

Cartilage repair strategies in the knee: A survey of Turkish surgeons



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ABSTRACT

Objectives: The purpose of this study was to analyze the trends in cartilage repair strategies among Turkish orthopedic surgeons for isolated focal (osteo)chondral lesions of the knee joint.

Materials and methods: A web-based survey of 21 questions consisting of surgical indications, techniques and time to return to sports was developed to investigate the preferences of members of the TOTBID and the TUSYAD.

Results: A total of 147 surgeons answered the questionnaire. 70% of the respondents were TUSYAD members. 82% of respondents had at least five years experience in arthroscopy. Half of the surgeons indicated that patient age of 50 was the upper limit for cartilage repair. Irrespective of activity level, microfracture (60–67%) was the most frequently used technique for lesions smaller 2.5 cm². In lesions larger than 4 cm², MACI was the most commonly advocated procedure (67%). In patients with high activity levels, mosaicplasty was the first choice (69%) for lesions between 2.5 and 4 cm² in size, followed by MACI (27%).

Conclusion: Patient age, activity level, BMI and lesion size were important determinants for the choice of treatment of isolated chondral lesions in the knee. These results reflect the choices of experienced knee surgeons in the country. Although not widely performed in Turkey and has limited reimbursement by the health care system, the first choice for defects over 4 cm² was second generation ACI. Third party payers & health reimbursement authorities should take into account that large defects require methods which are relatively expensive and need high technology. Cross-sectional survey, Level II.

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Introduction

Injuries to the articular cartilage of the knee are common. Due to its inherent lack of vascular supply and limited intrinsic regeneration capacity of articular cartilage, untreated cartilage defects may lead to early onset osteoarthritis. The management of symptomatic focal traumatic articular cartilage lesions of the knee in active individuals remains a substantial challenge. Although a variety of methods have the potential to stimulate the formation of a new articular surface, none of the current techniques including

microfracture, autologous or allogenic osteochondral grafts, autologous chondrocyte implantation (ACI), growth factors and scaffolds are able to replicate the original anatomy and architecture of hyaline cartilage.^{1,2} Choosing the best technique that addresses the individual defect is a challenge for the orthopedic surgeon. Smaller defects not affecting the subchondral bone are usually treated with microfracturing while lesions with loss of subchondral bone can be managed with autologous osteochondral autograft transfer (OAT) ie. mosaicplasty. Defects larger than 2.5 cm², can still be managed with microfracture and OAT however, their limited effectiveness in larger lesions has led the search for advanced cartilage repair strategies such as matrix-assisted chondrocyte implantation (MACI).

There is no universally accepted algorithm for treatment of cartilage defects and the treatment preferences of Turkish

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orthopedic surgeons are not known. The goal of this study was to analyze the treatment preferences of Turkish orthopedic surgeons for different types of cartilage defects and to potentially highlight treatment recommendations.

Material and methods

A 21-item electronic questionnaire prepared by the members of the TUSYAD Cartilage Committee was designed to collect data on indications for surgery, patient characteristics (including patient age, BMI, activity level) and treatment options to evaluate the cartilage repair practice patterns of Turkish orthopedic surgeons (Table 1 shows first 16 questions). This survey was performed on Turkish Society of Orthopedics & Traumatology (TOTBID) and Turkish Society of Sports Injuries, Arthroscopy & Knee Surgery (TUSYAD) members. The survey was completed via the web using Survey Monkey (<http://www.surveymonkey.com>). The ICRS (International Cartilage Repair Society) Classification for focal cartilage lesion was used to define cartilage defects.³

Results

Surgeon demographics

A total of 147 surgeon members of TOTBID filled out the questionnaire. Ninety eight (70%) of the responders were also members of TUSYAD. Approximately 1/3 of the respondents practiced in a private hospital, 1/3 in a university clinic, 15% in a state hospital and 13% in a state teaching and research hospital. Seventy nine percent of the respondents performed knee arthroscopy as the most frequent procedure. This was followed by arthroplasty (48%) & trauma surgery (42%). Most of the surgeons had more than 5 years experience in knee surgery and performed more than 50 arthroscopic procedures per year. The majority of the surgeons treated cartilage defects in the knee and ankle joints arthroscopically, arthroscopic treatment of shoulder cartilage defects were less frequent (Table 2).

