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Chondromalacia patellae

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Abstract
Chondromalacia patellae (CMP) is usually described as an overload injury, caused by malalignment of the femur to the patella and the tibia. Chondromalacia patellae also occur as a result of trauma to the chondrocytes in the articular cartilage (leading to proteolytic enzymatic digestion of the superficial matrix). Adolescents and young adults (age group 17–35 years) are commonly affected. Active young adults who participate in running sports or workers who increase stress in their patellofemoral joint by repeated stair climbing and/or kneeling have a higher incidence of chondromalacia. Exercises and activities that require deep knee bending, jumping and landing, pushing or pulling heavy loads and stopping and starting will place very high stresses on the patellofemoral joint and the patellar tendon. So, those activities should be avoided. Initial treatment for chondromalacia patellae includes rest and vitamin D, but these therapies do not regenerate cartilage. The primary goal for treatment and rehabilitation of chondromalacia patellae is to relieving the pain. Initial pain management involves avoiding motions which irritate the kneecap.

Keywords: chondromalacia patellae, knee arthroscopy, diagnostic criteria, rehabilitation

Introduction

Definition

The abnormal softening of the cartilage on the underside of the kneecap (patella) is known as Chondromalacia Patellae (CMP). It causes pain in the front of the knee. It is one of the most common causes of chronic knee pain. [1]

Etiology

Chondromalacia patellae (CMP) is usually described as an overload injury, caused by malalignment of the femur to the patella and the tibia. Chondromalacia patellae also occur as a result of trauma to the chondrocytes in the articular cartilage (leading to proteolytic enzymatic digestion of the superficial matrix). It may also be caused by instability or malt racking of the patella which softens the articular cartilage [2]. Certain individuals are predisposed to develop chondromalacia patellae: females, knock-kneed or flat-footed runners, or those with an unusually shaped patella undersurface.[1]Chondromalacia is also seen as a complication of injuries, immobilization, and surgical procedures that lead to quadriceps atrophy. The cause is the micro-trauma created by the decreased pull of the quadriceps muscle on the patella. An abnormal Q angle is often the cause. The Q angle is the measurement of the pull of the quadriceps muscle relative to the pull of the patellar tendon on the patella. A normal angle is 14^{O}in men and 17^{O} in women. An abnormally high Q angle indicates lateral pull of the patella in the trochlear groove of the femur and a mechanism of articular cartilage wear and tear. Patella alta (high riding), and patella baja (low riding), are both conditions that have also been implicated as a cause of chondromalacia. Foot and ankle anatomic variances (pes planus) that cause an increased valgus orientation of the knee cause increased lateral wear of the patellofemoral joint. Shoes, for example, high-heel shoes, which create increased stress on the patellofemoral joint, can also contribute to chondromalacia. Intra-articular injections of bupivacaine and high doses or frequent intra-articular injections of corticosteroid lead to softening and/or articular cartilage dysfunction. Most often, chondromalacia is associated with abnormal (microtrauma) wear and tear of the patellofemoral joint's hyaline cartilage. Lateral positioning of the patella in the patella-femoral joint is a frequent cause of chondromalacia [1].

Epidemiology

Adolescents and young adults (age group 17–35 years) are commonly affected [3]. Active young adults who participate in running sports or workers who increase stress in their patellofemoral joint by repeated stair climbing and/or kneeling have a higher incidence of chondromalacia [2]. The incidence is however more common in females and this is attributed to increased Q angles in women [3].

Pathophysiology

Hyaline cartilage is composed of chondrocytes that are dispersed throughout an extracellular matrix. This matrix consists of type 2 collagen, proteoglycans, and water. The chondrocytes produce the proteoglycans and which are then secreted into the extracellular matrix. Hyaline cartilage is avascular. Its nutrients diffuse into the matrix from synovial fluid. It does not repair well because of the lack of blood supply. The cartilage reacts to both the environment and physical loads. Destruction of hyaline cartilage can occur in response to chondrotoxic substances injected into a joint. Hyaline cartilage degeneration also occurs in response to microtrauma wear and tear. Repeated activities that create compressive stress on the patella-femoral joint or increased

loads applied to the joint can lead to chondromalacia. [2] Certain structural characteristics such as Q angle greater than a specific threshold number and Pathophysiologic processes such as inflamed peripatellar synovial lining and fat pad tissues and increased osseous metabolic activity of patellar bone can be the consideration of pathophysiologic factors. [4]

Common symptoms of chondromalacia patella include:
Pain in the kneecap
A clicking or grinding noise when bending or straightening the knee
Discomfort and pain with movement
Knee swelling
Knee stiffness [5]
There is an associated symptom of the knee 'giving way' or 'locking'.
There may be slight effusion and quadriceps atrophy. [1]

Stages of Chondromalacia patellae [6]
The modified Outer bridge Stages of chondromalacia is divided into four stages by MRI, typically using fat-saturated proton density sequences.

