Results of microfracture in osteoarthritic knee with focal full-thickness articular cartilage defects

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The Master's Thesis
submitted to the Department of Medicine
the Graduate School of Yonsei University
in partial fulfillment of the requirements
for the degree of Master of Medicine

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June 2011

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June 2011

ACKNOWLEDGEMENTS

First of all, I would like to express many thanks to Professor Chong Hyuk Choi for his invaluable guidance and consistent support. He has been a very benevolent mentor who clearly demonstrated what rigorous scholarship and what the responsibility of scholars to the world mean.

I also acknowledge helpful comments of Professor Woo Suk Lee and Professor Sung Rae Cho. They pointed me out to have the logical thinking and flowing.

Furthermore, I really thank to my wife, two sons – Bio, Jio and parents who inspired me to further efforts during the writing of this thesis.

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Abstract

Results of microfracture in osteoarthritic knee with focal full-thickness articular cartilage defects

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Purpose **:** We aim to characterize clinical and radiological results of arthroscopic microfracture in patients with focal full-thickness cartilage defects of the medial femoral condyle in the osteoarthritic knee.

Materials and Methods **:** Our study population consisted of 76 patients (17 men and 59 women) with the mean age of 60.6 years . All patients underwent partial (n = 60) or subtotal (n = 16) meniscectomy. Follow up period was a minimum of 36 months. Group I included 38 osteoarthritis patients who were aged over 50 years and presented with symptomatic medial meniscus tears and focal grade IV full-thickness articular cartilage lesions. Medial meniscectomy and microfracture on the medial femoral condyle were performed on the Group I patients. The results of Group I

was compared to 38 osteoarthritis patients (Group II) who were selected from more than 100 patients who underwent only meniscectomy for medial meniscal tears accompanied with a focal full thickness cartilage defect in the medial femoral condyle.

Results **:** At the time of the three-year follow-up, a total of five failures (6.6%) were reported: four Group I patients and one Group II patient . The two groups showed no significant difference in the Lysholm score, the Tegner activity score and the visual analog pain scale at three years after surgery. However, at the time of three months follow-up, Group II showed significantly more improvement in Tegner activity and the visual analog pain scores compared with Group I. Younger patients (under 60 years old) scored better on visual analog pain scale than did older patients regardless of their treatment group.

Conclusion **:** We conclude that, in osteoarthritis patients with symptomatic medial meniscus tears, arthroscopic microfracture surgery for a focal full thickness cartilage defect on the medial femoral condyle did not confer any additional benefit to meniscectomy.

Key words : knee, osteoarthritis, microfracture

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I. Introduction

Articular cartilage damage is observed in at least 60% of patients while undergoing an arthroscopic knee procedure,[1, 2] appearing as a focal traumatic osteochondral defect, an osteochondritis dissecans (OCD) lesion, an early isolated degenerative lesion, or diffuse degenerative disease.[3] Surgical management for an early isolated degenerative articular cartilage defect of the knee presents a significant challenge to orthopedic surgeons. Many surgical procedures have been developed to treat articular cartilage lesions of the knee, including abrasion arthroplasty,[4] osteochondral autografts,[5, 6] autologous chondrocytes implantation,[7] and microfracture. Microfracture is indicated for focal full-thickness loss of articular cartilage in a weight bearing area between the femur and the tibia or an area of contact between the patella and the trochlea.

It is a technically simple, safe, and cost-effective treatment option for focal articular cartilage lesions of the knee. Although this technique may provide practical advantages for the surgeon, the published clinical outcomes are limited to young patients with traumatic focal defects. For cartilage defects of an osteoarthritic knee, unicompartmental or total knee arthroplasty (TKA) may demonstrate predictably favorable results. However, these options may not be appropriate for a patient who wants to maintain a high level of athletic activity. Thus, when focal cartilage defects are accidentally found in a patient with osteoarthritis while undergoing other arthroscopic procedure for meniscal lesion or loose body, a treatment decision needs to be made for focal full thickness cartilage defects. So far, most surgeons have not performed microfracture for cartilage lesions in the osteoarthritic knee when diffuse, multiple or large lesions found on the joint surface. However, treatment options for small and focal lesions vary according to the surgeon's preference. In this situation, microfracture could be used as an additional procedure, and some investigators reported that arthroscopic microfracture can consistently achieve significant symptomatic and functional improvement in the osteoarthritic knee.[8-10]

Our hypothesis is that in early osteoarthritis patients with symptomatic medial meniscus tears, arthroscopic microfracture surgery for focal full thickness cartilage defects on the medial femoral condyle did not confer any benefits in addition to meniscectomy alone.