Conservative treatment

The most common non-surgical treatment offered by the respondents were intra-articular hyaluronic acid injections (80%) and physiotherapy (75%). This was followed by lifestyle changes (70%), systemic pain medication (65%), oral glucosamine (60%) and platelet rich plasma injections (41%). The rate of surgeons using steroid injections was only 5,6% (Fig. 1).

Surgical treatment

The upper age limit for cartilage surgery was reported as 50 years by 52%, 40 years by 25% of the surgeons and 60 years by 12%. Obesity was also an important factor in deciding surgical treatment. The upper limit of body mass index (BMI) was accepted as 30 kg/m² by 58% and 25 kg/m² by 22% of the respondents. Location of the cartilage defect had a significant effect on the outcome. The best results were obtained in the lesions of the femoral condyles (85% of the surgeons). The most commonly performed cartilage procedure was microfracture (60–80%) followed by mosaicplasty (20–40%). MACI was utilized by less than 10% of the surgeons. A third of the surgeons performing microfracture accepted the upper age limit as 50. Seventeen percent lowered this limit to 45 while twenty-three percent of the surgeons thought that age was not an important factor (Fig. 2). Microfracture was performed using a dedicated instrument by 81% of the surgeons. More than half of the surgeons (58%) did not use a continuous passive motion device (CPM) after

surgery. The most common usage was reported to be 2 h/day in the first week for respondents who used a CPM device (27%). Partial weight bearing after microfracture was allowed in 4 weeks by 23% of the surgeons, while for 22% this time period extended to 6 weeks. Twenty five percent of the respondents allowed full weight bearing on the 6th post-operative week. Time to return to sports following cartilage repair was advocated at 6 months for microfracture (86%), 9 months for mosaicplasty (63%), and 12 months for MACI (73%) (18 question).

Lesion size & depth

In patients with high activity levels, ICRS grade 3–4 lesions smaller than 2.5 cm², were most frequently treated with microfracture (60%) followed by mosaicplasty (40%). For mid-size lesions between 2.5 and 4 cm², mosaicplasty was the first option (69%), followed by MACI (27%). In lesions larger than 4 cm², MACI was the most commonly advocated procedure (67%). Ninety percent of the surgeons had never used scaffold augmented microfracture but 17% would consider its use in active patients under 45 years of age (Fig. 3). In patients with low activity levels, ICRS grade 3–4 lesions smaller than 2.5 cm² were most frequently treated with microfracture (67%) followed by mosaicplasty (23%). For mid-size lesions between 2.5 and 4 cm², microfracture was still the first option in 54% followed by mosaicplasty in 69%. In lesions larger than 4 cm², MACI was the most commonly advocated procedure (38%), followed by mosaicplasty in 30% and microfracture in 28% (Fig. 4). Fifty percent of the surgeons would not offer surgical treatment for symptomatic ICRS grade 1–2 lesions smaller than 1 cm² but would consider surgery in larger lesions. The preferred operative treatment of ICRS grade 1–2 lesions between 1 and 4 cm² was debridement in 53%, antegrade or retrograde drilling was the second choice. For cartilage lesions involving the subchondral bone, 42.4% of the surgeons would address both bone and cartilage defects. This would involve a one stage operation in 25.4% while a two stage operation would be advised in a significantly less number of cases (7.6%). Only 13% of the surgeons would prefer microfracturing to treat such lesions, while a total of 28.8% would utilize either an osteochondral plug or bone grafting + ACI depending on lesion size.

Discussion

Several important trends have emerged from the findings of this study. Mosaicplasty or ACI was the first choice in high activity patients for mid sized (2,5–4 cm²) defects. This may be due to the progressive deterioration of the outcomes of microfracture over the years and implies the need for a more durable treatment in these cases. Although limitations for reimbursement & cost are important issues, MACI was the first choice for larger defects (over 4 cm²). Third party payers & health authorities should consider this need for advanced cartilage regeneration techniques and should implement the necessary regulations and reimbursement systems to make these treatments available to orthopedic surgeons. It is interesting to note that, although cell free scaffolds were available, 90% of the surgeons had never used this technique at the time of the study. This may be explained by the limited evidence for the efficacy of these cell free implants.

