Osteochondral Multiple Autograft Transfer (OMAT) for the Treatment of Cartilage Defects in the Knee Joint

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Abstract

The ideal articular cartilage repair tissue should be durable and well-integrated. We have been performing osteochondral multiple autograft transfers (OMAT) since 1996 with the experience we had using carbon fiber implants. We call this technique OMAT instead of mosaicplasty because we use uniform osteochondral autografts.

Osteochondral multiple autograft transfer (OMAT) was performed either by arthrotomy or arthroscopy on 12 patients (6 male and 6 female) for the treatment of cartilage defects in the knee joint. The patients ranged in age from 20 to 63 years (mean: 38 years). All had weightbearing-related pain or decrease in the range of motion. None had instability or malalignment. The average follow-up time was 4 years (range: 2 to 8 years).

Clinical results were satisfactory. All of the patients were improved initially by the procedure and 85% are still pain free. The mean Lysholm knee rating score was 56 points preoperatively and 86 points postoperatively. Second-look arthroscopy (five patients) demonstrated a normal shiny appearance and color of the grafted area. We observed slight joint effusion postoperatively that disappeared in two months. There was no donor site morbidity.

OMAT is a promising surgical technique for the treatment of articular cartilage defects. Long-term follow-up with more patients and histological and biomechanical evaluation of chondral interfaces are the subjects of our continuing study.

In a recent study, 31,516 knee arthroscopies revealed that chondral lesions were present in 63%, with an average of 2.7 hyaline cartilage lesions per knee. The treatment of cartilage defects in the knee joint is controversial. Most of the commonly used techniques yield a repair tissue with unidentical histological and biomechanical properties as the original. The ideal articular cartilage repair tissue should be durable and well-integrated. It should also provide a clinical improvement and eliminate or significantly postpone the need for arthroplasty.

Arthroscopic lavage, arthroscopic debridement, spongialization, arthroscopic abrasion arthroplasty, subchondral drilling, microfracture, and carbon-fiber matrix applications promote the development of fibrocartilage. Applications of osteochondral autografts, fresh osteochondral allograft, periosteal arthroplasty, perichondral arthroplasty, and chondrocyte transplantation with or without biodegradable materials promote the development of the repair tissue resembling hyaline cartilage.

Outerbridge and colleagues used osteochondral autografts for the treatment of osteochondritis dissecans. Hangody popularized mosaicplasty for larger cartilage defects in the femoral condyle and patella.

We have been performing a similar technique since 1996 with the experience we had using carbon fiber implants (Fig. 1). We call this technique as osteochondral multiple autograft transfer (OMAT) instead of mosaicplasty because we use uniform osteochondral autografts.

Materials and Methods

Osteochondral multiple autograft transfer (OMAT) was performed either by arthrotomy or arthroscopy on 12 patients (6 male and 6 female) for the treatment of cartilage defects in the knee joint. They ranged in age from
20 to 63 years (mean: 38 years). All had weightbearing-related pain or decrease in the range of motion. None had instability or malalignment.

During diagnostic arthroscopy, full-thickness crater-like chondral defects larger than 10 mm in diameter (Outerbridge IV) located on the weightbearing area of the femoral condyle (9 patients) or lateral femoral condyle (one patient) or on the patella (two patients with osteoarthritis, in conjunction with total knee arthroplasty) were considered for OMAT (Figs. 2, 3, and 6). Up to five osteochondral cylinders, 3.5 mm in diameter and 10 mm long, were used during these procedures (Fig. 2). The grafts are taken by using the instruments that were originally made for the removal of broken screws (Fig. 2). Donor site was either the lower weightbearing area of the patellofemoral joint when arthrotomy was used or the intercondylar notch area when arthroscopic surgery was used (Fig. 4). When arthrotomy was used, the donor site was the area of minimal weightbearing, and when arthroscopic surgery was used, the donor site was the
intercondylar notch area (Fig. 4).

Full weightbearing was permitted in all patients in the sixth postoperative week, but two patients with patellar repair were permitted immediate weightbearing.

The average follow-up time was 4 years (range: 2 to 8 years).

Results

Clinical results were satisfactory. All of the patients were improved initially by the procedure, and 85% of them are still pain free. The mean Lysholm knee rating score was 56 points preoperatively and 86 points postoperatively.

Second-look arthroscopy (five patients) demonstrated a normal shiny appearance and color of the grafted area (Figs. 5 and 7).

We observed slight joint effusion postoperatively that disappeared within two months. There was no donor site morbidity.

Discussion

When we performed arthroscopic procedures including lavage, debridement, abrasion arthroplasty, subchondral drilling, or microfracture, these techniques provided temporary pain relief in short-term followup. However, most of long-term follow-up studies do not demonstrate adequate pain relief, probably due to fibrocartilaginous repair tissue that lacks the durability and the mechanical properties of articular hyaline cartilage.

We also used artificial matrix, carbon fiber scaffolds to enhance ingrowth of repair fibrocartilage and to support the fibrocartilage. We observed that carbon is well tolerated by human tissues, and most of patients in our series have experienced satisfactory results without adverse effects. However, poor results have been reported in another study: there was seeding of carbon debris within synovium producing a histiocytic giant cell reaction, but without any evidence of progressive synovitis.

Outerbridge first used osteochondral autografts for the treatment of osteochondritis dissecans in the femur. But Hangody popularized mosaiplasty that provided surgical treatment for larger cartilage defects. The histological analysis of transplanted cartilage demonstrates
that the specimens were composed of 70% to 80% hyaline cartilage. The biopsy at 4.5 years demonstrated normal appearing chondrocytes, high glycosaminoglycan (GAG) content, normal orientation of chondrocytes and matrix elements, and matrix integration between the hyaline and the fibrocartilage. The grafts are obtained from the lower-weightbearing periphery of the patellofemoral joint or intercondylar notch area. The donor sites healed in a manner similar to the sites when subchondral drilling is used (Fig. 4).

Good or excellent (91%) results have been reported at the 3-year followup.4 The success rate was 85% for patellar cartilage defects. We obtained similar results in our patients with a success rate of 85% at an average of 4-years followup. Osteochondral autografts may cause donor site morbidity, but it seems to be well compensated in our patients and in other studies.13 This issue is related to the size of the defect. For larger defects other techniques should be considered.

OMAT is a promising surgical technique for the treatment of articular cartilage defects. Long-term follow-up with more patients, and histological and biomechanical evaluation of chondral interfaces are the subjects of our continuing study.

References