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Osteochondral autografts in full thickness patella cartilage lesions

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ABSTRACT

The purpose of this study was to evaluate clinical, functional and imaging results of full thickness patella cartilage lesions treated with osteochondral autografts (OCA). We studied a consecutive case series of 10 patients. At follow-up, Lysholm and International Knee Documentation Committee (IKDC) scores were obtained. Magnetic resonance imaging (MRI) evaluation was performed at an average of 8 months post-op. The average cartilage lesion area was 1.2 cm^2. An average of 1.9 grafts was used per patient. The average Lysholm scores were: pre-op 73.8 ± 8.36; post-op 95 ± 4.47 points ($p<0.05$). The average IKDC post-op score was 95 ± 1.74 points. No postoperative complications were registered. In the MRI analysis we found that in all cases, OCA presented flush characteristics when compared with adjacent cartilage. The majority of cases presented no fissures in the graft–receptor interface (60%). In 80% we observed mild bone marrow edema around the graft. According to the International Cartilage Research Society (ICRS) cartilage lesions classification, all grafts were considered 1A; in the periphery cartilage was classified as 1A in 60%. We conclude that patellar OCA is a good alternative for the treatment of full thickness patellar cartilage lesions, offering good clinical, functional and imaging results at midterm follow-up.

1. Introduction

There are few reports of osteochondral autografts (OCA) performed at the patella or femoral trochlea, with results not as encouraging as the ones observed in the femoral condyles [1,2].

According Nomura et al. [3], this could be secondary to the great functional demand that the patellofemoral articulation is loaded during daily living and sports activities and secondary to the reaction forces of the arm lever produced by the patella and femoral trochlea [4].

Among the procedures described to treat cartilage lesions, OCA offers 100% hyaline cartilage, mostly in the center of the osteochondral plug. The periphery of the plug will regenerate with fibrocartilage, similar to that obtained after microfractures [1,5].

The purpose of the present study is to evaluate clinical, functional and imaging results obtained in patellar full thickness cartilage lesions treated with OCA.

We hypothesized that the use of OCA for the treatment of patellar full thickness cartilage lesions could offer good and excellent results in the majority of cases treated with this procedure when compared with other cartilage procedures used for the treatment of these lesions.

2. Methods

A prospective study of a consecutive case series of ten patients with symptomatic patellar full thickness cartilage lesions classified according the International Cartilage Repair Society (ICRS) as grade 4, treated with OCA in a six year period was included in this study (November 2000–April 2007).

The indications to perform a patellar OCA were: painful symptomatic cartilage lesion ≤2.5 cm^2, preferably of traumatic origin and ≤40 years of age. Regarding technical issues, all cases were performed through a mini arthrotomy, with special care in plug placement with perpendicular orientation to the bone surface and that the maximum plug length does not exceed 10 mm to avoid damage of the anterior cortical of the patella. In Figs. 1 and 2 we observe an appropriate placement and OCA surface orientation regarding the receptor site.

The inclusion criteria for this study were: Patients with painful symptomatic patellar cartilage (anterior knee pain) lesions treated with OCA and no other cartilage procedure in the patella or other knee compartments.

The exclusion criteria were multiligamentous lesions, anterior cruciate ligament (ACL) concomitant reconstruction, other cartilage lesions and painful symptomatic patella cartilage lesions greater than 2.5 cm of diameter or degenerative origin. These cases were excluded from our study since the associated procedures performed simultaneously to OCA could alter the final results.

We followed our cases once every year with clinical evaluations. At an average follow-up of 37.3 months (24–70), Lysholm and the 2000

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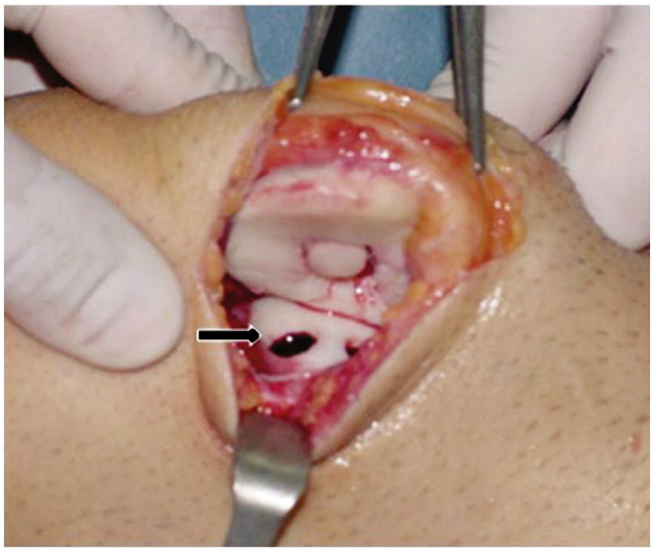

Fig. 1. We observe a knee mini arthrotomy, where the black arrow points the harvest area for the OA placed in the patella.

