

Arthroscopic Microfracture Method Results in Chondromalacia Patellae and Our Cases

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ABSTRACT

Chondromalacia patella is the softening, fraying or ulceration of the cartilage located at posterior side of patellae and is accompanied by anterior knee pain. Generally it is imaged through arthroscopic procedures. It is not clinically significant as long as it is not painful. While softening and swelling is observed initially, fissuration and subchondral bone exposure can also be seen later. The prioritized method is the conservative treatment. Trimming the free parts helps the patients who didn't benefit from this treatment. In the presence of patellar malalignment, lateral retinacular release, proximal and distal alignment surgery and surgeries aiming at tibial tubercle elevations can be performed. Autologous chondrocyte transplantation yields better results when applied with alignment surgery. The mean age of 38 patients, who were diagnosed with stage 4 chondromalacia patella on different dates and who underwent arthroscopic microfracture method is 37.6 (29-52). The mean follow-up time is 22.3 months (9-33) (Figure 1-2-3-4). Our patients were evaluated pre-operationally and in follow-ups according to Lysholm score. While the Preop Lysholm score was 66.6, post-op score became 83.4.

KEY WORDS: Anterior knee pain, Chondromalacia patella, Patellofemoral pain, Alignment surgery.

INTRODUCTION

Knee injuries (intraarticular and extraarticular structures) mostly occur when people engage in contact sports like football, basketball and handball and individual sports like ski and waterski. In knee joint, joint cartilage can get injured on its own or it can be accompanied by ligament and meniscus injuries. They can manifest themselves as acute traumatic lesion in the form of chondral, osteochondral fractures and as a lesion in the form of chondromalacia (condropenia) resulting from overstrain [6].

Chondromalacia patellae was defined by Buedinger for the first time in 1906 [8, 23]. Not every anterior knee pain is chondromalacia patellae. This term denotes anterior knee pain along with the softening, fraying and ulceration of the thick cartilage in the posterior side of the patella [3].

Anterior knee pain is widespread during adolescence and young adulthood. Knee cartilage changes take places after 20s more than 50% and after 50s more than 94% [21]. 29% of chondromalacia is seen in the knees imaged through arthroscopic methods [23]. It is possible to examine the chondromalacia in 4 stages as follows:

- Stage I: Softening and swelling [23]. The presence and size of the lesions can be noted for the future references. The affected area can be incised with a blind probe starting from the top of the lesion [18].

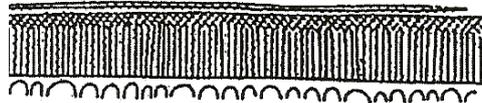


Image 1: Normal Joint Cartilage [10]

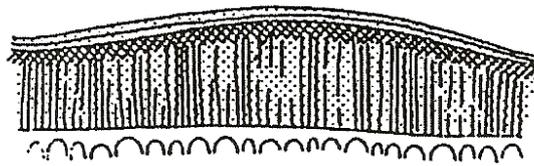


Image 2: Stage 1 [10]



Image 3: Stage 1 MR Image [10]

- Stage II: Fragmentation and fissuration (below 0.5 inch) [23]. Trimming the patellae with the aim of removing the free material might help to a certain extent [18].

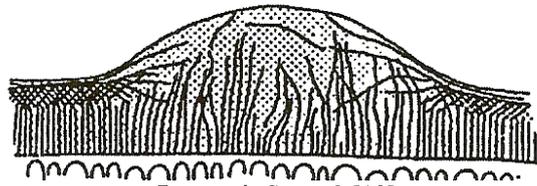


Image 4: Stage 2 [10]

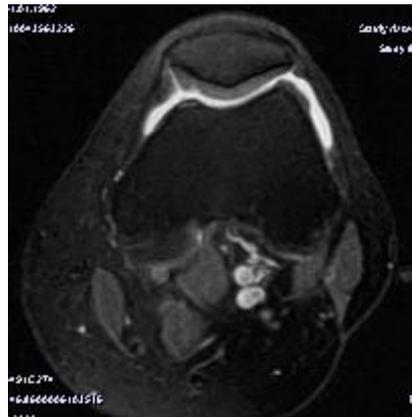


Image 5: Stage 2 MR Imaging [10]

- Stage III: Fragmentation and fissuration over 0.5 inches [23]. Broad fibrillation of a surface is seen. Outer appearance is disappointing for the doctor. Although symptomatic treatment is the established rule, arthroscopic trimming is the method that will be preferred [18].