II. Materials and Methods

Our study population consisted of 76 patients (17 men and 59 women) with the mean age of 60.6 years (50-74). All patients underwent partial (n = 60) or subtotal (n = 16) meniscectomy. Follow up period was a minimum of 36 months (mean: 42 months, range: 36 to 50 months). Group I included 38 osteoarthritis patients who were presented between May 2004 and June 2006 with symptomatic medial meniscus tears and focal grade IV full-thickness articular cartilage lesions of the medial femoral condyle categorized according to the Outerbridge classification.[11] Partial medial meniscectomy and microfracture on the medial femoral condyle were performed on these 38 patients by the senior author. To compare the results of Group I, matched-group analysis was performed with 38 osteoarthritis patients (Group II) who were selected from more than 100 patients who underwent only medial menisectomy for medial meniscal tears accompanied with a focal full thickness cartilage defect in the medial femoral condyle between 2002 and 2006. Matching parameters were age (within 3 years), gender, length of follow-up, and surgeon. For both groups, inclusion criterion was osteoarthritic patients with a Kellgren-Lawrence radiographic Grade[12] 2 or 3, and indications for surgery were as follows: persistent mechanical meniscal pain[13] despite 6 months of conservative treatment which consisted of medication and physical therapy, a clear meniscal sign (positive McMurray test or joint line tenderness), the absence of varus

thrust in walking, and the mechanical axis laying across the lateral half of the tibia plateau according to standing radiography of the whole lower limbs (hip to ankle). Exclusion criteria included knees with multiple chondral lesions or diffuse chondral lesions, traumatic chondral lesions, severe osteoarthritis (Kellgren-Lawrence Grade 4), severe varus axis, ligament instability, inability to follow the rehabilitation protocol, and incomplete radiographic studies. Clinical assessment was retrospectively performed using the arthroscopic surgery database, medical records, and telephone interviews. Clinical outcome was evaluated by using the Lysholm score[14], the Tegner activity scale[15] and visual analog scales (VAS) - grading of knee pain. On the 100 mm VAS, scores (0-100) for pain (0 = no pain; 100 = worst possible pain) [16,17] were recorded. Patients were evaluated before the operation, 3 months, 12 months and 36 months after surgery. A failure was defined as a case requiring a new surgical procedure for the same knee during the follow-up period. Radiographic evaluation included standing weight-bearing anteroposterior view and full-length anteroposterior view. The radiographs were classified according to the Kellgren and Lawrence grading system. AP radiographs were taken while the patient extended the knee joint and evenly distributed the body weight on both lower extremities. For evaluation age effect, patients who did not have a failure were assigned to four different groups (Group I – young: 15 patients, Group II – young: 16 patients, Group I – old: 19 patients, Group II – old: 21 patients) by

their age (50-59 years or 60-74 years) and treatment (microfracture and observation).

Surgical Technique

Both group patients underwent arthroscopic meniscectomy. The torn meniscal region which was unstable was selectively removed, and the stable parts were saved as much as possible. In Group I, the microfracture procedure was performed as described by Steadman et al.[18] The focal lesion was debrided down to subchondral bone and laterally to healthy surrounding cartilage with the use of arthroscopic shavers. The area of the lesion was calculated as millimeters squared after measuring the length and width using a meniscal probe.[19] Angled awls were used to make holes through the subchondral bone plate approximately 3 to 4 mm apart. Marrow elements accessed by subchondral bone could be seen as they essentially came from all microfracture holes after the inflow was stopped. The same postoperative pain medication was administered to both groups. The postoperative rehabilitation protocol after microfracture plays a critical role in optimizing outcomes, and it is also well-described in the literature.[10] The goals of the initial 8-week healing phase were to protect the marrow clot, restore the full joint range of motion and patellar and patellar tendon motion, restore normal quadriceps function, and decrease joint swelling. After completion of the initial healing phase, patients progressed to weight bearing as tolerated, and most patients weaned off crutches over the

period of 1 week.

Statistical Analyses

The statistical analyses were performed using the Statistical Analysis System (SAS) software. Descriptive statistics, including means, standard deviations, and minimum and maximum values were calculated for every group. Repeated measures analysis of variance (ANOVA) was used to determine whether there were significant differences between both groups. If there were significant differences, a post-hoc test with the Bonferroni adjustment was used to determine which time points were significantly different from each other. The level of significance for all statistical tests was established as $P < 0.05$.