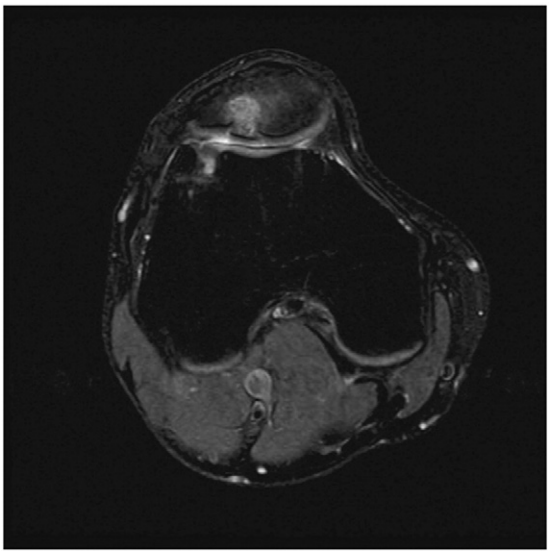

Fig. 3. Post-op sagittal view in T2 weighted signal MRI of a patient treated with patellar osteochondral autograft. In this case we observe a flush cartilage level of the graft–receptor interface, presence of fissures less than 2 mm and a slight bone marrow edema (less than 1 cm) in the receptor site. This case was classified as nearly normal (1A) in the graft and peripheral chondral tissue, according the ICRS cartilage lesion classification.

subjective International Knee Documentation Society (IKDC) scores were obtained. At follow-up, we asked the patients if they had changed their sports activities secondary to knee pain. In our series, prior surgical intervention, all patients were diagnosed with patellar instability, and six of them with associated patellofemoral malalignment.

All cases were males, with an average age of 20.2 years (15–38) at the time of surgery. According to laterality, seven knees were right and three left sided.

A post-op MRI study was performed at an average of 8 months (6–10) after the procedure and analyzed by one senior musculoskeletal radiologist, studying imaging parameters previously described in the literature for osteochondral autografts evaluation [6]. A General Electrics® resonator of 1.5 T (GE Medical Systems, Milwaukee, WI), in proton density, T1 and T2 sequences, and in coronal, sagittal and axial views was used for this purpose. Images were assessed for the relative signal intensity from the repaired area compared with the native cartilage; morphologic features of the repaired area (flush, proud, or depressed with respect to native cartilage); nature of the interface (presence/absence and size of fissures) with the adjacent (native) surface, fissures were assessed as being small (<2 mm) or large (>2 mm). Integrity of the cartilage over the donor and native surfaces was graded using the modified International Cartilage Research Society (ICRS) classification. The presence or absence of subchondral edema was evaluated as mild (<1 cm^2), moderate (1–3 cm^2), or severe (>3 cm^2), as we observe in Fig. 3.

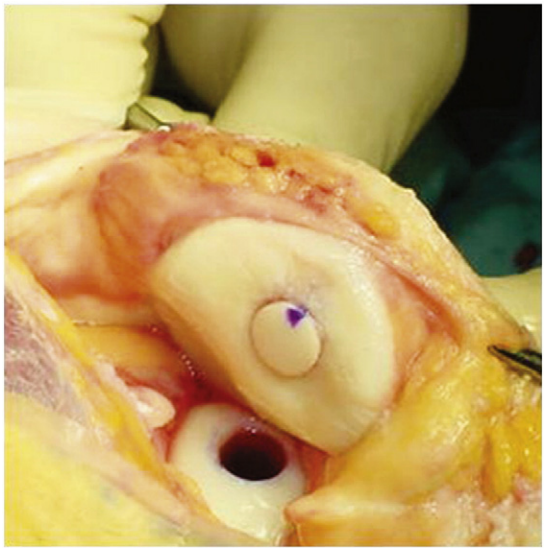

Fig. 2. Open arthrotomy for full thickness patellar chondral lesion treated with osteochondral autografts. In this figure we observe the donor and receptor sites.

