Patellofemoral disorders are a common cause of knee pain and sometimes it can be quite difficult to make a diagnosis, because, besides PF disorders due to lateral compression or instability, the pain may be caused by a parapatellar posttraumatic disorder, overuse syndrome, sympathetic algodystrophy or internal knee derangement. Thus, a thorough history and careful physical examination are essential for accurate diagnosis. Besides conventional radiographic views, axial Computerized Tomography (CT), Magnetic Resonance Imaging (MRI) or arthroscopy could sometimes be important. If physical therapy for at least 6 months fails, lateral release is performed in the lateral patellar compressive syndrome (lateral tilt), while either proximal or distal realignment of the extensor mechanism is done in the case of subluxation due to the altered Q angle or patellar height abnormality. In cases of dysplastic and shallow flat trochlea the trochleoplasty could be performed. In the presence of cartilage destruction, tibial tubercle elevation and medialisation are accompanied by arthroscopic debridement or shaving, which could diminish further cartilage symptomatology. In any case, the treatment must be addressed to the primary cause.

Key words: patellofemoral disorders, patellar instability, diagnosis, treatment.

INTRODUCTION

Patellofemoral (PF) disorders and instabilities are probably the most common cause of knee pain, and they include a variety of conditions such as patellar instability, soft tissue abnormalities and patellofemoral arthrosis. The first dislocation mostly occurs in adolescent females and if subluxation is established the risk of new episodes of dislocation rises up to 50%. Beside the objective instability, the more discrete condition (potential instability) are presented only with the pain, locking. There have been many attempts to classify PF abnormalities, based on the condition of cartilage, the presence of pain due to malalignment, imbalance or overuse, but Merchant’s classification is the most systematic and precise among them, dividing PF disorders into five main groups.

In this article the authors discuss PF disorders in the narrower sense (due to nature of disease abnormality): lateral patellar compressive syndrome and instabilities (subluxation and dislocation), which are quite different and should be separated from other conditions, such as post-traumatic conditions, chondromalacia, plica syndrome and overuse syndromes. Patellofemoral dysplasia and instability are anatomically related to the patellofemoral joint and the end-stage of this disorder could be arthrosis with total derangement of the PF joint and disability of knee function.

HISTORY

Originally the main idea was to obtain a stable patella, i.e. to stabilize the "slipping patella". In the past many conditions like patella alta, ligamentous laxity, PF bone hypoplasia, weakness of the quadriceps muscle, genu valgum or genu recurvatum were thought to predispose to patellar instability. For a long period muscle exercises were instituted to strengthen the weak m. vastus medialis and to make vastus lateralis stronger. This pulls the patella laterally, especially during running or jumping, when lateral luxation of the patella occurs. Muscle imbalance as well as anatomical abnormalities are the basis both for patellar instabilities and reasonable surgical procedures were: proximal extensor mechanism realignment, proximal capsular reefing, patellar tendon splitting and its medial transfer. On the other hand bone procedures on the hypoplastic lateral femoral condyle were also performed by Albee, as well as tibial tubercle transfer and trochleoplasty by deepening of the trochlea (Dejour). An understanding of the pathoanatomic basis is the corner stone for
proper diagnosis and therapy of PF disorders and some important anatomic data are presented here.

ANATOMIC CONSIDERATION: MORPHOLOGY OF TROCHLEA, PATELA AND PATELLAR TENDON

Trochlea is concave and depth of its groove is important for the patellar stability. The lateral femoral condyle are mostly affected - it is shallow, reducing the patellar lateral stability, i.e. abnormality of trochlea correlate with PF instability.

The patella, the largest sesamoid bone, has an anterior surface of mean dimensions 4.0cm height, 4.1cm width, 2cm thickness. The proximal part, which resembles the base of a triangle is the place of quadriceps muscle insertion, while the patellar tendon is inserted on the apex. Three quarters of the posterior patellar surface are articular, while the distal quarter (25%) is nonarticular. The central ridge divides the articular surface into medial and lateral facets; the differences between them described by Wiberg. His classification of patellas into four types is based on the predominance of the lateral facet over the medial one, which leads to lateral patellar instability. Actually, this patellar morphology correlates with pathologic patellar tracing in the trochlear groove, which results initially in asymptomatic overloading of the lateral facet, then subluxation and lastly in patellar dislocation.