III. Results

Three years after treatment, no patient had been lost to follow-up. Four patients were not available for examination in the outpatient clinic. However, these patients (none of whom had a failure) were contacted by telephone, and they answered the questionnaire. Medial meniscus tears were posterior horn or root tear in all patients and treated with partial meniscectomy. The mean size of the medial femoral cartilage lesion was 170 mm^2 (100 to 320 mm^2), and the lesions were located on the weight bearing dome in the range of 10 to 100 degree knee flexion. No significant difference between the treatment groups

was found in the defect size (P = .519). Before surgery, the treatment groups showed no significant difference in the Lysholm score (P = .692), the Tegner activity scale (P = .517), the visual analog score (P = .826), and Kellgren-Lawrence grade (P = .605). At the time of the three-year follow-up, a total of five failures (6.6%) were reported: four Group I patients (10.5%) and one Group II patient (2.6%). The mean time from arthroscopy to total knee arthroplasty was 28.8 months (range, 18 to 48 months). Clinical data on patients who did not have a failure were collected until postoperative three years. The mean Lysholm scores, the Tegner activity scale and the mean scores on the visual analog pain scale significantly improved (P < .001) postoperative three years in both groups. In Group I, 27 patients (79.4%) showed improved Lysholm scores after the operation, two patients (5.9%) no change, and five patients (14.7%) a reduction in Lysholm scores. The mean score increased from 65.1 before the operation to 80.3 after the operation (P < .001). After the surgery, Tegner activity score was improved for 27 patients (79.4%), showed no change for five patients (14.7%), and dropped for two patients (5.9%). The mean score significantly increased from 2.9 to 4.2 (P < .001). Patients were assessed using a VAS both pre- and postoperatively. In this assessment, 25 patients (73.5%) reported pain reduction, seven patients (20.6%) no change, and two patients (5.9%) an increase in pain. The average VAS decreased from preoperative 68.2 down to 23.8 at the last follow up (P < .001). Compared with baseline values, 82.1% of Group II improved on the Lysholm score, 71.8% showed an improvement on the Tegner

activity scale, and 89.7% had less pain. However, there was no significant difference in the Lysholm score from baseline to postoperative three years between the two groups (*P* = .503) (Figure 1).

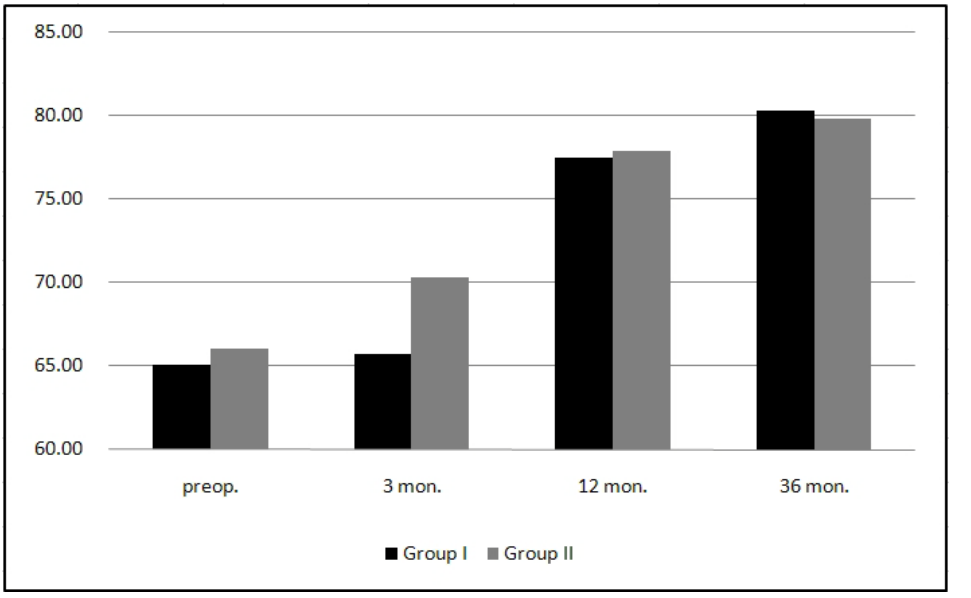

Figure 1. Bar graph showing the Lysholm scores from before operation to the last follow up point. Postoperative 3-year Lysholm scores revealed no significant difference between the treatment groups (P = .503). Group I (microfracture) - black and Group II (observation) - gray. No significant difference between the treatment groups was found in the Tegner activity scale (*P* = .833 and .950) (Figure 2), the visual analog pain scale (*P* = .785 and .856) (Figure 3) one year and three years after treatment.

