Mosaicplasty
Long-Term Follow-Up

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Abstract
The successful treatment of chondral and osteochondral defects of the weightbearing surfaces is a challenge for orthopaedic surgeons. Autologous osteochondral transplantation is one method that can be used to create a hyaline or hyaline-like repair in the defect area. Ten years of clinical experience with autologous osteochondral mosaicplasty are described. Clinical scores, imaging techniques, arthroscopy, histological examination of biopsy samples, and cartilage stiffness measurements were used to evaluate the clinical outcomes and quality of the transplanted cartilage in a total of 831 patients who underwent mosaicplasty. According to our investigations, good-to-excellent results were achieved in 92% of the patients treated with femoral condylar implantations, in 87% of those treated with tibial resurfacing, in 79% of those treated with patellar and/or trochlear mosaicplasties, and in 94% of those treated with talar procedures. Long-term donor-site disturbances, which were assessed using the Bandi score, showed that patients had 3% morbidity after mosaicplasty. Sixty-nine of 83 patients who were followed arthroscopically showed congruent gliding surfaces, histological evidence of the survival of the transplanted hyaline cartilage, and fibrocartilage filling of the donor sites. Four deep infections and 36 painful postoperative hemarthroses were experienced as complications arising from the surgical procedures. On the basis of both these promising results and also those of other similar studies, autologous osteochondral mosaicplasty would appear to be an alternative for the treatment of small and medium-sized focal chondral and osteochondral defects of the weightbearing surfaces of the knee and other weightbearing synovial joints.

In orthopedic practice, it can be observed that the treatment of full-thickness cartilage defects of the articular surfaces of weightbearing joints is a frequent problem. Focal chondral and osteochondral defects of the loading surfaces often cause symptoms such as pain, swelling, clicking, and instability, and may lead to early degenerative changes. In order to treat such problems, there are various surgical options available that use surgical resurfacing, but the clinical outcomes of these procedures are controversial. Traditional resurfacing techniques, such as debridement, subchondral penetration, and abrasion arthroplasty, have been shown to have limited value because of the poor biomechanical characteristics of the ingrown repair tissue. Over the past twenty years, numerous investigators have developed new techniques to provide hyaline or hyaline-like repair for articular defects. These recently introduced resurfacing alternatives include periosteal and perichondral grafts, morselized autologous osteochondral mixtures, biomaterials, autologous chondrocyte transplantation, osteochondral allografts, and autologous osteochondral transplantation.

Most of these techniques are supported by experimental data, but only autologous chondrocyte transplantation and autologous osteochondral transplantation have been used extensively in clinical practice.

Previous experimental and clinical experience with autogenous osteochondral grafting has demonstrated that the transplanted hyaline cartilage has a good rate of survival. Despite this observation, two problems with the process have been noted: the donor cartilage must be taken from less weightbearing areas, which naturally limits the procurement field, and fact that the use of large grafts can...
cause incongruity at the recipient site, which permanently alters the biomechanics of the joint.15-18

In order to avoid these problems we clearly saw that the usage of small-sized multiple cylindrical grafts would permit more tissue to be transplanted while preserving the integrity of the donor site, and the use of grafts in a mosaic-like implanting fashion would allow progressive contouring of the new surface.19-21

Principles of the Procedure

In 1991, several studies on animals and cadavers were carried out to develop the mosaicplasty resurfacing technique. Our basic thesis was that the mosaic-like transplantation of multiple, small-sized, cylindrical osteochondral grafts harvested from the relatively less weightbearing periphery of the patellofemoral joint might provide a congruent re-surfaced area. The transplanted hyaline cartilage should, in theory, survive the procedure and result in a more durable surface than that provided by fibrous repair tissue. Donor-site repair by the natural healing processes should result in filling of the tunnels with cancellous bone and coverage of the surface with reparative fibrocartilage.

Histological Results in Experimental Groups of Animals

In the preclinical phase and in later experimental controls, the mosaicplasty concept was tested in German Shepherd dogs, horses, and cadaver.20-22,23 Macroscopic and histological evaluations of the recipient and donor areas showed consistent survival of the transplanted hyaline cartilage, the formation of a composite cartilage layer from transplanted hyaline cartilage and the ingrowth of fibrocartilage from the osseous base of the defect, deep matrix integration of the transplanted cartilage with the surrounding tissue at the recipient site, and filling of the donor sites to the surface with cancellous bone capped with fibrocartilage by eight weeks. Fibrocartilage coverage of the donor holes appeared to provide an acceptable gliding surface in these limited weightbearing areas.