The vertical position of the patella determines the same orientation of the patellar tendon in relation to the joint line. The patellar tendon (PT) is a strong structure: in the central third its width is 24-33mm with a thickness of 3-5mm. The average length of the PT is 4.6cm. The orientation of the patellar tendon is slightly lateral, making a valgus alignment of the extensor mechanism. This lateral position is called the Q angle and if it exceeds 10 degrees (15 degrees in females), it is considered abnormal with a tendency for lateral patellar instability.

Lateral retinaculum (LC) is a strong and complex structure, consisting of two layers: a superficial and a deep one. During the lateral release procedure, most of these structures must be resected, especially the deep transverse retinaculum.

The medial retinaculum seems to be weaker than the lateral one, and it consists of medial patellofemoral and medial patellotibial ligaments. There is an interesting and important relationship: a longer patellar tendon is associated with a weaker medial retinaculum and more frequent lateral patellar subluxation.

The quadriceps tendon is the only active-dynamic stabilizer of the patella.

FIGURE 1.
PATELLAR TILT TEST: IN THE LATERAL PATELLAR COMPRESSION SYNDROME (LPKS) IT IS IMPOSSIBLE TO RAISE THE LATERAL BORDER OF THE PATELLA ABOVE THE HORIZONTAL AXIS, WHILE FOR THE NORMAL PATELLOFEMORAL JOINT IT IS POSSIBLE.

FIGURE 2.
MOBILITY OF THE PATELLA IN THE MEDIAL DIRECTION IS RESTRICTED IN LPKS, WHILE PATELLAR DISPLACEMENT IN THE LATERAL DIRECTION BY MORE THAN 50% OF ITS DIAMETER IS INDICATIVE FOR PATELLAR INSTABILITY I.E. WEAK MEDIAL-PATELLAR STRUCTURES.

FIGURE 3.
PATELLOFEMORAL INDEX (PT- INDEX BETWEEN LENGTH OF PATELLA AND PATELLAR TENDON) IS NORMALLY 1.02 AND NOT EXCEEDED BY MORE THAN 10-20%.
The symptoms of PF dysfunction are the same: pain, locking, giving way, swelling. Most of these symptoms can also be found in other internal knee derangements, so are not very specific for PF dysfunction and making the diagnosis subtle.

The most prominent sign of PF dysfunction is an aching pain located behind the patella, more often on the medial side of the joint. This pain is aggravated during sitting with flexed knees and stair climbing. Acute trauma only worsens the preexisting PF disorder. A bilateral and insidious onset is more characteristic for the PF problem than for internal knee derangement.

**DIAGNOSTICS: PHYSICAL AND RADIOLOGICAL EXAMINATION OF THE PATELLOFEMORAL JOINT**

Physical examination is of great importance. The patient should be assessed for signs of patella instability such as: femoral anteversion, genu valgum, or recurvatum, patella alta, exceeded Q angle, positive patellar apprehension test, glide test. Patellar tilt (inability to raise the lateral patellar facet which is an indicative sign for the lateral patellar compressive syndrome (Figure 1). Patellar instability is evaluated both in medial and lateral directions (with an extended knee) and must be compared to the unaffected knee. In a normal knee the patella cannot be displaced by more than 50% of its diameter in either direction (Figure 2). In patellar instability apprehension test is positive. Pressure on the patella during the guidance could elicit pain and crepitus, which is more characteristic for late stages when arthrotic changes are developed.

Also during flexion and extension of the knee tracking of the patella is observed, and marked lateral displacement should be noticed\(^1\). The final stage in the physical examination is aspiration of any possible intraarticular effusion by which haemarthros can be differentiated from effusion, and the presence of droplets in cartilage lesions\(^7,18\).