Image 6: Stage 3 [10]



Image 7: Stage 3 MR Imaging [10]

- Stage IV: Cartilage erosion until subchondral bone [23].

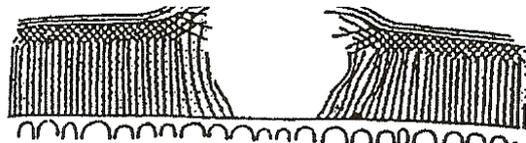


Image 8: Stage 4 [10]

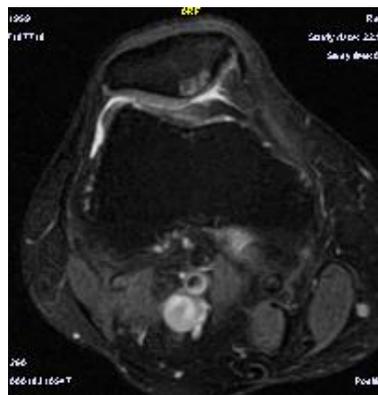


Image 9: Stage 4 MR Imaging [10]

In patellar cartilage, chondromalacia is seen highly even in normal knees [1, 20]. Fibrillation starts at very young ages in the periphery of the medial facet. These changes are asymptomatic and not progressive. These changes seen from the beginning of the middle ages start at the lateral and can extend to subchondral bone. Serious cartilage damage is rarely seen. In addition to chondromalacia, conditions like malalignment cause pain [2]. All these changes are also known as superficial changes associated with age [17, 23].

In the knee with chondromalacia, excessive lateral compression syndrome might be seen. This problem arises out of the shortened lateral retinaculum and tilting of patella to lateral. The problem area is above the most protruded part of the patella articular surface and elliptical region localized to the lateral and the upper and lower parts of this region are preserved [3]. Pain and changes result from the excessive shearing forces on the lateral of this face due to the anatomic nature of the thick cartilage in the most protruded region of the articular surface of patella. This strain is responsible for softening, fissuration and degeneration [3]. Yet another factor that cause pain among young individuals is basal degeneration, softening and edema development in the deep parts of the cartilage. As a result, superficial cartilage can turn into a blister and become an open chondromalacia due to distinct separation of superficial cartilage from deep cartilage [17].

Chondromalacia accounts for the problem in which the problem is limited to articular cartilage. If the problem reached subchondral bone, and progressed to a condition in which subchondral sclerosis, cyst and osteophytes are present then it is called “patellofemoral arthritis” [23].

ETIOLOGY

Etiology in patellar chondromalacia is the overload on lateral facet of the patella associated with malalignment and shearing forces in the central protrusion of the patella. In this case, a softening in the cartilage might be expected since the load in the medial facet of the patella is reduced. Also, in prolonged immobilization, direct traumas in the anterior knee might trigger the problems associated with chondromalacia following the arthroscopic surgeries [23].

It is superficial matrix swelling along with collagen fiber network structure deformity especially in the matrix lines in superficial and transition zones as the pathological finding [15, 23].

Fibrillated cartilage contain surface fibrils penetrated through middle layers. Intense electron material covering the internal surfaces of the fissures was detected and it was observed that it contained the impaired components of the matrix. In association with these changes, an increase is observed in chondrocyte clusters and the organelles in the chondrocytes.

Proteolytic enzymes such as cathepsin D that emerge following hypo-pressure lead to deformation and fissure formation in the cartilage by demolishing the keratan sulfate, chondroitin 4 sulfate and chondroitin 6 sulfate chains which are covalently bound to the protein nucleus in proteoglycan matrix [6,15,16,17,21,22].

The one seen in medial facet is the degeneration seen in association with the lack of contact necessary for the patellar articular cartilage nutrition [15, 23].

Jackson gathered etiological factors under two major groups as biomechanical and biochemical [10, 18].