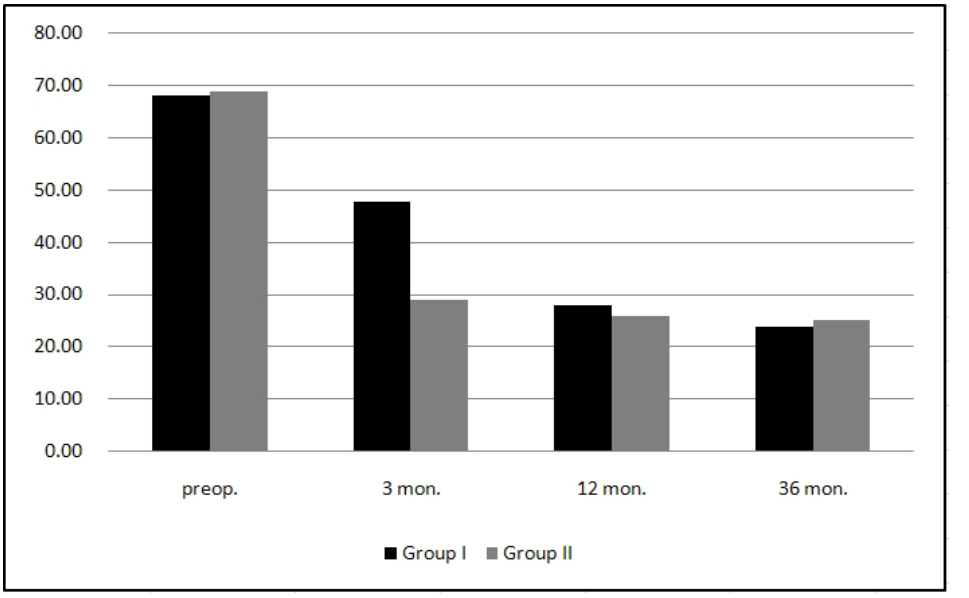

Figure 2. Bar graph showing the Tegner activity scale from before operation to the last follow up point. Postoperative 3-year Tegner activity scale revealed no significant difference between the treatment groups (P = .950). Group I (microfracture) - black and Group II (observation) - gray.

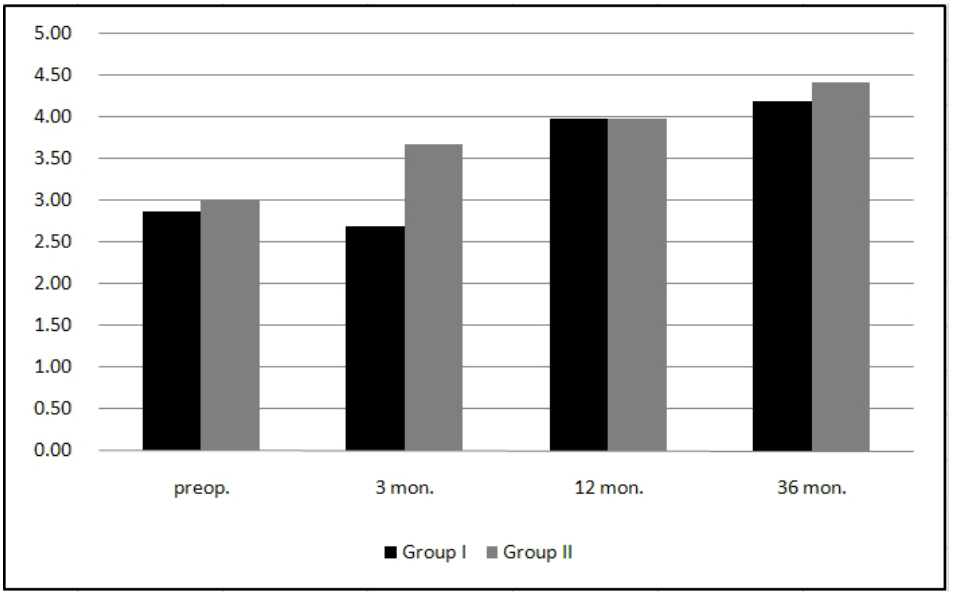

Figure 3. Bar graph showing the visual analog pain scale from before operation to the last follow up point. Postoperative 3-year visual analog pain scale revealed no significant difference between the treatment groups (P = .856). Group I (microfracture) - black and Group II (observation) - gray.

