Transchondral Drilling and Osteochondral Autografting (Mosaicplasty) in Knee Articular Cartilage Defects

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Background: The cartilage is a complex and specialized tissue. It is extremely difficult to repair or to replace it, once damaged. The management of cartilage defects remains controversial and over the last five decades various treatment options and surgical techniques have been tried to optimize the clinical outcome.

Objective: The aim of this study is to evaluate, but not to compare the results of two of the most used cartilage repair techniques: transchondral drilling and osteochondral autografting.

Material and methods: Between January 2009 and June 2010, we performed 55 transchondral drillings and 10 mosaicplasties on patients with articular cartilage defects of the knee. All patients were followed up at 6 months. Hughston clinical and radiological scales were used to evaluate the patients in the transchondral drilling group.

Results: The Hughston Clinic score was 2 in 2 cases (3.6%), 3 in 5 cases (9.9%) and 4 in 48 cases (86.5%), giving over 95% of good results. The Hughston radiological score was 2 in one case (2%), 3 in 4 cases (7.3%) and 4 in 50 cases (90.7%). In the mosaicplasty group,the average area of the osteochondral lesion covered with autologous osteochondral transplantation ranged from 0.8 to 6 cm^2 (average: 2.13 cm^2). The diameter of the grafts used ranged from 6 to 10 mm and 1 to 6 grafts were used in each case to achieve >90% covering of the lesion area.

Conclusions: Both techniques offer satisfactory functional outcome and do not compromise the patients' future options.

Keywords: transchondral drilling, osteochondral autografting, mosaicplasty, articular cartilage

Introduction

The cartilage is a complex and specialized tissue. It is extremely difficult to repair or to replace it, once damaged. The repair tissue found in the cartilage defects is fibrocartilage, which is mechanically and chemically inferior to hyaline cartilage [1]. The management of cartilage defects remains controversial and over the last five decades various treatment options and surgical techniques have been tried to optimize the clinical outcome.

In a review of 993 knee arthroscopies in patients with a mean age of 35 years, there was an 11% incidence of full-thickness lesions that could have benefited from surgical treatment [2]. In a larger and more generalized study, Curl et al. reviewed 31,516 knee arthroscopies of patients in all age groups and reported chondral lesions in 19,827 (63%) of patients; 5% of all cases were found in patients younger than 40 years of age who had grade IV lesions [3]. A review of 1,000 arthroscopies by Hjelle et al reported chondral or osteochondral lesions of any type in 610 patients (61%), out of which 190 patients had focal lesions (19% of all cases). Many of these lesions were clinically silent at the time of detection [4].

Keeping in mind that those procedures are relatively new, we presented the author's and the Orthopedic Clinic's experience in using these techniques. The aim of this study is to evaluate, but not compare, the results of two of the most used cartilage repair techniques: transchondral drilling and osteochondral autografting.

Material and methods

Between January 2009 and June 2010, we performed 55 transchondral drillings and 10 mosaicplasties on patients with articular cartilage defects of the knee. The study is a prospective longitudinal one, with 6 months patient follow-up. In the group with transchondral drilling, 39 patients (70.9 %) were male. In the group with mosaicplasty, 8 patients were male and 2 female. The medial condyle was affected in 58 cases (89.23%).

The mean age for the group with transchondral drilling was 42.55±9.32 years, the patients being between 19 and 49 years old. For the group with mosaicplasty, the mean age was 44.23±6.87 years, the patients being between 39 and 51 years old.

In all patients we performed a conventional radiography (anteroposterior and lateral views). In 8 patients, 6 from the transchondral drilling group (10.9%) and 2 patients from the mosaicplasty group we performed a CT scan. Magnetic resonance imaging was performed in 13 patients from the transchondral drilling group (23.6%) and 4 patients from the mosaicplasty group.

The performed procedure was chosen based on patient age, physical activity and lesion size.

Table I. Hughston clinical scale

Excellent	4	Normal sports activity No symptoms Normal physical examination
Good	3	Normal sports activity Knee pain with intense activities Normal physical examination
Average	2	Normal sports activity Knee pain and swelling with intense activities Normal physical examination
Bad	1	Knee pain and swelling with moderate activities Flexum less than 200
Failure	0	Restriction of sports Knee pain and swelling with daily activities Flexum more than 200

Table II. Hughston radiological scale

4	Normal
3	Defect or sclerosis
2	Flattening of the condyle
1	Irregular condyle with narrowing of the joint space less than 50%
0	Knee arthritis with narrowing of the joint more than 50%

The opportunity of surgical intervention was raised when the patient showed no improvement after the conservative treatment. All patients were followed-up at 6 months. Hughston clinical and radiological scales were used to evaluate the patients in the transchondral drilling group (Tables I and II).

Surgical technique

Transchondral drilling. This technique was carried out with arthroscopy. After a conventional installation for knee arthroscopy, the diseased area is identified. This identification is made on the gross appearance of articular cartilage, gray or yellowish, with a frosted consistency, and abnormal to palpation due to its softening.