1. Biomechanic Reasons:

A. Acute: (Patella dislocation with chondral or osteochondral fracture, direct trauma, patella fractures that lead to uneven joint surfaces)

B. Chronic: (Recurrent patella subluxation or dislocation, increased Q angle, Quadriceps imbalance, axis disorder that emerge following femur fracture, excessive lateral compression syndrome, meniscus injury coexisting with patella movement and stability loss, reflex sympathetic dystrophy)

2. Biochemical Reasons:

A. Diseases: (rheumatoid arthritis, recurrent hemarthrosis, alkaptonuria, peripheral synovitis, Sepsis and adhesions)

B. Iatrogenic: (recurrent intraarticular steroid injection, prolonged immobilization)

C. Degenerative: (Primary osteoarthritis)

CLINICAL FINDINGS

In chondromalacia patellae, sensitivity and arthroscopic changes in lower patella pole are the most significant findings. Arthroscopy is proved to be a considerably reliable method in making patella diagnosis. Fibrillation and fragmentation of the surface can be probed through direct view and soft areas can be detected [18]. The major complaint is sometimes the pain localized in the medial of the joint line behind patella and the pain in popliteal fossa. It is particularly increased in activities like climbing up stairs and sitting for a long time when the knee is at flexion [10, 18]. Pain might be bilateral and is not related to any trauma. Location of the pain might cause some misdiagnoses. Meniscal pathologies causing pain in the anteromedial of the line and Patellofemoral pain complaints are confused with each other and wrong treatment methods might be applied. Second complaints of the patient with patellar dysfunction include complaints that are defined with clicking noise from the patellofemoral joint, discharge feeling, locking terms and used for clarifying the soft rhythm interruption or disorder of the considerably normal patellofemoral movement [29]. Patient can feel friction especially when the load on the patellofemoral joint increases (climbing up and down the stairs) or can be felt very mildly. Effusion is seen in the knee joint of majority of the patients with patellofemoral joint syndrome. Also, quadriceps atrophy is identified in chronic cases [10].

CLASSIFICATION

Chondromalacia Patellae is classified as follows: [10, 15, 18]

- *Closed chondromalacia:* It is the simple softening of patella articular cartilage and is expressed with blister formation. Since macroscopic surface continuity is available, final diagnosis is made through arthroscopic probe examination. In microscopy, fibrous metaplasia and cell flattening and edema in the deep layer of the cartilage is observed.

- *Open chondromalacia:* Single or multiple fissures are available on the cartilage joint surface. They are coexisting with the softening in the peripheral areas. If this softening and fissures are outside the patella-femoral contact areas, they do not cause patellofemoral pain. Fibrillation in the articular cartilage continues with fissure and ulceration. In ulceration, localized cartilage body loss is present. Subchondral bone is exposed. Subchondral bone which seems polished is called as eburnation. This case is the final step of the cartilage degeneration. In microscopy, increased degeneration and necrotic cells are observed in periphery areas of the chondrocytes showing hyperactivity.

- *Chondrosclerosis:* Hardening is available in the cartilage contrary to the softening. The

surface looks yellow. Hardening is palpated through probe. Total loss is observed in the articular cartilage quality. Lesion is not available on fibrocartilage but on collagen and proteoglycane structure.

- **Fray formation:** It is generally localized in the medial facet. The basis of the pathology is lack of contact which is necessary for the cartilage nutrition.
- **Superficial changes:** They result from the elevation and tear of cartilage lamina layer.
- **Global chondromalacia:** In the previous definitions, it is given that the lesion is localized in a single facet. This is the emergence of chondromalacia throughout all patella articular cartilage for various reasons like patella fracture or arthrofibrosis.

TREATMENT

a) Conservative Treatment:

Conservative treatment is the basic treatment in majority of the symptomatic chondromalacia patellae cases [28]. Conservative treatment aims at relieving the patient complaints and reducing the cartilage destruction and prevent the progress of degeneration. Therefore, conservative treatment is not limited to prescribing medicine and applying physical treatment to the patient. Patient's way of life and activities should be re-arranged with the trainings that will be provided [10].