Supported by the reproducible experimental confirmation of the mosaicplasty concept, clinical application was begun in 1992.19-21 During the following ten years, the clinical results reported by various investigators matched the results seen in the animal tests, and, since 1995, the procedure has been used with equal success in numerous clinics throughout the world.24-33 The results in the present study were identical to those of the earlier follow-up studies.24-33

Indications

Initially, autologous osteochondral mosaicplasty was limited to relatively small or medium-sized focal chondral and osteochondral defects of the weightbearing surfaces of the femoral condyles and the patellofemoral joint. As notable success was achieved in these joints, the indications were extended to other diarthrodial surfaces, including talar, tibial, humeral capitular, and, recently, femoral head lesions. Theoretical and practical considerations indicate that the ideal diameter of the defect is between 1 cm² and 4 cm². Donor-site availability and other technical circumstances mainly determine these limitations. Usually, both of the patellofemoral peripheries allow graft harvest for defects of 3 cm² to 4 cm² in size. Under certain conditions, the mosaicplasty can be used as a salvage procedure for defects as large as 8 cm² to 9 cm², but such extension of the indication can result in a higher rate of donor-site morbidity.34 Age appears to be a limiting factor. Fifty years of age constitutes the recommended upper limit for this procedure, which corresponds to clinical experiences with single-block osteochondral transfer.

In treating patients, it is important that resurfacing is recognized as only one element of treatment. In every case, it is necessary to treat any additional joint abnormalities that would contribute to joint failure. Accordingly, the treatment of instability, malalignment, and meniscal and ligament tears must be incorporated in the operative and postoperative rehabilitation algorithms. Autologous osteochondral mosaicplasty permits an immediate full range of motion, but requires two weeks of non-weightbearing and an additional two to three weeks of partial weightbearing (30 to 40 kg) after the operation. This protocol can be modified easily in accordance with established guidelines for concurrent anterior cruciate ligament reconstruction, high tibial osteotomy, and meniscal reinsertion or resection.

Theoretical contraindications for mosaicplasty include infection, tumor, and generalized or rheumatoid arthritis.

Materials and Methods

Between February 1992 and February 2002, 831 mosaicplasties were performed at our institution. The implantations involved the femoral condyles in 597 procedures, the patellofemoral joint in 118, the talar dome in 76, the tibial condyles in 25, the capitulum humeri in 6, the femoral head in 6, and the humeral head in 3. Two-thirds of the patients underwent surgery because of a localized Grade III or Grade IV cartilage lesion, according to the Outerbridge classification system.19 whereas one-third underwent surgery because of osteochondral defects. In 85% of the patients, concomitant surgical interventions also were performed. The majority of these concomitant procedures were anterior cruciate ligament reconstructions, realignment osteotomies, meniscal surgery, and patellofemoral realignment procedures. The results of the resurfacing procedures were evaluated at regular intervals using standardized clinical scores and radiography, and beyond this, selected patients were also assessed with magnetic resonance imaging, second-look arthroscopy, histological analysis of biopsy materials, and cartilage stiffness measurement. Femoral,

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24-33

19-21
tibial, and patellar implants were evaluated according to the modified Hospital for Special Surgery scoring system,\textsuperscript{19} the modified Cincinnati knee-rating scale,\textsuperscript{19} the Lysholm scale,\textsuperscript{35} and the International Cartilage Repair Society scoring system, and donor-site disturbances were evaluated according to the Bandi score system.\textsuperscript{2,14,17,26} Patients with talar lesions were assessed using the Hannover ankle evaluation,\textsuperscript{36} and donor-site morbidity was evaluated according to the Bandi scoring system.\textsuperscript{14,30} During the ten-year period, 83 patients were examined with second-look arthroscopy to assess the quality of the resurfaced area and the morphologic features of the donor sites. Nineteen patients had a second-look arthroscopic examination performed between two months and six years postoperatively because of persistent or recurrent pain, swelling, or postoperative intraarticular bleeding; 23 had arthroscopy performed between one and nine years postoperatively because of a second trauma; and 41 had arthroscopy performed between two and four months postoperatively to evaluate the quality of the resurfaced area in order to determine the earliest possible date for a return to a professional sports activity. In a limited series involving 23 patients, cartilage stiffness measurements were performed with use of a computerized arthroscopic indentometric device, the Artscan 1000 (Artscan Oy, Helsinki, Finland), at a pressure of 10 N. The map of normal human knee articular cartilage, which had been revealed in former studies,\textsuperscript{37} enabled us to observe and compare measurements of the resurfaced area.