2.1. Statistics

We used parametric tests for 2 independent samples (T test studies) in our statistical analysis for the pre-op and post-op Lysholm scores, given the normal distribution of continuous data.

3. Results

An average of 1.4 associated procedures (1–4) was performed in each case. In Chart 1 we describe the associated procedures performed. The most frequent associated procedures were the reconstruction of the medial patellofemoral ligament (15%), chondral fragment fixation with bioabsorbable screws (15%) and microfractures (15%). Distal bone realignment with an Elmslie–Trillat procedure was performed in one case (8%).

The average cartilage lesion area treated with OCA was 1.2 cm^2 (0.9–2). According to the anatomic location, 8 cases were located at the medial patellar facet, one case in the central area and one case in the lateral patellar facet.

The harvest area was the superior lateral femoral trochlea in 8 cases and the superior medial trochlea in 2 cases.

During the procedure 1.9 plugs (1–4) were used in each case; with an average plug diameter of 6.95 mm (4.5–8) and an average plug length of 10.8 mm (8–11) (Fig. 4). We used a plug with a length of 11 mm in the central patellar lesion case. During the procedure we observed macroscopically an appropriate plug final position, maintaining at all times the anterior cortices of the patella intact.

The functional outcomes are described in Table 1. The average pre-op Lysholm score was 73.8 ± 8.36 (66–86) points; post-op average Lysholm score was 95 ± 4.47 (90–100) points ($p<0.05$). The IKDC subjective knee score was obtained only after the procedure, with an average of 93.6 ± 1.74 (92–96) points.

On the subject of current sports activities at follow-up, concerning those performed prior surgery; none of the patient's referred changes secondary to knee pain.

Regarding Lysholm evaluations, 100% of the cases referred good (60%) and excellent (40%) scores at follow-up. We have not documented post-op complications secondary to the OCA procedure at 3 to 6year follow-up. None of the patients underwent another knee surgery secondary to the initial cartilage lesion.

We documented that in all of our cases, OCA presented flush characteristics when compared with the adjacent cartilage. Regarding fissures found between the graft and receptor site, the majority of cases presented no fissures in the graft–receptor interface

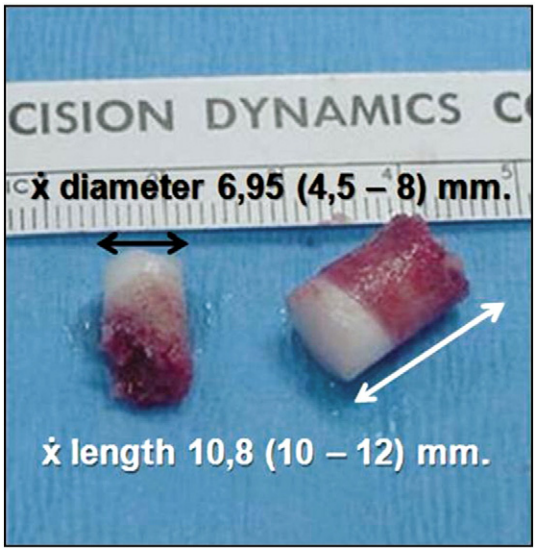

Fig. 4. In this picture we present average (Ẋ) length and diameter of the OA used in our cases. One of the plugs was longer than 10 mm, since it was used in a central area defect.

(60%). In 80% of the cases we observed mild bone marrow edema (less than 1 cm) around the osteochondral plug. According to the ICRS cartilage lesion classification on MRIs, all of the grafts cartilage was considered nearly normal (1A). In the periphery of the plug, the cartilage was classified as 1A in 60% of cases, 1B in 20% and 10% as grade 2 and another 10% as grade 3B (Chart 2).

4. Discussion

Full thickness cartilage lesions represent a very frequent pathology in the knee, resulting in an important challenge for the treating surgeon, mainly when they are located in the patella [7,8].

These lesions are especially frequent in young and active patients, presenting the tendency to complicate in time with knee pain, compromising this way the quality and quantity of activities, regarding daily living as well as sports activities, since the natural history of these lesions does not present spontaneous healing [4,6,9,10].

OCA transplantation is a technique used for the treatment of full thickness cartilage lesions, restoring injured hyaline cartilage and offering some degree of structural subchondral bone support [1,3–5,9].

Table 1
In this table we observe average Lysholm functional knee scores obtained pre-op and post-op and the International Knee Documentation Committee (IKDC) subjective score obtained post-op.