Multiple perforations (5–10) using a fine 1.2–1.5-mm diameter K-wire are made through the articular cartilage, opposite to the lesion of the subchondral bone and passing beyond the zone of sclerosis that circumscribes the lesion. After the drilling, one must observe bleeding from the healthy underlying bone through the puncture holes [5]. Postoperatively, non-weight-bearing for 1 month using two crutches with free mobilization of the knee has been proposed, with the discontinuation of sports activities. Follow-up involves clinical and radiographic monitoring. The resumption of sports activities was allowed 6 months after surgery.

Mosaicplasty. Autologous osteochondral transplantation was carried out with the OATS technique (Osteochondral Autograft Transplantation System, Arthrex, Naples, USA), which allows for press-fit graft implantation. We used the miniopen technique. Grafts were harvested from the lateral or medial edge of the trochlea. The depth of the donor osteochondral plug ranged from 12 to 15 mm and the recipient site was drilled to such a depth so as to compensate for any potential subchondral bone loss and at the same time allow for some bone impaction. Care was taken to achieve perpendicular graft insertion, deliver the graft flush with the joint surface and reproduce the joint curvature as close to anatomical as possible. A drain was inserted in the joint for 24 hours and patients were encouraged to start passive mobilization of their knee as soon as pain allowed. Touch-toe weight bearing was advocated for 4–6 weeks and patients gradually progressed to full weight bearing thereafter.

For patients with a second look, condrocyte survival was evaluated by imunohistochemistry. We used CD31 and CD34 as markers, to assess the angiogenesis.

Results

In the transchondral drilling group, we encountered no perioperative complications. The Hughston Clinic score was 2 in 2 cases (3.6%), 3 in 5 cases (9.9%) and 4 in 48 cases (86.5%), giving over 95% of good results. The Hughston radiological score was 2 in one case (2%), 3 in 4 cases (7.3%) and 4 in 50 cases (90.7%). We found a significant correlation between the clinical and radiological Hughston score ($p < 0.001$, $r = 0.96$). All the patients were able to resume their regular duties and life style.

In the mosaicplasty group,the average area of the osteochondral lesion covered with autologous osteochondral transplantation ranged from 0.8 to 6 cm^2 (average: 2.13 cm^2). The diameter of the grafts used ranged from 6 to 10 mm and 1 to 6 grafts were used in each case to achieve >90% covering of the lesion area. Two patients had a second look arthroscopy for ongoing swelling, pain or clicking 6 months following their initial procedure. Arthroscopic assessment was combined with arthrolysis in one case. The grafts were found to be stable, well incorporated and with satisfactory chondrocyte survival in all cases. In both patients, symptoms improved significantly. No donor-site related morbidity was recorded. One patient had a superficial wound infection that was successfully managed with oral antibiotics and one had a deep vein thrombosis and was successfully treated.

Discussions

All patients in our series have maintained a conservative treatment by restriction of sports activities for an average of 6 months, and the use of surgical treatment was offered to one of the following criteria: instability or fragments sequestration, persistence of symptoms in a compliant patient, and the imminent closure of the physis. These indications were similar to those found in the literature [6]. For many authors, multiple transchondral drilling was the preferred treatment of juvenile osteochondritis condylar after failure of conservative treatment. Cepero et al. [6] showed excellent and good clinical and radiological results in 98% of patients operated on for arthroscopic drilling. Other study showed a normalization of radiological images in 87.5% of patients treated by drilling and all patients were clinically asymptomatic at 4 years of decline [7]. In our

series, all patients were operated by multiple arthroscopic transchondral drilling with good clinical and radiological results in over 95% of cases.

Osteochondral defects spontaneously heal with fibrocartilage and treatment options such as abrasion arthroplasty, also promote the formation of fibrocartilaginous tissue, whose load-bearing properties and histological characteristics are significantly inferior to those of normal hyaline cartilage [8–10]. In weight-bearing areas of the knee, this can cause impairment of smooth load transmission, leading to point loading and thus predisposing to development of osteoarthritis. Osteochondral transplantation and autologous chondrocyte implantation that can provide hyaline cartilage covering of the articular surface defect. Autologous chondrocyte implantation leads to covering of the defect with predominantly hyaline or hyaline-like cartilage [11], although this has been challenged by recent reports [12]. A number of authors have reported a high rate of symptom relief and functional improvement, as well as very satisfactory survival of the transplanted hyaline cartilage [13–22]. This method, though, has certain limitations, namely, increased donor site morbidity and a less favorable outcome when used for relatively large defects (>2×2 cm) [22, 23].

Conclusions

All patients from the group with transchondral drilling had good postoperative clinical and radiological outcomes, therefore confirming the validity and effectiveness of multiple transchondral drilling in the treatment of articular cartilage of the knee.

Patients from the mosaicplasty group also had a favorable evolution; both techniques offer satisfactory functional outcome and do not compromise the patients' future options.

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