**Investigation (Radiological, CT, MRI) of the patellofemoral joint**

In the initial radiographic examination of the PF joint one should obtain a standard anteroposterior (AP) lateral weight bearing radiograph, as well as an axial PF view-skyline patellar view (most commonly Laurin and Merchant views\(^19,20\)). In the true lateral view the patellar alignment in the femoral condyle can be assessed, as well as the depth of the femoral trochlea, and the position (i.e. length of the patellar tendon) of the patella is noticed, named as patella alta or patella baja. There are several measurements for this feature. The most sensitive is Insall-Salvati’s method (the index between the patellar tendon and the patella), which for the normal knees is 1.02 (Figure 3).

The axial - skyline view can be obtained in the knee flexed for 20 degrees\(^15\) or 40 degrees\(^20\). The latter is more standardized. On axial radiographs the following parameters of PF congruence are measured: sulcus angle (137 degrees), lateral PF angle (normally open laterally), PF index (up to 1.6), congruence angle, lateral patellar displacement obtained on stress radiography (Figures 4a,b,c,d). Also the femoral trochlear depth can be seen\(^21\). Better imaging of the PF joint can be obtained by computerized tomography (CT)- Figure 5, while Magnetic Resonance Imaging (MRI) could visualize soft tissue structures, such as medial patellofemoral ligament rupture, thickness of lateral patellar retinaculum\(^1,2,22,23,24,25\) (Figure 6). Arthroscopy, is nowadays rarely performed as diagnostic, but more during surgery procedures\(^1,4\).
**CLASSIFICATION**

PF dysplasia includes the following entities: lateral patellar compressive syndrome (LPCS chronic subluxation, recurrent dislocation instability entities) and chronic dislocation of the patella. An important sequel of these conditions is PF arthrosis. Some of them could be treated non-operatively, in early stages, but for others surgery is the best option.

**TREATMENT**

Treatment of LPCS, consists of rest, restriction of demanding activities, a quadiceps exercise-rehabilitation program, antiinflammatory drug administration, immobilisation by a brace appliance.

In the acute-painful phase of LPCS, rest is necessary. Restriction of certain activities is easily achieved in the elderly, but in younger patients the restriction of sports activities diminishes the quality of life to a great extent. For this group of patients, it is more appropriate to consider surgery, than to expect them to change their life style. Quadiceps exercises to correct muscle imbalance are probably the most important part of nonoperative treatment, because in LPCS there is a deficit in muscle strength due to the reflex inhibition caused by pain 4,5,26,27. If nonoperative treatment is ineffective after 6 months, lateral release procedures should be considered, either open or arthroscopically assisted2,4,15,28. Actually the main indication for lateral release is pain due to the tight lateral retinaculum, without pathologic patellar mobility. Lateral release is most effective in young patients without cartilage changes3,30,31. The release is started from the lateral superior patellar corner, and both vastus lateralis obliquus tendon and lateral retinaculum are sectioned (Figure 7). Prior to skin closure, it should be possible to elevate the patella by at least 70 degrees from the horizontal axis. Also, if abnormal patellar tracking is present after lateral release, medial duplication of the medial capsule should be done (Figure 8). As a procedure lateral release is effective in 54% to 100% of cases7. Complications of lateral release include hemarthrosis-bleeding and medial subluxation of the patella32.

Treatment of patellar instabilities: beside lateral release, operative treatment consists of reconstruction of medial patellofemoral ligament, tibial tubecle medialisation (or distalization osteotomy) and trochleoplasty.

In cases of acute dislocation conservative treatment reports high redislocation rates (52%), especially in females (57% females vs 32% males) and young patients (84% at ages under 14 years, but only 41% in the third decade of life)32,33, while the reports after surgical treatment of acute dislocation of the patella indicate a lower recurrence rate: from 0% to 14%2,3,35.