Conservative treatment applications include activity modification and rest, nonsteroid anti-inflammatory drugs, quadriceps strengthening exercises, patellofemoral joint immobilization and patellar banding. From quadriceps strengthening exercises, semi squat exercises (closed kinetic chain) are more effective compared to straight leg lifting exercises (open kinetic chain), which has been recommended for a long time [7]. These treatments provide relief in vast majority of the patient complaints [2, 3, 23].

Exercises are the first options in the treatment. Clinicians, who believe that this diseases results from quadriceps insufficiency, strongly recommend this treatment [28].

Isometric exercises adapted from complete extension to 30° flexion, straight leg lifting and the exercises performed against a resistance increase nutrition in joint cartilage through repetitive compression [18].

Regulating the activities increases symptoms by probably enhancing patella-femoral reaction forces with activities such as flexion over 100°, running, cycling in particular. Patient relatives can be informed about the activity decrease in the activity at the beginning. In drug therapy, arachidonic acid formation arising out of the cell wall phospholipids post-traumatically is prevented through steroids and nonsteroid anti-inflammatory drugs inhibit cyclooxygenase enzyme directly and reduce prostaglandin synthesis. Pain is dulled by preventing arachidonic acid formation through steroid application. However, cell wall lysis and phospholipid accumulation continue [18].

b) Surgical treatment:

Treatment in chondromalacia patellae should be suitable for the etiology. Various success rates are obtained through various treatment methods [18]. In patients with failed conservative treatment, surgical treatment might be considered. Doğanay listed the treatment techniques as follows [10]:

- **Open or arthroscopic reduction and internal detection:**

Chondral and osteochondral pieces should be located when nails or screws are appropriate to use. The bed from where the piece takes it roots should be debrided until solid cartilage tissue and subchondral region should be definitely revived [10, 25].

- **Debridement and lavage:**

It is a palliative application. It should be preferred in old patients with a few symptoms and low activity. Technically, joint should be washed, meniscus tears should be treated, intra-articular free pieces should be removed, fibrillations in the cartilage should be cleared away [9, 10, 14].

- **The techniques that stimulate the bone marrow:**

The methods helping the stem cells in the bone marrow reach lesion region, differ and provide cartilage recovery accordingly include subchondral drilling, abrasion arthroplasty, and microfracture methods. In abrasion arthroplasty, it is recommended to clean the surface with scraper or engined tools until reaching bleeding subchondral bone layer. Microfracture method is based on bleeding formation as a result of subchondral bone drilling [9, 10, 25].

- **Autologous chondrocyte transplant:**

It is a technique recommended for symptomatic patients with high activity expectation, lesion sized between 2–10 cm² in a single condyle [10].

- **Osteochondral autograft (mosaicplasty):**

It is based on the adaptation of the grafts obtained from the damaged joint surfaces on which there is no overload onto lesion area [10].

- **Osteochondral allograft:**

It is a technique that recommend the usage of fresh osteochondral grafts obtained from the cadaver. Since the tissue rejection is at a negligible rate, post-operative immunosuppression is not required [10].

- **Soft tissue grafts:**

It is based on the principle of suturing the soft tissue on the lesion both on its own and as a supportive treatment to the other methods in order to achieve cartilage recovery. Periost or perichondrium can be used as soft tissue graft [10].

- **Biological and Synthetic Materials:**

Studies continue with the aim of obtaining material which will correct osteochondral defects, which bear cartilage properties or serve as the roof in lesion region until recovery is achieved by affecting the growth hormones and cells [10].

In general sense, surgical treatments can be classified under two titles [23].

1. These are the surgeries that correct the patellar alignment or regulate extensor mechanism with the aim of patellofemoral stress. It is aimed to prevent the existing abnormality to grow into osteoarthritis [23].
 - a. Lateral retinacular release
 - b. Proximal and distal alignment surgery
 - c. Tibial tubercle elevation surgery
2. These are the surgical treatments aiming at reducing cartilage damage. If there is no biomechanical abnormality, it is performed with the aim of reducing the treatment symptoms [23].
 - a. Cartilage trimming
 - b. Incision
 - c. Drilling
 - d. Subchondral bone trimming
 - e. Spongialisation

- **Cartilage trimming and incision:**

It is the trimming of cartilage fibrillation and movable flaps. In this method, it necessary to perform the procedure as conservative as possible, but to trim the free pieces that causes tripping gently during each flexion and extension. Upon achieving the smooth surface, no further procedure should be performed. This method is suitable for stage III lesions (fibrillation). In this method, while the tripping and crepitation loss with knee movements provide relief in the patient, proteoglycane lytic enzymes that arise inside the joint as a result of the cartilage damage create synovial irritation and remove synovial effusion and inflammatory pain might be the advantages of the method [3, 23].