	Lysholm	IKDC
Pre-op	73.8 ± 8.36 (66–86)	–
Post-op	95 ± 4.47 (90–100)	93.6 ± 1.74 (92–96)

Jakob et al. [11] performed a retrospective study in 52 patients with full thickness patellar cartilage lesions treated with OCA, 18 females and 34 males with an age average of 34 years (14–66); 23 cases were classified intraoperatively as ICRS grade III and 29 as ICRS grade IV lesions. In their series, 16 cases of OCA were performed at the patellofemoral joint: one case of osteochondritis dissecans of the patella, 5 cases of patellofemoral malalignment with recurrent episodes of patellar dislocation and 10 cases with patellofemoral osteoarthritis. With a minimum 2 years of follow-up, they found 86% of the cases with a significant improvement in knee function, increasing to 92% at last follow-up regarding International Cartilage Repair Society (ICRS) scores. In the same series, at 4 to 41 months after surgery, a second look arthroscopy was performed in 10 cases. During the second look arthroscopy they classified the entire previously implanted OCA surface as “almost normal”. Histological samples revealed that the transplanted cartilage kept the hyaline characteristics, corroborating results obtained in previous similar studies that evaluated the quality of transplanted cartilage [5,12]. In their study they include as well cases with degenerative lesions; this could alter their results at follow-up.

In the literature, clinical results of patellar OCA present a wide range of results. Bentley et al. [13] presented their results of a prospective randomized series of 100 patients with symptomatic knee cartilage lesions, treating one group with autologous chondrocyte implantation and the other group with mosaicplasty. The mosaicplasty group consisted of 42 patients, with five of them performed in the patella. They followed up their series with functional Cincinnati and Stanmore scores; 69% of the cases presented good and excellent results with mosaicplasty. The five patellar cases were considered failures, with regular clinical results. All of these cases needed revision surgery in the first or second year of the initial treatment.

Miniacci et al. [1] present their results of eight full thickness patellar cartilage lesions treated with OCA. They observe that an

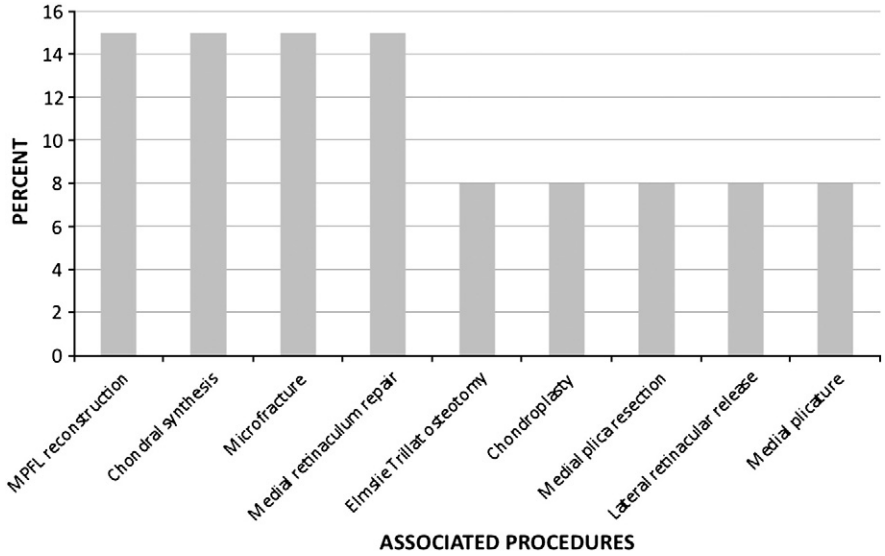

Chart 1. We observe the associated procedures performed when treating full thickness patellar cartilage lesions with OCA. Medial patellofemoral ligament (MPFL) reconstruction, cartilage fragment synthesis, microfractures and medial retinaculum repair were the most frequently performed. OCA: osteochondral autografts.