However, at the time of three months follow-up, Group II showed significantly more improvement in the Tegner activity scale (P = .004) and the visual analog pain scale (P < .0001) compared with Group I. There was a tendency toward low Lysholm score in the microfracture group postoperative three months, but there was no significant difference (P = .115). However, this tendency was not found one year and three years after surgery. Also, three years after treatment, younger patients (below sixty years old) showed better visual analog pain scores than did older patients (P = .034 in Group I, P = .014 in Group II), regardless of their treatment group.

Among patients who did not have a failure, Grade 2 Kellgren-Lawrence radiographic changes were present in four Group I patients and in five Group II patients three years after treatment. Grade 1 Kellgren-Lawrence radiographic changes were present in 19 (53%) Group I patients and in seventeen (43%) Group II patients three years after treatment. However, no significant difference was found between the two groups regarding the frequency of radiographic changes postoperative three years.

IV. Discussion

A consensus has not been reached for optimal treatment options for osteoarthritis with focal full thickness chondral lesions. Although arthroscopic lavage and debridement of the arthritic knee have provided some pain relief, this benefit is usually temporary.[19-21] Steadman have reported good clinical outcome after microfracture in patients aged between 13 and 78 years with total treated area from 20 to 2000 mm^2 (with mean postoperative Lysholm score ranging from 74 to 89).[9, 22, 23] However, it would seem reasonable to believe that, after undergoing the microfracture procedure, a small lesion in a young individual tend to heal better than a large lesion in an old individual, as the evolving repair tissue is better protected and the pool of chondrogenic cells is higher in the first case. Kreuz et al.[24] found better clinical outcome in patients aged 40 years or younger compared to patients over 40 years after microfracture for full-thickness defects ranging from 100 to 400 mm^2 in size. Similarly, Knutsen et al.[25] reported better results two years after microfracture in patients younger than 30 years, or in defects smaller than 400 mm^2.

However, Miller et al. reported on outcomes after microfracture in 81 patients with degenerative knees.[9] The average patient age was 49 years (range: 40-70 years), and the average size of degenerative lesion measured 229.5 mm^2 (range: 25-2000 mm^2). The average time of follow-up was 2.6 years (range: 2-5 years). Their Lysholm scores improved from preoperative 53.8 to postoperative

83.1, and Tegner scores from 2.9 to 4.5. In 2006, Bae et al.[8] reported that patients with full thickness chondral defects in the osteoarthritic knee could have improved function and see an increase in joint space after microfracture. They reported that the joint space were widened by 1.06 mm on standing anteroposterior radiographs and by 1.37 mm on standing lateral radiographs. Also, Yen et al.[10] reported that microfracture is a cartilage restoration technique which has been proven to provide clinical benefits in the osteoarthritic knee, and it is a relatively simple procedure that can be concurrently performed with other arthroscopic procedures and requires minimal equipment. They concluded that it is vital to select appropriate patients who are with minimal malalignment and ability to adhere to the postoperative regimen, and the success of microfracture depends upon surgical technique and rehabilitation after surgery. Based on the evidence of above studies, microfracture was used as an incidental procedure for accidentally discovered small articular defects in the osteoarthritic knee. Actually, microfracture is a one-stage procedure that is not as technically demanding as other techniques. Moreover, the procedure is inexpensive and can be done as an incidental procedure when articular defects are found during other surgeries. However, fibrocartilaginous tissue produced by microfracture technique does not have the biomechanical properties and durability of the original articular cartilage and the treatment probably does not alter the progression of osteoarthritis. Therefore, microfracture is not a curative treatment; however, symptom relief has been observed in many patients over

several years. It is reported that the results are good for small and focal chondral lesions which occur in patients with moderate osteoarthritis.[8, 10, 20] Unfortunately, no randomized or controlled prospective studies have appropriately evaluated this technique for osteoarthritic patients. So, the use of bone marrow stimulation techniques in patients with knee osteoarthritis has not been validated yet.

