

Ministry of Defence

Synopsis of Causation

Chondromalacia Patellae

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September 2008

Disclaimer

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

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1. Definition

- 1.1 The word “chondromalacia” translates as “[cartilage](#) softness”. Consequently chondromalacia patellae is a pathological diagnosis, however the term has a record of indiscriminate usage. In particular, the diagnosis has tended to be used synonymously with both [anterior knee pain](#) and patellofemoral pain syndrome (PFPS). As a result, many patients who have been clinically diagnosed as suffering from “chondromalacia patellae” are found subsequently on investigation to have no evidence of patellar [articular](#) degeneration.
- 1.2 When applied correctly, the term “**anterior knee pain**” provides a description of a symptom rather than a clear diagnosis, and thus encompasses a number of medical conditions (including chondromalacia) that cause pain in the anterior part of the knee. **PFPS** is a diagnosis that should be applied only to individuals who have pain behind the kneecap (retropatellar pain) in the absence of damage to the cartilage or any other distinct pathology. However, retropatellar pain is generally self-limiting, and so patients are usually treated in the primary care setting without resort to the more complex investigations that are necessary to determine whether or not the cartilage has suffered damage. Moreover, as no clear association has been demonstrated between radiological/[MRI](#) changes in affected knees and outcomes in terms of pain and knee function, the distinction between chondromalacia patellae and PFPS may be more theoretical than practical.¹
- 1.3 Several systems of classification have been proposed, some based on changes within the cartilage, others on the size of lesion. In general, four stages are identified, as exemplified in the following classification:
 - Grade I: Localised softening with minimal or no break in the surface
 - Grade II: Area of fibrillation or fissuring and an irregular surface
 - Grade III: Definite fibrillation with fissuring extending down to the underlying bone
 - Grade IV: Disappearance of cartilage, allowing exposure and erosion of underlying bone²
- 1.4 There is no evidence of progression to [patellofemoral osteoarthritis](#), which is probably a different entity.³ In contrast to osteoarthritis, where initial changes to the cartilage occur on the surface, the changes in chondromalacia patellae commence in the deeper layers of cartilage and involve the surface layer later in the development of the condition.

2. Clinical Features

- 2.1 Chondromalacia patellae features is a prominent diagnosis in cases of knee pain and disability affecting children, adolescents and young adults, and among individuals who participate in certain vigorous sporting activities. However, it also should be appreciated that many cases of chondromalacia patellae remain undetected, as the condition may be symptomless.
- 2.2 Much of the literature is derived from clinical series and provides little if any information about the incidence or prevalence of chondromalacia patellae in the general population.⁴
- 2.3 The most frequently reported symptom of chondromalacia patellae is pain, described as a dull, aching discomfort localised around or behind the kneecap. The pain is often precipitated by ascending or descending stairs, squatting, and sitting with knees flexed for prolonged periods (sometimes called the “theatre sign”). As [cartilage](#) does not have a nerve supply, it cannot be the direct source of the pain, which is therefore thought most likely to arise from the abnormal force transmission through the softened cartilage to the underlying bone. However, the correlation between pain and damage to the cartilage is poor. Soft tissues around the patella may also play a role in pain generation. Other symptoms that may feature are a sensation of catching or giving way, [crepitation](#), and puffiness or swelling of the knee.²
- 2.4 Physical examination may be somewhat non-specific but chondromalacia patellae may be accompanied by [quadriceps](#) wasting, effusions and retropatellar [crepitus](#).
- 2.5 Pathological findings correlate poorly with the severity of knee pain and disability. Nevertheless, investigations are necessary to confirm the presence of damage to the cartilage and to search for underlying aetiology. [MRI](#) has proved useful in chondromalacia patellae in establishing moderate to severe loss of cartilage. Plain X-rays and [CT](#) are of little use in diagnosing this condition except in cases where advanced disease has led to changes in the underlying bone.⁵
- 2.6 [Arthroscopy](#) is ideally suited for determining both the presence and pattern of degeneration of the cartilage. The degree of fibrillation and fragmentation of the surface can be explored under direct vision, and areas of softness can be identified by careful probing.