Patients who underwent a shoulder, elbow, or hip procedure also had follow-up examinations regularly; however, because of the limited series to date, the findings from these operations cannot be detailed in the current study.

### Surgical Technique

Autologous osteochondral mosaicplasty involves obtaining small-sized cylindrical osteochondral grafts (2.7, 3.5, 4.5, 6.5, and 8.5 mm in diameter) from the minimal weightbearing periphery of the femoral condyles at the level of the patellofemoral joint and transplanting them to prepared defect sites on the weightbearing surfaces. Combinations of different graft sizes allow a 90% to 100% filling rate. Fibrocartilage grouting, stimulated by abrasion arthroplasty or sharp curettage at the base of the defect, is expected to complete the new surface.

Autologous osteochondral mosaicplasty can be done as an open procedure, through a miniarthrotomy (Figs. 1 and 2), or arthroscopically. The technique of these surgical procedures is similar and there are only small technical differences at certain steps of each operation.

Cartilaginous lesions are defined only at arthroscopy. If the preoperative differential diagnosis includes such a lesion, the patient should be advised of the possibility of a mosaicplasty. The patient should be prepared for an open procedure, as the site may be inaccessible because of its location posteriorly or because of an inability to flex the knee sufficiently. General or regional anesthesia with tourniquet control is recommended for this procedure, and prophylactic antibiotics are used.

The patient is positioned supine with the knee free to flex to 120°. The contralateral extremity is placed in a stirrup. After the defect is identified, its edges are debrided to healthy hyaline cartilage with curettes, a knife blade, or an arthroscopic resector blade. The base of the lesion is abraded or curetted down to viable subchondral bone. At this point, a drill-guide is used to determine the number of grafts that are needed. By tapping the drill-guide down to viable subchondral bone, optimal filling of the defect can be projected.

![Figure 1](image1.jpg) **Figure 1** Miniarthrotomy for performing mosaicplasty. The donor site area can be reached by extending the knee joint.

![Figure 2](image2.jpg) **Figure 2** Miniarthrotomy mosaicplasty. The recipient area is reached by flexing the knee.
During an open procedure, the periphery of both femoral condyles at the level of the patellofemoral joint can serve as donor sites. During the arthroscopic approach, the medial border of the medial femoral condyle is recommended as a primary donor site because distension pushes the patella laterally, allowing perpendicular access to the medial femoral condyle. If necessary, the lateral border can be used as a secondary harvest site.

An appropriately sized tubular chisel is introduced perpendicular to the donor site. This harvester device is then tapped into the donorte site. A depth of 15 mm is usually recommended for resurfacing of cartilage defects and a depth of 25 mm is appropriate for osteochondral defects because, in the latter case, the grafts should fill the bone loss as well. After tapping and toggling, the chisel is removed and the graft is delivered from the harvester with use of a chisel guard. It is very important to push out the grafts from the osseous end to avoid damaging the hyaline cartilage cap.

Insertion of the grafts is done through the universal guide. As a first step in the implantation, this guide is tapped into the osseous base of the defect. The 3-mm long cutting edge is introduced into the osseous base with use of the shoulder of this tool to help define a perpendicular access to that part of the defect. With the assistance of this universal guide, a recipient tunnel is created with use of the appropriately sized drill bit. A dilator is then used to create a conical shaped recipient tunnel for easy insertion of the transplanted graft. Finally, insertion of the graft is done with an adjustable plunger to match the surface of the graft to the surrounding articular surface. Proceeding with this step-by-step sequence (drilling, dilating, and delivering), all of the grafts are inserted. In uncontained or marginal lesions, the grafts are implanted in a perpendicular fashion. When all of the holes are filled, the knee is put through a range of motion with varus and valgus stress to seat the grafts fully and to ensure their press-fit stability. The portals are closed, and the joint is drained through a superior portal. After surgery, an elastic bandage is used to reduce bleeding from the donor sites.