- **Subchondral drilling, cortical abrasion and spongialization:**

This method is exposure of cancellous bone under in advance stage chondromalacia in which subchondral bone is exposed, through making apparent and functioning of the fibrous tissue by replacing the defect. Since spongialisation is the complete removal of subchondral bone and exposing the spongios bone, it is more aggressive. Since the results are not predictable, it should be performed in a limited region and the malalignment should be corrected with different methods, if necessary [23].

- **Lateral retinacular release:**

Lateral capsular loosening is a technique commonly used in patello femoral pain syndromes as open, subcutaneous or arthroscopical [18]. Lateral retinacular release is an effective method in patients with excessive lateral patellofemoral compression [23]. Lateral retinacular release, which can be performed open or arthroscopically, is quite a successful method in early stages when patellofemoral osteoarthritis is not developed, if the subluxation of the patella to the lateral has been shown with computed tomography in patients in whom lateral retinaculum reduction is clinically manifested [23].

- **Elevation of tibial tubercle:**

The aim of this method proposed by Maquet [19] is to reduce patellofemoral joint contact pressure by increasing the strength arm of patellar tendon. In this method, the fragment in which tubercle is available, is slided to anteromedial and in this way excessive lateral compression on patellofemoral joint is eliminated since there is no need to take graft and patellar tendon is medialized [15, 23].

- **Autologous cartilage transplantation:**

Since the chondral damage is at distal or lateral, Fulkerson osteotomy yields fruitful results. But, if the damage is at medial or superior, cartilage transplantation should be considered. When the damage is deep and wide, the treatment of the defect with this method provides the advantage of bringing hyaline cartilage to the damaged area. In this method, if autologous cartilage transplantation is decided during primary surgery, it is transplanted with a second surgery after extracting cartilage from the joint and acculturating it in the laboratory. Correcting the alignment problems surgically helps the result be better. The results of the autologous chondrocyte transplantation are better with tibial tubercle anteromedialization [13, 23, 24].

The best treatment method that will be applied in chondromalacia patellae is the one planned in line with the etiological reasons and arthroscopic stages [18].

APPLICATION

38 patients who applied to our unit for various reason and diagnosed with stage 4 chondromalacia patellae and in whom we performed microfracture were included in the study. The common complaint of all the patients is kneecap pain, locking, difficulty in climbing stairs, swelling. 22 of them are female, 16 of them are male. No patient with metabolic disorder or who smoke is included in our study. The mean age of our patients is 37,6 (29-52). Average follow-up duration is 22,3 month (9-33). All the patients underwent physical examination, roentgenography and magnetic resonance imaging (MRI) (Figure 1-2-3-4). Lysholm scoring was performed in all patients pre-operationally and the same scoring was performed in the follow-ups. Pre-op Lysholm score of our patients is 66,6.

Standard arthroscopic joint examination was performed in all patients entering through anteromedial and anterolateral portals after the routine preparation under tourniquet under spinal or general anesthesia. Joint lavage was performed by 9 litres of saline solution. Upon making stage 4 chondromalacia pateallae diagnosis; microfracture application was performed in the areas where subchondral bone is exposed. Upon performing bleeding management by opening tourniquet, portals were closed and the procedure was finalized. All patients stayed at the hospital one night. The patients were recommended to do quadriceps strengthening exercises and avoid movements that will strain patellofemoral joint. All patients were followed clinically.

In the clinical follow-ups of the patients, Lysholm scoring was performed. While the Preop Lysholm score of the patients was 66,6, post-treatment average score was 83,4. General personal satisfaction of our patients was 82,4%.