3. Aetiology

- 3.1 The lack of consensus that is evident in agreeing a precise classification for chondromalacia patellae, PFPS and anterior knee pain is reflected in the persisting uncertainties that exist over causation and treatment. Inconsistent use of these terms has led to an element of disparity in the literature over the causes of chondromalacia patellae.
- 3.2 A number of factors have been put forward as contributing to the development of chondromalacia patellae although, for many individuals, the condition is self-limiting and the cause remains **unknown**. Recognised causes of chondromalacia patellae may be classified as either **mechanical** or **biochemical** in origin.²
- 3.3 **Mechanical factors** may be related to:
- trauma; or
 - anatomical predisposition

The following contributory factors with a tendency to increase the risk of **overload** have been implicated:⁶

- **malalignment** of the lower extremity and/or the patella
- **muscular imbalance** of the lower extremity
- **overuse**

With patellar malalignment, resultant softening of the [articular](#) cartilage is probably related to the impact loading and shearing that occurs as the patella is compressed against the lateral [femoral condyle](#).⁷

3.3.1 **Traumatic factors** implicated in the development of chondromalacia patellae include:^{2,8}

- trauma to the anterior aspect of the knee, especially from a direct blow occurring whilst the knee is flexed, e.g. from a fall or dashboard injury during a motor vehicle accident
- fracture of the patella
- posttraumatic malalignment following fracture of the femoral shaft
- meniscal injury with loss of stability of the patella
- previous knee surgery (see also section 4.5)

3.3.2 **Anatomical predisposition:** Factors in this category include:^{2,8}

- patellar [subluxation](#)
- excessive lateral pressure syndrome (ELPS), a condition that is associated with a chronic lateral patellar tilt
- patellar dislocation, especially if recurrent and/or subjected to forceful reduction
- [patella alta](#)
- increased [quadriceps](#) angle
- quadriceps muscle imbalance, leading to maltracking of the patella through the femoral groove

3.4 **Biochemical factors** may be responsible for primary cartilaginous degeneration leading to the development of chondromalacia patellae. There may be an association with certain specific conditions including:²

- rheumatoid arthritis
- recurrent haemarthrosis
- alkaptonuria
- peripheral synovitis
- sepsis and adhesions
- repeated intra-articular steroid injections
- prolonged immobilisation

3.5 **Overuse** can be a factor in the development of chondromalacia patellae, occurring in association with certain vigorous sporting activities e.g. gymnastics. PFPS has been reported as a frequent phenomenon among recruits undergoing military training. In a recent prospective study, a large number of those affected were engaged in jobs or sports that place a burden on the knee. A period of reduced activity appears to have been the main factor contributing to a lessening of symptoms.⁹