Results
The clinical scores observed in our series demonstrated good-to-excellent results in 92% of the patients who had femoral condylar implantations, in 87% of those who had tibial resurfacings, in 79% of those who had patellar and/or trochlear mosaicplasties, and in 94% of those who had a talar procedure (Fig. 3). The Bandi score, which was based on evaluations that were done over a one- to ten-year interval, showed that 3% of the patients had slight donor site disturbances. Sixty-nine of the 83 patients who were monitored arthroscopically demonstrated good gliding surfaces, histological evidence of survival of the transplanted hyaline cartilage, and fibrocartilage covering of the donor sites. Fourteen patients (four with chondral lesions and ten with osteochondritis dissecans) had slight or severe degenerative changes at the recipient sites. In the 21 patients who had arthroscopic indentation testing during a second look operation, most demonstrated stiffness of the resurfaced area that was similar to that of the surrounding hyaline cartilage.

Complications in the entire series included four deep infections and 36 painful hemarthroses after surgery. The patients with infections were treated successfully by arthroscopic or open debridement, whereas the patients with a hemarthrosis were treated by aspiration and nine of them were managed with arthroscopic or open debridement. Two patients had thromboembolic complications.

Discussion
A previous multicenter, prospective study involving 413 patients compared four arthroscopic resurfacing techniques: Pridie drilling, abrasion arthroplasty, microfracture (a fibrocartilage-type cartilage repair), and mosaicplasty (a hyaline cartilage-type resurfacing procedure).34 That study showed that hyaline-like resurfacing provides a substantially better clinical outcome than the other techniques, especially after three, four, and five years.

The durability of the mosaicplasty results was investigated in another study, which involved an assessment of the clinical outcome in patients who were monitored for in excess of three years.34 Between February 1992 and August 1996, 126 mosaicplasties (the first patients reported in the present series of 831 patients) were performed at our institution and 113 of these patients had complete follow-up. Two-thirds of the patients were managed with a mosaicplasty as a result of full-thickness cartilage defects, and one-third underwent the procedure due to osteochondral defects. Good-to-excellent clinical outcomes, according to the modified Hospital for Special Surgery scores, were achieved in 91% of the patients at three to six years of

Figure 3 Open mosaicplasty on the femoral trochlea.
follow-up.\textsuperscript{34}

Intermediate-term results after talar mosaic-like implantations were evaluated separately in a third study.\textsuperscript{36} Thirty-six patients who were treated between March 1992 and August 1997 were followed for an average of 4.2 years (range: 2 to 7 years). The average age of the patients at the time of the procedure was 27 years (range: 16 to 47 years). The average area of the defects treated with mosaicplasty was 1 cm$^2$, and the average number of grafts per patient was three (range: 1 to 6). The patients were assessed clinically with use of the Hannover and Bandi scoring systems. Second-look arthroscopy was performed in eight patients, and a total of four biopsy specimens also were evaluated at 12, 24, 29, and 34 months postoperatively. No long-term morbidity was noted at the donor site of the ipsilateral knee, according to the Bandi scoring system, but six patients reported slight or moderate pain in the patellofemoral area with strenuous physical activity albeit only during the first postoperative year. According to the Hannover scoring system, the result was excellent in 28 patients, good in six, and moderate in two. The second-look arthroscopy showed normal and congruent appearing surfaces. Staining of the biopsy specimens showed type II specific normal articular cartilage collagen and articular cartilage proteoglycans. These results were compared with those in a control biopsy specimen and were found to be of a similar quality.\textsuperscript{36}

Autogenous osteochondral mosaicplasty is an innovative and promising treatment for focal chondral and osteochondral articular cartilage defects that are between 1 cm$^2$ and 4 cm$^2$ in size. The success of the procedure depends primarily on the adherence to proper indications and attention to technical details.

In a series of more than 800 patients, involving various diarthroidal joints with various functions and biomechanical loads, the composite results have been in the good-to-excellent range in a high percentage of patients with a low complication rate.\textsuperscript{14-18} The results in older patients (those who were more than 45 years old) were less impressive, emphasizing the importance of having an age limitation for the procedure (an upper limit of 50 years). Several independent evaluations have described similar results, which suggests that when a well-standardized technique is followed

**Figure 4** Open mosaicplasty on the femoral head.

**Figure 5** Mosaicplasty on the medial aspect of the talar dome. A medial malleolar osteotomy was required to achieve a perpendicular approach to the lesion.

