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Patellofemoral (anterior knee) pain syndrome: symptoms, causes and guideline based treatment options

Abstract

The Patellofemoral Pain Syndrome (PFPS), also known as Anterior Knee Pain (AKP), is defined as: A complex of pain complaints around the patella (retro-/ peri-patellar), mainly non-traumatic of origin, which leads to a restriction during loaded activities, such as squatting, climbing stairs and cycling.[1] Clinicians[2] should make the diagnosis of PFPS using the following criteria:

1) The presence of retro-patellar or peri-patellar pain,
2) Reproduction of retro-patellar or peri-patellar pain with squatting, stair climbing, prolonged sitting, or other functional activities loading the Patellofemoral Joint (PFJ) in a flexed position, and
3) Exclusion of all other conditions that may cause anterior knee pain, including tibiofemoral pathologies.

Although treatment of patellofemoral pain often begins with simple measures like rest, avoidance or modification of activities that increase the pain, such as climbing stairs, kneeling or squatting or, if needed, over-the-counter pain relievers, most recommended interventions were exercise therapy, foot orthoses, patellar taping, patient education and combined interventions. Not recommended were manual therapy (in isolation), dry needling, patellar bracing, and electrotherapeutic modalities.

To evaluate subjective symptoms and functional limitations PROMs (Patient Reported Outcome Measures), such as the KPS/AKPS,[3] KOOS-PF[4] and VAS/NPRS, are valid and reliable assessments.

Keywords: patellofemoral pain syndrome; treatment guidelines, PROMs

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Introduction, incidence and prevalence

Wallis[5] claims patellofemoral pain to be a common musculoskeletal condition with an estimated prevalence of between 23% and 29% in adult and adolescent populations. According to Ummels[6] one in four athletes, of which 70% are between the ages of 16 and 25, will have to deal with this PFPS or AKP. Women seem to have a higher risk of developing a PFPS than men. 55% of all women develop these complaints. If we look at the Dutch data, we see that of the general population about 22.7% have patellofemoral complaints. In adolescents this is 28.9% (69% female).[6] An analysis of the Pearl Diver record database (a large national database of orthopaedic conditions)[7,8] reported a prevalence of PFP diagnoses between 1.5% and 7.3% of all patients seeking medical care. Patellofemoral pain occurs across the life span, but the highest prevalence of PFP appears to be in those between 12 and 19 years of age. The Pearl Diver[8] data analysis however reported the highest percentage of PFP diagnosis in the 50-to-59-year age group. The discrepancy in prevalence related to age may be due to activity level, or treatment in a sports clinic versus in a general practice office.

Aetiology

The exact cause of PFPS, except due to a trauma, is not known, but the literature shows that it is believed to be an abnormal compression of the patellofemoral joint. Gulati[9] classified the cause into two categories: patellar mal-alignment and patellar mal-tracking. According to Collado[10] PFPS seems to be multi factorial, resulting from a complex interaction among intrinsic anatomic and external training factors. The pain symptoms can be originated on various patellofemoral structures: the subchondral bone, the infrapatellar adipose tissue, the retinaculum, and ligamentous structures. In his review Lankhorst[11] summarised factors associated with PFPS, comparing patients and controls, such as a larger Q-angle, sulcus angle and patellar tilt angle, less hip abduction strength, lower knee extension peak torque and less hip external rotation strength. Possible predictive risk factors for PFPS were identified by Neal et al.,[12] He stated that Q-angle was not, but quadriceps weakness and increased hip abduction strength in adolescents were a risk factor for future PFPS.

Diagnosis of PFPS, differential examinations and outcome measures[2,3,6]

Following symptoms are normally specific to PFPS: retro-patellar or peri-patellar pain, both reproducible when squatting, climbing stairs, due to prolonged sitting and similarly loaded activities; a positive patellar tilt-test; exclusion of all other possible sources of pain and patellofemoral pain cluster of findings. Differential examination should follow as there should always other knee disorders to be considered, which do not fit within the patellofemoral pain cluster, systemic or medical conditions that may affect retro-patellar or peri-patellar pain or psychological problems for which rereferral to a general practitioner / psychologist is indicated.

Classifications (Patient Profiles)[6]

If PFPS is diagnosed, 4 (four) classifications (or patient profiles) can be distinguished with their profile-specific test(s):

1) PFPS overload without other restrictions;
2) PFPS with coordination deficits;
3) PFPS with muscular imbalance (strength);
4) PFPS with mobility restrictions

The following profile-specific tests can help confirm the assumed diagnosis:

Profile 1 (PFPS overload without other restrictions):

- The eccentric step-down test and
- The anterior-knee-pain-reproduction tests.

Profile 2 (PFPS with coordination deficit):

- Dynamic valgus with the lateral step-down-test
- Frontal plane valgus during one-leg squat (>10° increase in Frontal Plane Projection Angle (FPPA)[13]

Profile 3 (PFPS with muscular imbalance (strength)):

- Hip Sit (Trendelenburg Test)[14]
- Hip muscle strength tests (isometric); (male <37% BM; female <30% BM):
- External rotators (male <13% BM; female <17% BM); Extensors (male < 28%; female <30% BM.
- Upper leg (isometric): Knee extensors (male <44% BM; female <37% BM); Knee flexors.

Profile 4 (PFPS with mobility restrictions):

- Hyper mobility: foot mobility tests: e.g., Navicular drop test (> 11mm)
- Hypo mobility: patellar tilt test (lateral retinaculum)
- Muscle length testing: hamstrings (<79.1°), gastronomies (dorsal flexion foot with knee stretched < 7.4°), soleus (dorsal flexion foot with bent knee (90°) < 14.8°, quadriceps (knee flexion) <134°), iliotibial band (Obertest (knee bent to 90°) <11°).