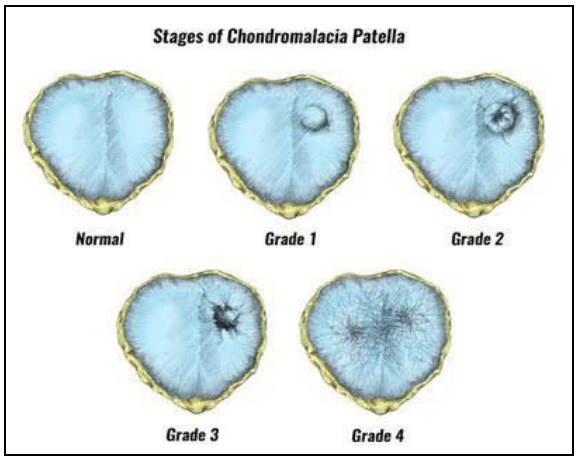

Fig 1: Stages of chondromalacia patella

Stage 1: Focal areas of hyperintensity with normal contour
Arthroscopically: Softening or swelling of cartilage
Stage 2: Blister-like swelling/fraying of articular cartilage extending to surface
Arthroscopically: Fragmentation and fissuring within soft areas of articular cartilage
Stage 3: Partial-thickness cartilage loss with focal ulceration
Arthroscopically: Partial thickness cartilage loss with fibrillation (crab-meat appearance)
Stage 4: Full-thickness cartilage loss with underlying bone reactive changes
Arthroscopically: Cartilage destruction with exposed subchondral bone.

Clinical Test
1. **"J" sign:** The patient is in supine or seated position and the knee extended from flexed position. Lateral deviation of the patella can be observed during the terminal phase of extension.
2. **Q – Angle:** Angle between a line from the Anterior superior iliac spine (ASIS) to the patella and a line from the patella to the tibial tubercle. Normal Q - Angle in male is 14^0 – 16^0 and in female is 16^0 – 18^0. Wider Pelvis → Higher the Q – angle → More susceptible to Anterior knee pain [7].
3. **Clarke's Test (Patellar Grind Test):** The patient should lie supineon the plinth while the clinician applies inferior compression (towards the toes) directly on the patella. While maintaining this level of compression, the patient should attempt an isometric quadriceps contraction. As contraction continues, the clinician should slowly increase the pressure applied to the patella. If the patient exhibits hesitation to complete the contraction, or reports pain or discomfort while maintaining the contraction the test is considered positive. [8]
4. **McConnell Test:** The patient is sitting with the femur laterally rotated. The patient performs isometric quadriceps contractions at 120^0, 90^0, 60^0, 30^0, and 0^0 with each contraction held for 10 seconds. If pain is produced during any of the contractions, the patient's leg is passively returned to full extension by the examiner. The patient's leg is then fully supported on the examiner's knee, and the examiner pushes the patella medially. The medial glide is maintained while the knee is returned to the painful angle, and the patient performs an isometric contraction, again with the patella held medially.
5. **Positive Sign:** If the pain is decreased, the pain is patellofemoral in origin. Each angle is tested in a similar fashion [9].

Diagnostic Criteria [10].
Entry criteria
- A patient with mechanical anterior knee pain aged less than 50 years
- No knee arthritis, peri-arthritis, internal derangement and other Patellofemoral pain syndrome (PFPS) upon history and physical examination.

Main clinical criteria
- Patellar facet tenderness test positivity: If patient is not able to maintain a quadriceps muscle contraction against manual resistance for longer than 2 seconds.
- Patellofemoral compression test positivity: If patient complaint of pain under and around the kneecap while tested patient in supine position with the tested knee flexed to 20^0 and then patella was compress against the femoral groove.
- Patellar crepitation or Robot test positivity: A person can feel the crunching or cracking sensation by placing a hand over the kneecap as the knee bends and straightens.

Complementary criteria
- Age ≤ 30 years-old
- Normal knee X-Ray

The presence of all of the entry criteria and at least one of the main clinical criteria along
with at least two points of the complementary criteria can establish the diagnosis of Chondromalacia patellae.