Despite the fact that there have been a variety of methods for cartilage repair, to date, no universally accepted treatment guidelines concerning patient age, lesion size, depth (chondral/osteochondral), rehabilitation or return to sports exist.⁴ Unfortunately, no clear recommendations have emerged from well designed, randomized-controlled trials for the treatment of focal cartilage defects.^{5–8} The aim of this survey was to analyze the preferences for treatment of focal knee cartilage defects among a community of

Table 1

First 16 questions of the survey.

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| <p>1. I am a member of Orthopaedic and Traumatology society <input type="checkbox"/> TOTBID <input type="checkbox"/> TUSYAD</p> <p>2. I work at a <input type="checkbox"/> State Hospital <input type="checkbox"/> Training and Research Hospital <input type="checkbox"/> University Hospital <input type="checkbox"/> Private Hospital <input type="checkbox"/> Private practice</p> <p>3. The most common surgical procedures in my practice are <input type="checkbox"/> Arthroplasty <input type="checkbox"/> Trauma <input type="checkbox"/> Arthroscopy-knee surgery <input type="checkbox"/> Foot and ankle surgery <input type="checkbox"/> Upper extremity surgery <input type="checkbox"/> General orthopaedics</p> <p>4. I treat cartilage lesions in the following joints <input type="checkbox"/> Knee <input type="checkbox"/> Ankle <input type="checkbox"/> Shoulder <input type="checkbox"/> Elbow <input type="checkbox"/> Hip</p> <p>5. My experience in knee surgery <input type="checkbox"/> 1 year <input type="checkbox"/> 1–5 year <input type="checkbox"/> 5–10 year <input type="checkbox"/> 10–20 year <input type="checkbox"/> >20 year</p> <p>6. I perform knee arthroscopies per year <input type="checkbox"/> <50 <input type="checkbox"/> 50–100 <input type="checkbox"/> 100–200 <input type="checkbox"/> 200–500 <input type="checkbox"/> >500</p> <p>7. When performing cartilage repair I set my maximum patient age as <input type="checkbox"/> <30 <input type="checkbox"/> <40 <input type="checkbox"/> <50 <input type="checkbox"/> <60 <input type="checkbox"/> No age limit</p> <p>8. When performing cartilage repair I set maximum patient BMI (body mass index) as <input type="checkbox"/> < 25 kg m² <input type="checkbox"/> < 30 kg m² <input type="checkbox"/> < 35 kg m² <input type="checkbox"/> BMI is not important</p> | <p>9. I get the best results in lesions located in the <input type="checkbox"/> Femoral condyle <input type="checkbox"/> Trochlea <input type="checkbox"/> Patella</p> <p>10. For nonoperative treatment of cartilage lesions I employ the following techniques <input type="checkbox"/> Non weight bearing <input type="checkbox"/> Physiotherapy <input type="checkbox"/> Oral Glucosamines <input type="checkbox"/> Intraarticular hyaluronic acid <input type="checkbox"/> Intraarticular steroid <input type="checkbox"/> Platelet rich plasma (PRP) <input type="checkbox"/> Analgesics <input type="checkbox"/> Change of lifestyle <input type="checkbox"/> Other</p> <p>11. In cases of subchondral bone deficiency I <input type="checkbox"/> Always try to treat cartilage and bone <input type="checkbox"/> Usually try to treat in one surgical setting <input type="checkbox"/> Usually treat with a two stage operation <input type="checkbox"/> Only perform microfracture <input type="checkbox"/> Only perform OATS <input type="checkbox"/> Perform OATS or MACI, depending on defect size</p> <p>12. When performing microfracture I set the upper age limit as <input type="checkbox"/> <30 years <input type="checkbox"/> <40 years <input type="checkbox"/> <45 years <input type="checkbox"/> <50 years <input type="checkbox"/> <60 years <input type="checkbox"/> Age is not important</p> <p>13. I use for microfracture procedure <input type="checkbox"/> K-wire <input type="checkbox"/> Drill bit <input type="checkbox"/> Microfracture instrument</p> <p>14. I begin weight bearing after microfracture <input type="checkbox"/> Immediately <input type="checkbox"/> 2. week <input type="checkbox"/> 4. week <input type="checkbox"/> 6. week</p> <p>15. I use continuous passive motion device after microfracture <input type="checkbox"/> Never <input type="checkbox"/> First week two hours/day <input type="checkbox"/> First week six hours/day <input type="checkbox"/> First six weeks two hours/day <input type="checkbox"/> First six weeks six hours/day</p> <p>16. I perform scaffold augmented microfracture <input type="checkbox"/> Never <input type="checkbox"/> Below 45 years, patients with high activity level <input type="checkbox"/> Always regardless of age <input type="checkbox"/> Always regardless activity level</p> |
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Table 2
Breakdown of surgeon demographics.