4. Prognosis

- 4.1 Many cases of chondromalacia patellae are self-limiting and treatment is primarily non-surgical. Conservative therapeutic interventions include the following:
- Isometric [quadriceps](#) strengthening and stretching exercises – restoration of good quadriceps strength and function is an important factor in achieving good recovery¹⁰
 - Hamstring stretching exercises
 - Temporary modification of activity
 - Patellar taping
 - Foot [orthoses](#)
 - Non-steroidal anti-inflammatory drugs
- 4.2 Surgery is indicated after all attempts at non-operative management have failed. Studies have shown that up to 20% of athletes fail to improve adequately with conservative measures.¹¹ In cases in which operative treatment is subsequently undertaken, there are two lines of approach, comprising:
- i. treatment directed at malalignment and other abnormalities of the extensor mechanism and the patellofemoral joint; and
 - ii. treatment of the diseased cartilage (although this course has some limitations due to the lack of blood supply to cartilage, restricting its healing capacity)
- 4.3 Pre-operative assessment will inform the choice of surgical procedure. A wide variety of measures are available, with options that include the following.^{2,8}
- lavage, which removes articular surface debris
 - [arthroscopic](#) shaving of the patella to remove superficial fibrillated cartilage
 - local excision of the defect coupled with penetration of the subchondral bone
 - articular cartilage regeneration by [chondrocyte](#) transplant
 - articular cartilage transplant
 - realignment procedures, which include lateral release of the patella and [osteotomy](#) in malalignment cases
 - patellofemoral [arthroplasty](#)
 - [patellectomy](#), which should be considered only as a final option when all other measures have failed
- 4.4 Surgical intervention has produced variable results. For example, the majority of studies show that over 80% of patients with chronic patellofemoral pain respond initially to lateral release of the patella but with increasing time there is a diminishing long-term benefit.¹¹ In a series involving cases of post-traumatic chondromalacia patellae, arthroscopic shaving and lavage generally provided only partial relief of symptoms, and few patients showed improvement beyond 2 years from the date of injury.¹² Results from patellectomy for chondromalacia patellae are even less encouraging, with one study showing only 29% of soldiers recovering to a fully fit category post-operatively.¹³ For athletes following surgery, a return to normal motion and strength in the affected leg should be demonstrated before the patient is allowed to return to athletic activities. There should be no significant pain or effusion, and any incision should be well healed.⁸

- 4.5 The realignment procedures that are used in the surgical treatment of chondromalacia patellae are designed to transfer stresses from an affected area of cartilage to a more healthy area. However, these procedures can themselves lead to problems if pre-operative assessment and/or surgical technique are inadequate. Renewed episodes of joint pain arising from the [medial patellar facet](#) can develop following overzealous lateral release or transfer of the tibial tubercle medially, or following a Hauser procedure.⁸ There have been reports of an increased incidence of osteoarthritis following the Hauser procedure (an older technique used for the treatment of recurrent dislocation of the patella that transfers the tibial tubercle in a medial, distal, and posterior direction).¹⁴
- 4.6 Some of the newer techniques for the treatment of chondromalacia patellae, such as chondrocyte transplant and cartilage transplant, have not yet been followed up for a sufficient length of time to be able to come to a definite conclusion about their long-term effects.

5. Summary

- 5.1 Chondromalacia patellae should only be diagnosed in cases where there is objective evidence of damage to the cartilage. The condition can be hard to distinguish from patellofemoral pain syndrome (PFPS), especially as some individuals with minimal changes in the cartilage have marked patellofemoral joint symptoms, whereas others have no patellofemoral pain despite marked changes.
- 5.2 The aetiology of chondromalacia patellae is ill understood and probably multifactorial, encompassing both mechanical and biochemical elements. Development of the condition may be associated with trauma or an anatomical malalignment predisposition. Malalignment of the lower extremity and/or the patella or muscular imbalance may be identified. Overuse may be a factor. However, for many individuals, the condition is self-limiting and the cause remains unknown.
- 5.3 Many patients who present with patellofemoral pain are treated successfully in the primary health care setting. The initial approach is non-operative, including temporary modification of activity and physiotherapy aimed at quadriceps strengthening. A range of surgical interventions is available where conservative measures have failed, with variable outcomes in terms of pain relief and function.