**Figure 6** Second-look arthroscopy two years after the mosaicplasty. The viable cartilage grafts aligned well with the surrounding healthy cartilage.
and when the indications are the same as those used in the present study, the results are reproducible.\textsuperscript{24}\textsuperscript{–35}

Appropriate treatment of the underlying causes of the cartilage lesion occupies an essential role in the success of any cartilage repair method. The nature of the mosaicplasty is such that it facilitates the integration of other corrective operations and accompanying rehabilitation protocols. The rehabilitation of the patients who had been operated upon was carried out observing a special protocol, developed at our department (Table 1). The rehabilitation process in question has always been a personal rehabilitation process, based on the principles of the special mosaicplasty

\begin{table}
\centering
\caption{Mosaicplasty Rehabilitation Protocol*}
\begin{tabular}{ll}
\hline
\textbf{General Viewpoints} & \\
Immobilization & \\
\hspace{1em} No Immobilization!† & \\
Ambulation‡ & \\
\hspace{1em} Two-crutch ambulation, non-weightbearing & Immediate \\
\hspace{1em} Two-crutch ambulation, partial loading (30-40 kg-s) & 2-4 weeks \\
\hspace{1em} Discontinue crutches, full weight-bearing & 4-5 weeks \\
Functional exercises & \\
\hspace{1em} Form walking, gait evaluation & 4-5 weeks \\
\hspace{1em} Step-up & 4-5 weeks \\
\hspace{1em} Step-down & 5-6 weeks \\
Range of motion & \\
\hspace{1em} Early range of motion encouraged & \\
\hspace{1em} CPM in case of extended lesions 2-4cm\textsuperscript{2} (in painless range) & Immediate (first week) \\
\hspace{1em} Full extension, flexion as tolerated & Immediate \\
\hspace{1em} Stationary bicycle & 3 weeks \\
Strength return & \\
\hspace{1em} Quadriceps & \\
\hspace{1em} Open chain exercises, leg raises & Immediate \\
\hspace{1em} Concentric contraction to full extension & 1 week (or earlier if tolerated) \\
\hspace{1em} Concentric contraction against resistance & 2 week \\
\hspace{1em} Isometric exercises in different angles & Immediate \\
\hspace{1em} Excentric exercises against resistance & 3-4 weeks \\
\hspace{1em} Hamstrings & \\
\hspace{1em} Isometric exercises in different angles & Immediate \\
\hspace{1em} Concentric and excentric strengthening against resistance & 1-2 weeks \\
\hspace{1em} Closed chain exercises§ & \\
\hspace{1em} Pushing a soft rubber-ball with foot & Immediate \\
\hspace{1em} Closed chain exercises with half weightbearing & 2-3 weeks \\
\hspace{1em} with full weightbearing & 5-6 weeks \\
\hspace{1em} Stationary bicycle with resistance & 2-4 weeks (if 90° knee flexion achieved) \\
\hspace{1em} Stairmaster & 6-8 weeks \\
Proprioception return & \\
\hspace{1em} Balance exercises standing on both feet & 5-6 weeks \\
\hspace{1em} Standing on one foot (hard ground) & 6-8 weeks \\
\hspace{1em} Standing on one foot (trampoline or aerostep) & 8-10 weeks \\
Return to activity & \\
\hspace{1em} Jogging & 10 weeks \\
\hspace{1em} Straight line running & 3 months \\
\hspace{1em} Directional changes & 4-5 months \\
\hspace{1em} Shear forces & 5 month$\ddagger$ \\
\hspace{1em} Sport specific adaptations & 5 months \\
\hspace{1em} Sport activity & 5-6 months$\ddagger$ \\
\textbf{Special Viewpoints} & \\
Weightbearing at different defects of knee & \\
Femur or tibia condyle, chondral defect, \textit{d} < 15mm & \\
\hspace{1em} Non-weightbearing & 1 week \\
\hspace{1em} Partial weight bearing & 1-3 Weeks \\
Femur or tibia condyle, chondral defect, \textit{d} 15mm & \\
\hspace{1em} Non-weightbearing & 2 weeks \\
\hspace{1em} Partial weightbearing & 2-4 weeks \\
\end{tabular}
\end{table}
Table 1  Mosaicplasty Rehabilitation Protocol* (continued)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur or tibia condyle, osteochondral defect</td>
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<tr>
<td>Non-weightbearing</td>
<td>3 weeks</td>
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<tr>
<td>Partial weightbearing</td>
<td>3-5 weeks</td>
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<tr>
<td>Patellar defect, d &lt; 15mm</td>
<td></td>
</tr>
<tr>
<td>Partial weightbearing</td>
<td>2 weeks</td>
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<tr>
<td>Patellar defect, d ≥15mm</td>
<td></td>
</tr>
<tr>
<td>Partial weightbearing</td>
<td>3 weeks</td>
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<tr>
<td>Quadriceps strengthening and patellar mobilization – differences at patellar defects</td>
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<tr>
<td>Vastus medialis strengthening!</td>
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<tr>
<td>Isometric exercises in extension</td>
<td>Immediate</td>
</tr>
<tr>
<td>Patellar mobilization</td>
<td>Immediate!</td>
</tr>
<tr>
<td>Isometric exercises in different angles</td>
<td>1 week</td>
</tr>
<tr>
<td>Open chain exercises</td>
<td></td>
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<tr>
<td>Against resistance</td>
<td>2 weeks</td>
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<tr>
<td>Eccentric exercises against resistance</td>
<td>3-4 weeks</td>
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<tr>
<td>Closed chain exercises</td>
<td>4-5 weeks</td>
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</tbody>
</table>