| Year of practice in knee surgery | Percentage (%) |
|-----------------------------------------|----------------|
| 0–5 years | 16 |
| 6–10 years | 22 |
| 11–20 years | 39 |
| 21 (+) years | 21 |
| Number of arthroscopies per year | |
| 50 (–) | 20 |
| 51–100 | 40 |
| 101–200 | 24 |
| 201 (+) | 17 |
| Joints treated arthroscopically | |
| Knee | 87 |
| Ankle | 67 |
| Shoulder | 18 |
| All 3 joints | 12 |

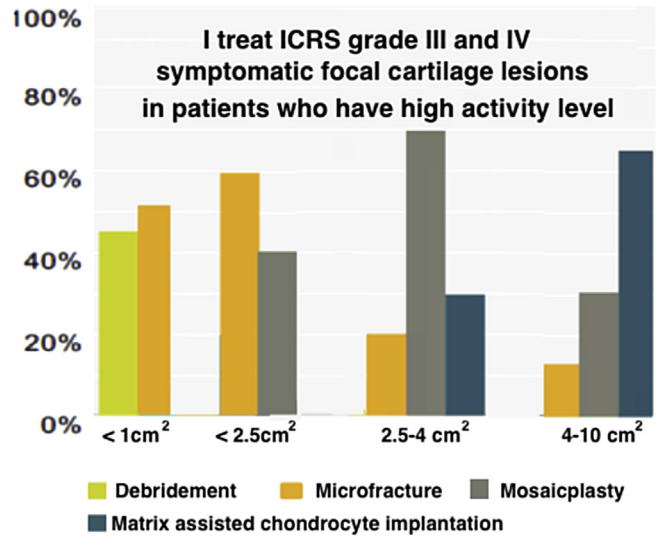


Fig. 3. Treatment preferences for athletes with high activity levels who have a symptomatic cartilage lesion (Answers for question 19).

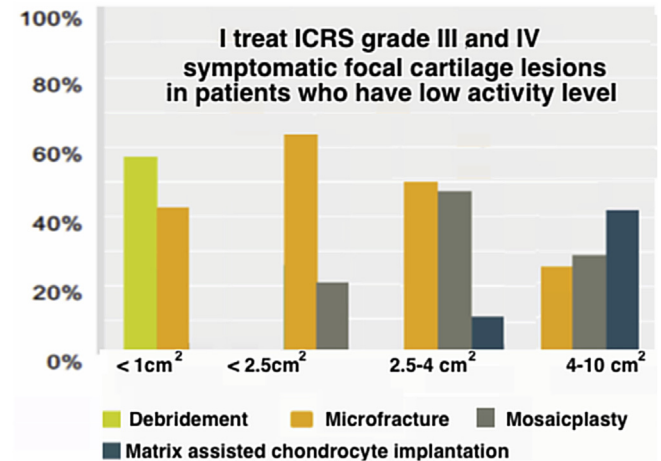


Fig. 4. Treatment preferences for athletes with low activity level who have symptomatic cartilage lesion (Answers for question 20).

