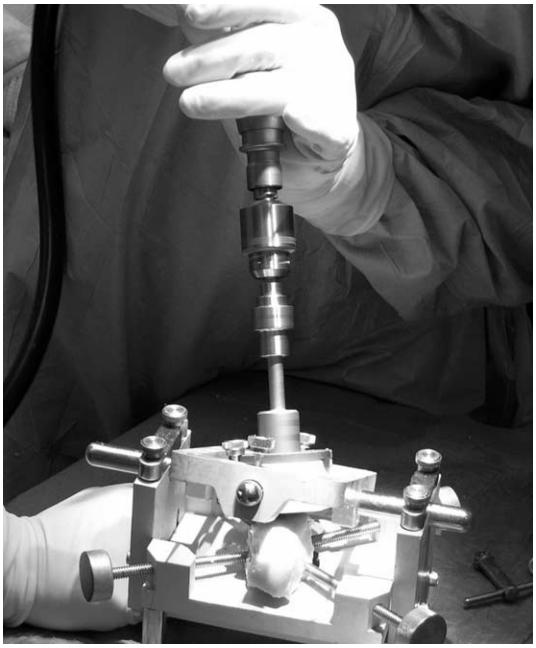

Fig. 3. Allograft core preparation in MEGA-OATS workstation.

come was evaluated with Tegner activity score and Lysholm knee score both pre- and post-operatively.

3. Results

Patients' Lysholm knee score increased from 37.8 (range: 31–47) pre-operatively to 73.8 (range: 34–99) post-operatively. Tegner activity score increased in all five patients; it ranged from 1 to 3 pre-operatively (mean: 2) and increased to 4 post-operatively (range: 2–7) (Table 1).

Four out of five patients went back to work within 4 months, two went back to light sporting activities and one went back to competitive sports (cricket). Functional recovery was satisfactory in four out of five patients, who judged the outcome of their procedure as very successful/successful; there was only one poor result.

Fig. 5. Donor plug before insertion in the recipient area.

Patients were hospitalised for a period ranging from 2 to 7 days (mean: 3.6 days) and no immediate post-operative complications were recorded. Three patients underwent a second look arthroscopy. One had significant ongoing pain and swelling and the second look arthroscopy revealed that the hyaline cartilage of the allograft used did not survive and the patient had a large area of exposed bone. A second patient had mild ongoing discomfort and the second look arthroscopy revealed good graft incorporation, a degenerate meniscal tear and only small areas of cartilage degeneration corresponding with the graft; following partial medial meniscectomy and debridement, his symptoms settled. The third patient was doing perfectly well until he had a further accident almost 2 years following his initial procedure. A fall from a height led to partial graft fragmentation and loose bodies in the joint that were subsequently removed arthroscopically. Eight months following arthroscopic washout and removal of loose bodies he was pain free and managed well with his daily activities.

4. Discussion

Large osteochondral defects emanating from either OCD or AVN lesions lead to an impairment of load transmission

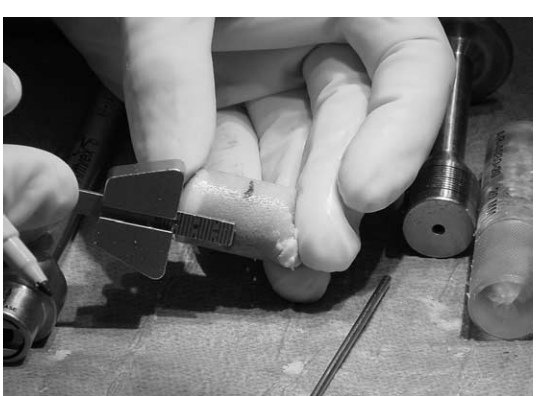

Fig. 4. Donor plug depth measurement.

Fig. 6. Donor plug inserted in recipient area with press-fit technique.

and are therefore considered to be a significant predisposing factor in the eventual development of osteoarthritis [3,5–7,9,10]. They are a very difficult condition to treat effectively, especially in young and active patients. The healing potential of hyaline cartilage is very poor and treatment options such as chondroplasty, drilling and microfractures that lead to the formation of fibrocartilage, may offer some symptomatic relief for a period of time, but the longevity of this is dubious, bearing in mind the limited ability of fibrocartilage to resist compression [1,11].

Fresh osteochondral allografts have been used for almost a century in the treatment of osteochondral defects of the knee and other joints [6,7]. The rationale behind this procedure is the transplantation of hyaline cartilage supported by a layer of subchondral bone with variable thickness, used to provide structural support and often at the same time restore an underlying subchondral bone defect. Their main indications are traumatic or non-traumatic osteochondral lesions, but they can also be used as a salvage procedure for complex intraarticular fractures [8,12–16]. They are more frequently used in the management of large osteochondral defects of the femoral condyles emanating from either OCD or AVN lesions [6,7,12].

Fresh allografts, used in a period of less than 7 days from harvest to implantation, guarantee near-complete chondrocyte survival, but generate a more significant immune reaction. Fresh frozen allografts though have been shown to largely obviate this problem, offering at the same time satisfactory chondrocyte survival if utilised within one to two months [17,18]. The underlying subchondral bone acts as a scaffold and is replaced by host bone through creeping substitution [6,7,11].

The option of autografts is more appealing, offering better safety, no immune reaction and superior graft incorporation, but their use has certain limitations, mainly in cases with significant subchondral bone loss and when the defect to be covered is of significant size. Osteochondral autograft transplantation with the mosaic plasty or the OATS technique has also been related with donor site co-morbidity, especially when used for relatively large defects [10,11].

Imhoff and associates [4] successfully used the MEGA-OATS technique for covering large osteochondral defects of the femoral condyle. This technique involves osteotomising the lateral or medial posterior femoral condyle in order to shape a single osteochondral plug of adequate diameter, which is subsequently used to cover the defect with press-fit implantation. Concerns have been raised though regarding the long-term effect of the loss of a sizeable part of the posterior femoral condyle in knee function. This method has also got significant limitations in the depth of subchondral bone defects that can be covered. Furthermore, the anatomical curvature of the posterior femoral condyle does not always allow for accurate reproduction of the anatomical curvature in the weight-bearing area of the knee [4].

The technique used differs only in the type of graft utilised; instead of using the posterior femoral condyle, an age and size matched fresh frozen distal femur allograft was used. With this technique one can cover sizeable osteochondral defects in a press-fit fashion, and easily compensate for significant subchondral bone loss, bypassing the potential risks emanating from the osteotomy and removal of the posterior femoral condyle. This technique also allows for more accurate reconstruction of the curvature of the femoral condyle and expands the indications of its use to other areas of the knee such as the trochlea. The fact that subchondral bone is slowly replaced by host bone with creeping substitution renders the graft area vulnerable to damage for a prolonged period of time, as demonstrated by the case where a relatively small injury led to partial graft fragmentation almost 2 years following implantation. It should be pointed out that reconstructive procedures for ligamentous laxity, osteotomies for axial malalignment or maltracking and meniscal repairs should take precedent or accompany osteochondral grafting.

In conclusion, we believe that this technique should be regarded as a viable salvage option in young patients with big osteochondral defects of the knee. It offers very satisfactory functional results, does not compromise the patients' future options and function and can be repeated in the future if need be.

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