The treatment of underlying causes can also modify the rehabilitation program. The most frequent combinations at knee applications are the following:

LCA-reconstruction combined with mosaicplasty:
- 2-4 weeks non-weightbearing (up to the mosaicplasty)
- 2 more weeks partial weightbearing
- 5°-90° ROM for 4 weeks
  - Mainly closed chain exercises for quadriceps strengthening
  - Hamstring strengthening in open and closed chain
  - Proprioceptive training!

Meniscus reinsertion combined with mosaicplasty:
- 4 weeks non-weightbearing
- 2 more weeks partial weightbearing
- 5°-45° ROM for 4 weeks

Retinaculum patellae reconstruction combined with mosaicplasty:
- 2-4 weeks non-weightbearing (up to the mosaicplasty)
- 2 more weeks partial weightbearing
- 0°-45° ROM for 4 weeks

HTO combined with mosaicplasty:
- Weightbearing (for 4 weeks only with crutches and only in extension) is up to the mosaicplasty, pain, and degree of the correction of the varus (lower correction – non-weightbearing, overcorrection – early weightbearing)

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*Uzsoki Hospital and Sanitas Private Clinic, Budapest, Hungary. †The main point of the rehabilitation is to ensure the early motion of treated joint to promote appropriate nutrition of transplanted cartilage. Cool therapy can be used during the first week to avoid postoperative bleeding and decrease postoperative pain. In a case of a concomitant procedure requiring external fixation of the affected joint (e.g., meniscus reinsertion), limitation of ROM for a short period by bracing can be allowed. ‡Extent, type (chondral or osteochondral), and location of the defect may modify weightbearing. §Partial loading promotes to transform connecting tissue (between transplanted plugs) into fibrocartilage, so these exercises are mainly important in the half-weightbearing period. On the other hand, with some closed chain exercises (e.g., cycling) it is possible to ensure cyclic loading, that makes the fluid- and nutrition-transport much more efficient between synovial-fluid and hyaline cartilage. ||Approximately 4-5 months are needed to form a composite hyaline-like surface on transplanted area, which tolerates shear forces. ¶Depending on depth and extent of the defect. If strength, power, endurance, balance and flexibility are not satisfying, sport activity is allowed only later.

Concerns regarding donor site morbidity remain an integral part of the current study. A recent biomechanical study demonstrated relatively high loading forces in the donor area but stated that to date there has been no evidence that graft harvest would result in further degenerative changes. In our entire study group, only transient symptoms could be attributed to the donor sites. The patients with talar, capitellar, femoral, and humeral head lesions who had knee surgery only for procurement of the osteochondral plugs served as the donor site controls (Figs. 4 and 5). Those patients, with a single rare exception, had no long-term symptoms in the knee. The symptoms in the knee resolved within six weeks in 95% of patients with a talar lesion and were completely resolved at one year in 98%. We believe that full recovery of the donor site is due to the peripheral position chosen for the donor area and the small size and proper spacing of the individual grafts. These elements allow the joint to reconstitute structurally and to accept the relatively low loads in these parts of the knee.

On the basis of these encouraging results from an in-
creasingly large series of patients and similar results from other centers, we believe that autologous osteochondral mosaicplasty may be a viable alternative treatment for localized full-thickness cartilage damage of the weightbearing surfaces of the knee and other weightbearing synovial joints (Fig. 6).

References