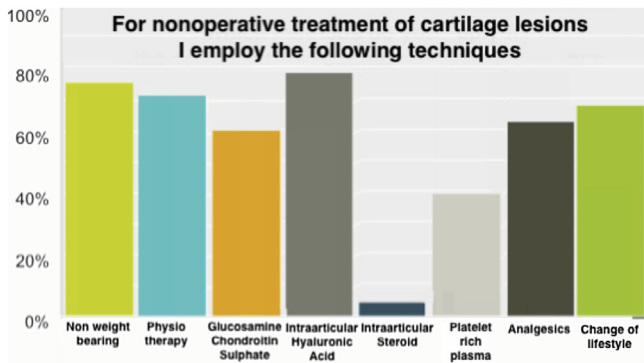


Fig. 1. Rate of non-surgical treatment modalities employed by the respondents.

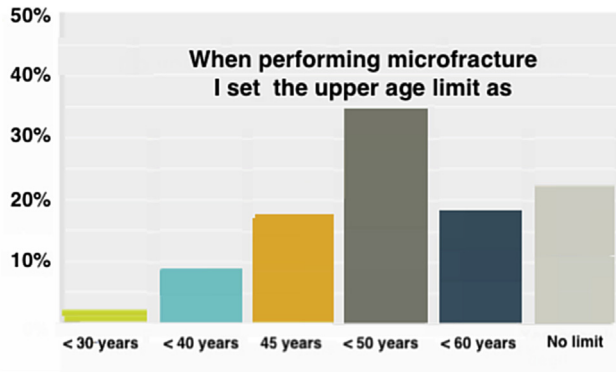


Fig. 2. For microfracture, the upper age limit accepted by surgeons.

experienced musculoskeletal surgeons. The findings of the study reflect the preferences of experienced and active knee surgeons in the country as 84% had been in practice more than 5 years. 80% performed more than 50 arthroscopic procedures per year. This survey of experienced surgeons may help to identify the most appropriate and current treatment methods until studies with higher levels of evidence can be performed.

Numerous agents for the conservative treatment of chondral lesions and early osteoarthritis.^{9–11} In this survey, the most frequently used conservative measures were intra-articular hyaluronic acid injections and physiotherapy. These were followed by lifestyle changes and systemic pain medication and glucosamine/chondroitin sulfate supplements. Less than half of the surgeons

used platelet rich plasma injections despite the hype and media pressure surrounding its use. Although preliminary studies describe symptomatic benefit of PRP injections for a limited time period; more studies are needed to clarify the role of different methods of production, PRP characteristics, presence and absence of leukocytes, clinical indications, way of administration and therapeutic protocols.¹² Although widely used by the rheumatologists, the ratio of surgeons who used steroid injections was only 5,6%. This may be due to its limited and short term benefit on pain and function.¹¹

Various surgical techniques, both reparative and regenerative, have been used to treat focal (osteo) chondral pathology.^{13–15} Since Steadman first described its use in the 1980s, microfracture has become popular as a first-line treatment for chondral injuries.^{16,17} The clinical outcome seems dependent on the patient's age, level of activity, defect location and postoperative regimen.^{16,17} The underlying principle of the microfracture technique is bone marrow stimulation and penetration of the subchondral bone plate resulting in the recruitment of mesenchymal stem cells which eventually differentiate into fibrocartilage.^{5,6,17–26} Although the initial results