We found no significant differences in clinical and radiological results between Groups I and II at the last follow-up point after adjusting for pretreatment values. Three months after surgery, the microfracture group tended to score low on the Tegner activity scale and high on the visual analog pain scale. This difference in clinical outcome may be attributed to weakness in quadriceps muscle due to nonweight bearing rehabilitation in microfracture group. Patients undergoing only menisectomy are generally allowed to return to their normal activities almost immediately after surgery. Patients undergoing both microfracture and menisectomy adhered to a strict postoperative rehabilitation regimen for 8 weeks after surgery. There is an advantage in Group II patients who return to their everyday activities sooner. Because no significant differences were seen in clinical and radiological results between the groups at the last follow-up point, in the setting of osteoarthritis, arthroscopic microfracture did not confer any additional benefit to menisectomy in medial meniscus tears patients with a focal full thickness cartilage defect on the medial femoral condyle.

In our present study, the success rate of Group I with microfracture

was 79.4% in terms of Lysholm score. A similar success rate has been reported before. In a study by Steadman et al. 80% of their patients rated their condition as improved seven years after microfracture surgery.[26] All these patients were under forty-five years of age when they were included in the study. Steadman et al.[23] also reported a failure rate of 13% in 61 patients (69 knees) with radiographically verified osteoarthritis treated with debridement and microfracture. In this present study, five (6.25%) patients required total knee replacement after an average of 28.8 months: four patients in microfracture group and one patient in observation group. Although no significance was found due to the small number of failure case, our hypothesis for higher number of failure cases in Group I was that microfracture could lead to destruction of subchondral bone integrity that is important for sustaining weight loading. The strengths of our study include a control group and the use of patient-administered outcome scores. Our study is the first study about the effects of microfracture on cartilage defects in osteoarthritis compared with control group.The present study indicates that even though we accidentally found focal cartilage defects in early osteoarthritis patients, arthroscopic microfracture surgery provided no additional benefit. Since patients over 60 years old showed particularly poor results after undergoing the procedure, we do not recommend arthroscopic microfracture to be used as an additory procedure for focal full thickness cartilage defects in osteoarthritis patients. We recognize the limitations of our present study. Important limitations of our study are that we

do not have the data of pure cartilage defect symptoms, and it is difficult to distinguish between results for microfracture and effects of meniscectomy for meniscal symptom. Other weaknesses of our study are the small number of patients, short follow-up, retrospective collection of data, and the fact that neither a routine second-look arthroscopy nor an MRI examination was performed.

V. Conclusion

We conclude that in early osteoarthritis patients with symptomatic medial meniscus tears, arthroscopic microfracture surgery for a focal full thickness cartilage defect on the medial femoral condyle did not confer any additional benefit to meniscectomy.

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Abstract (In Korean)

슬관절 퇴행성 관절염 환자에서 국소 전층 연골 결손에 대한 미세 골절술의 결과

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최 윤 진

목적: 본 연구의 목적은 슬관절 퇴행성 관절염 환자에서 국소 전층 연골 결손에 대해 관절경적 미세골절술 후 임상적, 방사선적 결과를 분석하는 것이다.

재료 및 방법: 연골판 부분 혹은 아전 절제술을 시행 받은, 3년 이상 추시가 가능한 38명의 슬관절 퇴행성 관절염 환자에서 연골 부분 결손에 대해 미세골절술을 시행하였고, 그 결과를 비교하기 위해 다른 38명의 환자군은 연골판 부분 절제술 이외에는 연골 결손에 대해서는 추가 수술을 시행하지 않았다. 두 번째 집단의 환자는 첫 번째 집단의 환자와 비교하기 위해 성별, 연령, 추시 기간에 따라 1:1

대응하였다. 임상적 결과는 Lysholm score, Tegner activity score, 통증 점수로 평가하였고, 최종 추시 시의 방사선적 퇴행성 변화를 판정하였다.

결과: 최종 추시 시에 전체 5명의 환자에서 슬관절 전치환술을 시행 받았으며, 첫 번째 집단에서 4명, 두 번째 집단에서 1명이 발생하였다. 그러나 두 집단간 임상적 결과나 방사선 검사 결과는 최종 추시 시에 통계적으로 의미 있는 차이를 보이지 않았다.

결론: 슬관절 퇴행성 관절염 환자에서 내측 반월상 연골판 파열 수술 시, 내퇴 내과에서 발견된 국소 전층 연골 결손에 대해 미세 골절술을 시행하는 것은 의미 있는 결과를 보이지 못할 것으로 사료된다.

핵심되는 말: 슬관절 , 골관절염, 미세골절술