Precautions
Exercises and activities that require deep knee bending, jumping and landing, pushing or pulling heavy loads and stopping and starting will place very high stresses on the

patellofemoral joint and the patellar tendon. So, those activities should be avoided. [11] Limitations of certain activities such as stairs, squatting, or running may help to reduce excessive stresses on the knee joint. Maintaining a healthy body weight can help take pressure off the knees and other joints as excess body weight may stress knees. [12]

Management

The treatment of this problem is usually non-operative and includes; weight loss, medication, activity modifications, softer soled shoes, physical therapy and occasionally injections. If these modalities are unsuccessful then surgery is an option. The goal of treatment is to improve pain and function. None of these options will change the underlying wear and there is nothing at this point that will re-grow cartilage [13].

Medical management

Upon diagnosis, initial treatment for chondromalacia patellae includes rest and vitamin D, but these therapies do not regenerate cartilage. Nonsteroidal anti-inflammatory drugs (NSAIDs)and Icing can be helpful in reducing pain and inflammation may also be prescribed, but studies show further degradation of cartilage with this therapy in humans. [14] Drugs such as Pain Killers and Muscle Relaxants can also helpful to reduce pain. [15] As chondromalacia patellae worsens, corticosteroid injections may be provided in an attempt to relieve pain symptoms. To ameliorate the resultant pain of chondromalacia patellae and reverse the process of cartilage degeneration, prolotherapy can be used which consisting of dextrose injections over a series of 4 visits. [16] Perineural Injection Treatment (PIT) is a recently developed treatment option that is directed adjacent to the peripheral nerves that are the source of pathology causing neurogenic inflammation and pain. Compared with physical therapy alone, PIT plus physical therapy reduced pain and stiffness and restored functional capacity. [17]

Physiotherapy Management

The primary goal for treatment and rehabilitation of chondromalacia patellae is to relieving the pain. Initial pain management involves avoiding motions which irritate the kneecap.

- Rest: Initially, knee activity should be reduced
- Pain-relieving modality: Cryotherapy for reducing pain and swelling. Use cold packs for 20 minutes at a time, several times a day. Do not apply ice directly on skin. Thermotherapy (therapeutic heat) for local vasodilation to reduce pain and stimulate healing, in the forms of ultrasound, moist hot packs. Short wave diathermy (SWD) is a deep heating modality that uses heat to provide pain relief, it improves the blood supply to targeted muscle, removal of waste products. Transcutaneous electrical nerve stimulation (TENS) is an electrical modality that provides pain relief by providing pain modulation. Neuromuscular electrical stimulation (NMES) to facilitate quadriceps muscle activity, which may be helpful in muscle reeducation in those who have acute pain, swelling, or significant weakness and are unable to properly activate their vastus medialis. [18]

Exercise Program

The aim of treatment is to calm pain and inflammation, to correct muscle imbalances, and to improve function of the patella. Muscle imbalances are commonly treated with stretching and strengthening exercises but improvement usually takes at least six to eight weeks. The most effective exercises are isometric and isotonic in the inner range. [16] Isometrics to quadriceps with the knee in slight flexion to avoid patellar movement, within the limits of pain. [3] It has shown that closed kinematic chain exercises can improve patellofemoral joint performance by increasing quadriceps muscle strength and patellar alignment correction. [19] Restoration of adequate quadriceps strength and function is an essential factor in achieving good recovery. [20] Quadriceps strengthening is most commonly recommended because the quadriceps muscles play a significant role in patellar movement. Strengthening of the hip abductors, adductors, and flexors should also be considered. [21] These exercises should be done regularly, twice a day. If symptoms are already present, it will take about 6 weeks.

For the straight leg lift and short arc lift, ankle weights can be added to increase resistance and strength of the quadriceps. Generally, after 1 to 2 weeks, ankle weights can be added (starting at 1 pound) and increased by 1 pound per week until you build to 5 pounds [11]. Stretching exercise to reduce tight structure (especially hamstring, calf, and iliotibial band stretching). [18] Joint mobilization techniques such as gentle gliding may helpful to attain a normal range of pain-free joint motion and reduce joint stiffness. [22] Ambulation has to be properly controlled to avoid excessive hyperextension of the knee; genu recurvatum has been reported as one of the common features following chondromalacia patellae [12].