DISCUSSION

In our study, the increase of the score point is 16.8. Microfracture method is based on creating bleeding as a result of the subchondral bone drilling [18, 23, 24]. The mean age of our patients is 37,6 and we believe that our patient's being young has positive effects on the result due to bone blood build up and recovery potential. Our average follow-up time is 22,3 months. Lysholm scoring questions functions like side determination, limping, support, locking, instability, pain, swelling, climbing stairs and squatting. Therefore, that it does not evaluate the recovery on the cartilage surface directly is the limitation of our study. Since we were not able to perform control arthroscopy on our patients, we think that it is necessary to conduct such studies in animal experiments. Metabolic diseases, chronic illnesses and smoking negatively effects tissue healing [11, 12]. We believe that our patients' not having metabolism disorders and that they are not smoking had positive impacts in their healing.

Joint lavage is beneficial in knee arthritis and cartilage lost [4, 26]. Because of beneficial effect of knee lavage, we used about 9 litres of saline solution during our arthroscopies. Patellar chondromalacia is common problem. We need treatment that reduces pain, increase moving performance and patient's satisfaction. In our study, we get our patients' all need by the method and without any discomfort to our patients. We advice microfracture and joint lavage to patellar chondromalacia.

CONCLUSION

Chondromalacia patella is the softening, fraying or ulceration of the cartilage located at the posterior side of patella and is accompanied by anterior knee pain. If patella malalignment is present, surgeries intended for lateral retinacular release, proximal and distal alignment and tibial tubercle elevation might be performed. The result is better when autologous chondrocyte transplantation is performed along with alignment surgery. In our study, we increased Lysholm scores of 38 stage 4 chondromalacia patellae patients from 66,6 to 83,4 with the arthroscopic microfracture method within our follow-up of 22,3 months. We achieved 82,4% patient satisfaction in our patients. The increase in Lysholm score in our study is better compared to studies in the literature. In this subject, we believe that studies with long-lasting follow-up and including arthroscopic imaging methods that evaluate the recovery on the articular surface directly in animal experiments are helpful.

CONTRIBUTION OF AUTHORS

The authors Aylin Zekioğlu and Ali Serdar Yücel gave support in the translation and summarization of the sources used in the research in addition to literature support.

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ANNEXES



Figure 1: Lateral knee graph of the patient on whom we performed applications.

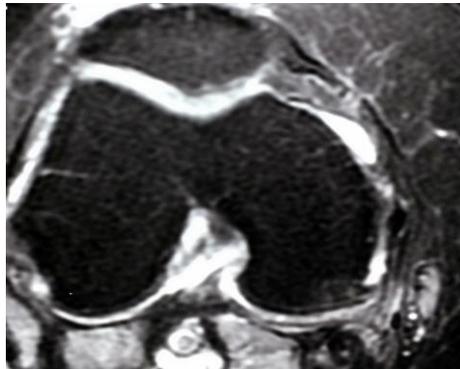


Figure 2: Transaxial MRI of the patient on whom we performed application.

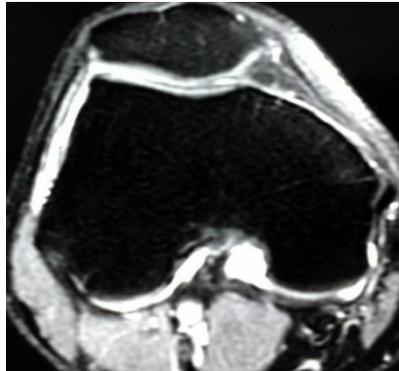


Figure 3: Transaxial MRI of the patient on whom we performed application.

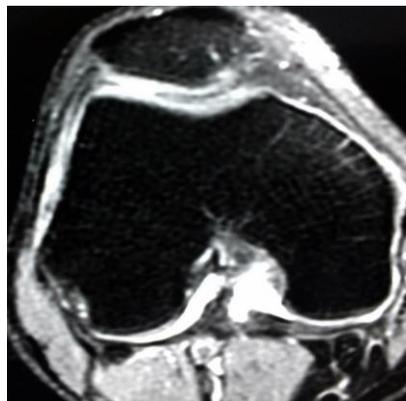


Figure 4: Transaxial MRI of the patient on whom we performed application.