6. Related synopses

Anterior Knee Pain

Internal Derangement of the Knee

Ostoarthritis of the Knee

7. Glossary

arthroscopy	Orthopaedic procedure that involves the introduction of a thin fiberoptic device into a joint space to allow direct visualisation and, in some cases, surgical repair of the internal structures.
arthroplasty	The surgical repair of a joint.
articular	Of, or pertaining to, a joint.
cartilage	Connective tissue that is more flexible and compressible than bone.
chondrocyte	Cell responsible for the secretion of the external matrix of cartilage.
collagen	Protein substance of the white fibres of skin, tendon, bone, cartilage, and all other connective tissue.
crepitation, crepitus	A sensation of grating, indicating a roughened joint surface.
computed tomography (CT) or computerised axial tomography (CAT)	An investigation technique that uses a computer to assimilate multiple X-ray images into a two-dimensional cross-sectional image.
femoral condyle	Rounded surface at the extremity of the femur (thigh bone).
magnetic resonance imaging (MRI)	An investigation technique used to image internal structures of the body, particularly soft tissues.
medial patellar facet	Circumscribed surface on the inner aspect of the patella.
orthosis (-es)	An external orthopaedic appliance designed to either prevent or assist movement.
osteotomy	Surgical cutting of a bone.
patella alta	A high-riding patella associated with recurrent dislocation or subluxation.
patellectomy	Excision of the patella.
quadriceps	Muscle of thigh.
subchondral	Beneath the cartilage.
subluxation	Abnormal movement of one of the bones that comprise a joint.

8. References

- ¹ Heintjes E, Berger MY, Bierma-Zeinstra SM et al. Exercise therapy for patellofemoral pain syndrome (Cochrane Review) In: The Cochrane Library, Issue 4, Chichester UK: John Wiley & Sons Ltd; 2003.
- ² Miller RH. Knee injuries. In: Canale ST, editor. Campbell's operative orthopaedics. 10th ed. St Louis, MO: Mosby, Inc; 2003. p. 2313-9.
- ³ Bentley G, Dowd G. Current concepts of etiology and treatment of chondromalacia patellae. Clin Orthop 1984;189:209-28
- ⁴ McAlindon TE. The knee. Ballière's Clin Rheumatol 1999;13(2):329-44.
- ⁵ Cone RO. Imaging sports-related injuries of the knee. In: DeLee JC, Drez D, Miller MD, editors. DeLee and Drez's orthopaedic sports medicine: principles and practice. 2nd ed. Philadelphia, PA: WB Saunders; 2003. p. 1641-3.
- ⁶ Thomee R, Augustsson J, Karlsson J. Patellofemoral pain syndrome: a review of current issues. Sports Med 1999;28(4):245-62
- ⁷ Fairclough JA, Graham GP. The knee. In: Hochberg MC, Silman AJ, Smolen JS, Weinblatt ME, Weisman MH, editors. Rheumatology 3rd ed. St Louis, MO: Mosby, Inc;2003. p 671.
- ⁸ Theut PC, Fulkerson JP. Anterior knee pain and patellar subluxation in the adult. In: DeLee JC, Drez D, Miller MD, editors. DeLee and Drez's orthopaedic sports medicine: principles and practice. 2nd ed. Philadelphia, PA: WB Saunders; 2003. p. 1799-1808.
- ⁹ Dorotka R, Jimenez-Boj E, Kypka A, Kollar B. The patellofemoral pain syndrome in recruits undergoing military training: a prospective 2-year follow-up study. Mil Med 2003;168(4):337-40.
- ¹⁰ Natri A, Kannus P, Jarvinen M. Which factors predict the long-term outcome in chronic patellofemoral pain syndrome? A 7-yr prospective follow-up study. Med Sci Sports Exerc 1998;30(11):1572-7.
- ¹¹ Perry JD. Sports medicine: the clinical spectrum of injury. In: Hochberg MC, Silman AJ, Smolen JS, Weinblatt ME, Weisman MH, editors. Rheumatology 3rd ed. St Louis, MO: Mosby, Inc;2003. p 749.
- ¹² Price AJ, Jones J, Allum R. Chronic traumatic anterior knee pain. Injury 2000;31:373-8.
- ¹³ Pailthorpe CA, Milner S, Sims MM. Is patellectomy compatible with an army career? J R Army Med Corps 1991;137(2):76-9.
- ¹⁴ Juliusson R, Markhede G. A modified Hauser procedure for recurrent dislocation of the patella. A long-term follow-up study with special reference to osteoarthritis. Arch Orthop Trauma Surg 1984;103(1):42-6.