Knee Braces

Bracing may be useful in supporting the patella and knee joint to reduce pain and symptoms, and to help them avoid antalgic movements and normalize gait as much as possible. [23] Typically, knee braces have a C- shaped lateral buttress that keeps the patella from deviating too far laterally. [24] A knee brace is also often prescribed for patients who want to stay active in sports. The usual brace prescribed is known as a patella stabilizing brace. It consists of a knee sleeve with passive patellar restraints plus or minus a patellar cutout, and a horse-shoe pad based laterally to keep the patella from tracking laterally [10].

Taping

Taping the patella into a certain position to reduce friction may be helpful. A technique embraced by some physical therapists is known as "McConnell taping". [25] Patella taping is used to keep the patella from tracking laterally.

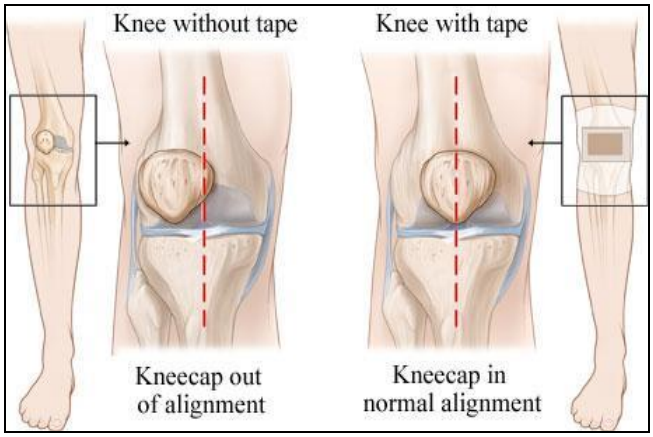

Fig 2 & 3: Technique of McConnell taping in Chondromalacia patellae

Foot Orthosis

The most effective way to decrease a high Q angle and to improve the tracking of the patella is to prevent excessive pronation with custom-fitted foot orthotics. [26] The orthotics provide support for the arches, which reduces excessive pronation, decreases the Q angle, and limits medial rotation, thereby improving tracking of the patella and reducing the torque forces on the connective tissues. The best orthotics for use in chronic knee conditions and patellar tracking disorders will have a layer of visco-elastic material. [27]

Lifestyle Changes

Wearing shoes appropriate to your activities. Warming up thoroughly before physical activity. Incorporating stretching and flexibility exercises for the quadriceps and hamstrings into your warm-up routine, and stretching after physical activity. Increasing training gradually and reducing any activity that has hurt your knees in the past. [28]

Surgical Management

If nonsurgical treatment fails to improve your condition, surgery may be suggested. The procedure used for patellofemoral problems varies. In severe cases a combination of one or more of the following procedures may be necessary.

Arthroscopic Method

Arthroscopy is sometimes useful in the treatment of the CMP. Looking directly at the articular cartilage surfaces of the patella and the femoral groove is the most accurate way of determining how much wear and tear there is in these areas. Surgeon can also watch as the patella moves through the groove, and may be able to decide whether or not the patella is moving normally. If there are areas of articular cartilage damage behind the patella that are creating a rough surface, special tools can be used by the surgeon to smooth the surface and reduce pain. This procedure is sometimes referred to as 'shaving the patella. [11]

Patellectomy

This is the most severe surgical treatment. This method is only used when no other procedures were helpful, but a significant consequence is that the quadriceps muscle will become weak. It is indicated when fragmentation and fissuring affect an area of more than 1.3cm in diameter. [29]

Autologous chondrocyte transplantation under a tibial periosteal patch

- Tightening of the medial capsule: If the Medial Capsule is lax, it can be tightened by pulling the patella back into its correct alignment.
- Lateral release: A very tight lateral capsule will pull the patella laterally. Release of the lateral patellar retinaculum allows the patella to track correctly into the femoral groove.
- Medial shift of the tibial tubercle: Moving the insertion of the quadriceps tendon medially at the tibial tubercle, allows the quadriceps to pull the patella more directly. It also decreases the amount of wear on the underside of the patellae. [30]

Postoperative Rehabilitation

Rehabilitation may be slower to allow the bone or cartilage to heal before too much strain can be put on the knee. The first few physical therapy treatments are designed to help control the pain and swelling from the surgery. [7] The physical therapist will choose exercises to help improve knee motion and to get the quadriceps muscles toned and active again. Muscle stimulation, using electrodes over the quadriceps muscle, may be needed at first to get the muscle moving again. As the program evolves, more challenging exercises are chosen to safely advance the knee's strength and function. The key is to get the soft tissues in balance through safe stretching and gradual strengthening. [31]

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