Thus, although, the overall recurrence rate of nonoperative treatment is 30%, some authors recommended closed reduction, immobilisation for 4 weeks, early quadiceps strengthening with partial weight bearing, because with aging recurrences are less probable1,2,136.

FIGURE 5.
AXIAL CT SCAN OF THE KNEE WITH CHRONIC PATELLAR SUBLUXATION WITH PATELLAR TILT

FIGURE 6.
MRI OF THE KNEE AFTER ACUTE PATELLAR DISLOCATION: TEARING OF THE MEDIAL SOFT TISSUE STRUCTURES IS VISIBLE.
attachments in order to correct the line of m.quadriceps action. This procedure includes medial muscle transfer, and additional lateral release through a separate incision. The reported success rate was 62-91%.

Muscle activity changes (vastus medialis vs vastus lateralis) were also demonstrated after Elsmise-Trillat operation when muscle activity became equal after the operation. Thus, during each operation a better position of vastus medialis must be obtained.

In the case of abdnormal Q angle distal realignment procedures are performed to reduce the increased Q angle and correct the height of the patella by detachment and transfer of the tibial tubercle medially. Most of these procedures include lateral release. As most patients already have cartilage changes, Fulkerson recommended anteriorization of the tibial tubercle, but by less than 1 cm (Figures 9). Nowadays, the procedures of Scuderi and Elmsie-Trillat are also popular with a frequently beneficial outcome (70-93% success rate). However, there are still pro and contra opinions about proximal or distal realignment due to the possibility of osteoarthritis developing after these procedures.

Thus, the Hugston operation put all procedures (distal and proximal realignment) in one operation. During these procedures beside medial alignment, the distalisation of patela could be obtained (in case of patela alta) or its shortening in patela baja.

Trochelaopsty includes operations on the lateral femoral condyle, ie. Albee procedure (elevation of the hypoplastic femoral condyle- Fig 10), or sulcus deepening procedures by Dejour (Figure 11). The surgical widening of altered patela was described by Morscher.

In case of developed patellofemoral arthritis is possible as a sequel of PF disorders, and should be considered during treatment. Some of the patients with malalignment of the patella also have cartilage changes- patellofemoral arthritis. In these cases patella shaving, subchondral bone drilling, spongoplasty, lateral retinaculum release and elevation of the tibial tubercle are performed according to Maquet’s idea. Nowadays, the patellofemoral arthroplasty is performed with new designed implants whis increase favorable outcome.

SUMMARY

PATELLOFEMORALNI POREMEČAJI I NESTABILNOSTI

Poremečaji patelofemoralnog zgloga su čest uzrok bola u kolenu, i nekada je teško postaviti tačnu dijagnozu, jer pored patelofemoralne nestabilnosti, bol može da bude posledica postratumatskih parapatelarnih promena, "over use" sindroma, simpatičke algodistrofije ili unutrašnjih promena u samom zglogu kolena. Stoga su anamneza i fizički pregled od velikog značaja. Pored konvencionalnih radiografiija, aksijalna kompjuterizovana tomografija, Magnetna rezonanca i arthroskopijska su nekada neophodni. Ako fizička terapija u trajanju od 6 meseci ne dovede do uspeha, primenjuje se resekcija lateralnog retnakuma patela kod lateralnog patelarnog kompresivnog sindroma, dok se kod subluxacije primenjuju proksimale ili distalne operacije ekstenzornog mehanizma kolena. Kod displaštenih trohlee femura vrši se trohleoplastika. Kod prisutnih promena na hrskavici uz arthroskopski debriandin, vrši se medijalizacija i ventralizacija tuberozitasa bijase sa pripojmen ligamenta patela. U svakom slučaju lečenje je usmereno na uzrok tegoba.

Ključne reči: patelofemoralna displazija, patelarna nestabilnost, dijagnoza, lečenje.

REFERENCES


FIGURE 11.
SCHEMATIC PRESENTATION OF DEEPENING OF TROCHLEA