of microfracture are satisfactory in 80% of the patients, the regenerate is mainly composed of fibrocartilage and the results begin to deteriorate over time after 4–5 years.^{5,6,24,26} In our survey, microfracture was found to be the most common cartilage repair procedure (60–80%) followed by mosaicplasty in 20–40%. MACI was performed by less than 10% of the surgeons. Many studies have shown that younger age and smaller lesions results in better outcomes following microfracture.^{5,6,17–26} While microfracture gives best results in patients under the age of 40 years, an upper age limit beyond which microfracture confers little or no benefit has not been established. In this survey, 23% of surgeons indicated that they had no upper age limit for performing microfracture, while 34% indicated an upper age limit of 50 years. This over utilization of microfracture may be due to the limited availability of other cartilage repair techniques due to reimbursement and regulatory issues. In patients with high activity level, lesions smaller than 2.5 cm², were most frequently treated with microfracture followed by mosaicplasty. This was reversed for mid size lesions between 2.5 and 4 cm² where mosaicplasty was the treatment of choice. Mosaicplasty is perceived as a more durable solution that achieves a covering of hyaline cartilage in these active patients. Comparative studies have shown higher activity levels and better clinical results after mosaicplasty compared to microfracture.^{18,27} However the utilization of mosaicplasty is limited by the size of the donor area. Donor site symptoms, although reported to be less than 5%, are also an important issue.²⁸ This has led to search for alternative solutions in larger defects over 4 cm². MACI has is an attractive option in these cases as the technique is not limited by the size and shape of the defect.^{22,24,29,30} Regulatory and reimbursement issues, the need for two stage surgery and expense are the main issues preventing widespread use of MACI. The first choice for large defects was MACI in this survey although less than 10% of the surgeons had performed the technique. This underscores the demand for advanced cartilage repair techniques in these rare but potentially debilitating cartilage lesions. The current regulations in Turkey severely limit the use of MACI and reimbursement is only possible in a select group of hospitals after pre-approval of the Ministry of Health. Third party payers still consider MACI as an experimental procedure although the technique has been in use for more than two decades and its efficacy has been demonstrated in over 20,000 patients treated with either 1st generation ACI or MACI.^{29,30} Third party payers should be aware of the need for advanced (albeit expensive) technologies for larger chondral defects. Microfracture was the most commonly preferred technique in small and mid-sized lesions in patients with low activity levels. MACI (48%) was the first choice in larger defects, although mosaicplasty (30%) & microfracture (25%) were also considered.

In our survey, body mass index (BMI) was considered an important factor in decision making by 84% of the respondents. The upper limit of cartilage regeneration surgery was stated as below 30 kg/m² by 58%. A BMI larger than 30 kg/m² has been correlated with an inferior outcome after microfracture and cartilage procedures.^{17,20} Hence, it would certainly seem logical to establish a BMI value beyond which microfracture should not be attempted.

The postoperative regimen after microfracture remains one of the most debated issues regarding this technique. CPM has been shown to improve the quality of regenerated cartilage in the experimental setting.³¹ However, no randomized, controlled studies have studied the beneficial effects of CPM in humans after microfracture.^{17,18,21,25} In our survey, more than half of the respondents did not use CPM in the rehabilitation phase. This might be due to constraints of expense and availability of home CPM devices. Those who used CPM after surgery most frequently recommended 2 h per day in the first weeks. The recommended 6 weeks therapy could not be completed for most of the cases, this

again is probably due to logistical problems and expense. Weight bearing after microfracture is another debated issue. The survey questions did not specify the size or location of the lesion, therefore a variety of answers were obtained. Partial weight bearing was allowed at 2 weeks by 13%, 4 weeks by 23%, 6 weeks by 22% of the respondents. Similarly full weight bearing was allowed at 2 weeks 6%, 4 weeks 9%, 6 weeks by 25% of the respondents. This indicates that the respondents adopted a conservative and restricted weight bearing regimen after surgery. Return to active sports following cartilage repair was accepted at 6 months for microfracture (86%), 9 months for mosaicplasty (63%), and 12 months for MACI (73%). This is in contrast to several studies in the literature which have found earlier return to sports after mosaicplasty compared to microfracture.^{18,27,32} The late return to sports after ACI is expected as these are complex cases and the desire of the surgeons to wait for maturation of the regenerate.

Although 90% of surgeons had never use the matrix-supported microfracture method, 17% considered that it could be a choice for individuals with a high activity level and younger than 45 years. This underscores the need for newer and innovative techniques based on the unsatisfactory results of microfracture.

In conclusion, this study gives important information on the trends of cartilage repair of Turkish orthopedic surgeons. Third party payers should take into account the need for advanced and probably more expensive cartilage repair technologies since current techniques have unsatisfactory outcomes in larger lesions and younger active patients.

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