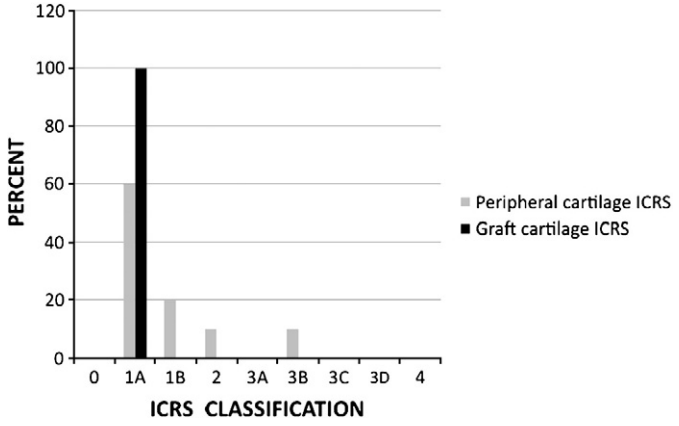

Chart 2. In this table ICRS classification of grafts and receptor area cartilage are described. All of the grafts presented nearly normal cartilage characteristics on MRI evaluations and the majority (60%) of the peripheral cartilage was nearly normal according the ICRS cartilage characteristics classification.

appropriate plug orientation and angulations regarding the femoral trochlea can be technically demanding when performed during arthroscopic surgery; recommending the use of a mini arthrotomy for appropriate visualization of the lesion. They present 88% of good and excellent functional results in their series.

In our study, all the cases were male young athletes, with an amateur level of sports activity. At follow-up, none of the patients referred to have altered their sports activity secondary to knee pain. We have not documented sports activities evaluations such as Tegner scores; this is a point to consider in future studies.

Kish et al. [14] presented a review of the indications, technique and results obtained in 57 cases of knee and talus OCA, separating their results according to anatomic location. They documented Lysholm and ICRS scores, obtaining 85% of good and excellent results in patellar mosaicplasty cases with a 3 year minimum follow-up. In our series the average follow-up was 3 years, and we obtained higher Lysholm scores, with 100% of the patients with good and excellent results. This could be secondary to the type of patient treated with patellar OCA; all of our cases were young males without degenerative lesions. For degenerative lesions in older patients we prefer to use the microfracture technique.

In a recent study by Nho et al. [15], they prospectively evaluated a consecutive series of 22 patients with full thickness patellar cartilage lesions treated with OCA in a 4 year period. The average age of their cases at time of surgery was 30 years. At follow-up they obtained pre-op and post-op IKDC, activities of daily living (ADL) and the short form 36 (SF-36) evaluations. The average pre-op IKDC score was 47.2 ± 14 improving post-op to 74.4 ± 12.3 ($p = 0.028$). Average pre-op ADL was 60.1 ± 16.9, post-op 84.7 ± 8.3 ($p = 0.022$). The average pre-op SF-36 improved from 64 ± 14.8 pre-op to 79.4 ± 15.4 post-op ($p = 0.059$). In their series they identified that patients with patellofemoral malalignment presented worst scores at follow-up when compared to those with normal alignment. They conclude that OCA is effective when treating focal full thickness patellar cartilage lesions presenting clinical improvement at follow-up. We have not documented at follow-up differences in the clinical evaluations between patients with and without patellofemoral malalignment.

In our study we have found higher functional scores in patients with full thickness patellar cartilage lesions treated with OCA compared to those previously published in the literature, with 60% of the cases with good and 40% excellent Lysholm scores [16] at medium term follow-up.

The MRI evaluation documented good imaging results in the majority of our cases, with appropriate healing of the plugs to the adjacent bone and good cartilage characteristics in the graft and in the donor site with this osteochondral plugs congruent with the cartilage surface. We observed as well that in all cases a subchondral bone step off was found, since the donor's cartilage is thinner than the patellar cartilage. We are not aware of the long term consequences of this finding.

On the MRI and according the ICRS cartilage lesion classification, all plug's cartilage and the majority of the peripheral cartilage (60%) were classified as 1A or nearly normal cartilage.

One of the weaknesses of our study is the few number of cases treated with patellar OCA; we need to continue with the evaluation of our series to increase the number of patients evaluated. We do not know if the associated procedures performed in our cases would be responsible for the clinical results obtained at follow-up; this is another weakness in our study.

Another weakness in this study is that we did not measure the core and gluteal muscle strength in our series of cases. This measurements are critical to knee stability and to the perceived pain symptoms during functional activities REF. This point can influence in the clinical results of our patients.

Future prospective randomized studies are needed to determine long term results of OCA procedures and to be able to correlate results with previously described techniques for the treatment of full thickness patellar cartilage lesions.

5. Conclusion

The OCA technique is a good surgical alternative for full thickness patellar cartilage lesions treatment in young, male individuals, obtaining good and excellent clinical, functional and imaging results at midterm follow-up.

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