PROM-tests (hip endorotation and exorotation) (Table 1).

Table 1 PFPS Profiles and their assessments

Profile 1 PFPS	**Profile 2 PFPS**	**Profile 3 PFPS**	**Profile 4 PFPS**
PFPS overload without other restrictions	**PFPS with coordination deficit**	**PFPS imbalance in strength (muscular imbalance)**	**PFPS with mobility restrictions**
The eccentric step-down test	Dynamic valgus with the lateral step-down-test	Hip Sit	Hyper mobility
The anterior-knee-pain-reproduction test	Frontal plane valgus during one-leg squat	Hip muscle strength tests	Hypo mobility
		Upper leg (isometric) Knee Test	Muscle length testing
			PROM-tests

Specific test information

Eccentric step-down-test

Purpose: Observe 'Kneeing in[15] phenomenon and pain provocation.

- The patient stands on a 15 cm bench.
- He/she has the hands on the hips and steps off the bench as slowly as possible with the affected leg forward.
- Then the patient gets off the bench with the other leg.
- Pay attention to the presence of pain and the 'kneeing in' phenomenon.

Navicular drop-test

Purpose: To test foot mobility.

- Mark the navicular tuberculum.
- The patient sits on the edge of the treatment table with the foot to be examined 'unloaded' on the ground in a 'neutral' position.
- Measure with a measuring rod the distance from navicular tuberculum to the floor.
- The patient stands relaxed, causing the navicular to sink.
- Remeasure the distance from navicular tuberculum to the floor.
- The test is positive if the difference between the two measurements is more than 5 mm.

Patellar lateral tilt-test

Purpose: To get an impression of any shortened lateral structures.

- The patient lies in a supine position.
- The therapist includes the patella with his thumb and forefinger.
- He pushes the medial side to posterior and lifts the lateral side.
- The test is positive if the lateral side cannot be raised into horizontal position.
- This indicates shortened lateral structures.
- The test can also be carried out with two hands.

PROMs (Patient reported outcome measures)

Purpose: assess, evaluate and revaluate the level of functioning of the patient.

- In addition to the subjective outcome measures, it is also important to use objective outcome measures.
- In this way, it can be investigated whether the patient is progressing and the intervention is successful.

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- At the level of ICF we know certain PROMs to measure the limitations in activities and pain: respectively the KPS/AKPS,[3] KOOS-PF[4] and VAS/NPRS.

Outcome measures AKPS (Anterior Knee Pain Score)[3] or KPS (Kujala Patellofemoral Score).[16]

Purpose: To evaluate subjective symptoms and functional limitations in PFPS.

- The complaints occur when climbing stairs, squatting, cycling, and sitting with bent legs for a longer period.
- 13 activity-level items.
- Also load capacity and degree of pain are evaluated.
- Support with the anamnesis

The KOOS[17] is a similar outcome measure tool, but more suitable for patients after ACL-reconstruction.

Therapeutic intervention in the various profiles[2,5]

According to Wallis[5] and Willy[2] following profile specific recommendations, listen below, should be followed (Table 2).

Table 2 Treatment recommendations for the different PFPS Profiles[2,5,6]

	Profile 1 PFPS **PFPS overload** **Without other restrictions**	**Profile 2 PFPS** **PFPS coordin-** **-ation deficit**	**Profile 3 PFPS** **PFPS imbalance** **in strength (muscular imbalance)**	**Profile 4 PFPS** **PFPS(with mobility** **restrictions)**
Recommended:	Taping plus Exercise Therapy,	Walking and Running Training	Exercise Therapy	Combined Execise Therapy with Mobilisation, Orthososes
	Prefab Foot Orthoses	Gait retraining (Forefoot)	Gait retraining (Forefoot)	Patellar Mbilisation
	Patient Education	-	Combined Exercises	-
Not recommended:	Knee orthoses	Knee orthoses	Knee orthoses	Knee orthoses only
	Solely taping	Solely taping	Solely taping	Solely taping
	Electro Therapy, Dry Needling	Electro Therapy, Dry Needling	Electro Therapy, Dry Needling	Electro Therapy, Dry Needling

Patient education

An important part of any treatment consists of patient education to implement the importance of active treatments like exercise therapy and biomechanical aspects, that may contribute to relative overload of PFJ (Patellofemoral Joint), as well as evidence for various treatment options.

Patella taping and adjusting load/load capacity (relative rest) I

In case of a Profile 1 PFPS (overload without other restrictions) Not recommended are patellofemoral knee orthoses, including braces, sleeves, or straps, but may tailored made patellar taping in combination with exercise therapy to assist in immediate pain reduction and enhance outcomes of exercise therapy in short term (4 weeks) is also not recommended is taping applied with aim of enhancing muscle function. Patients with abnormal pronation may use prefabricated foot orthose to reduce pain but only in short term (up to 6 weeks) and these foot orthoses should be combined with an exercise therapy program. There is insufficient evidence to recommend custom foot orthoses over prefabricated foot orthoses.

Combined interventions

In case of a Profile 2 (PFPS coordination deficit); e.g., walking and running training. Gait retraining consisting of multiple sessions of cuing to adopt forefoot-strike pattern (for rear foot-strike runners), cuing to increase running cadence, or cuing to reduce peak hip adduction while running are possible options.

Exercise therapy in case of profile 3 PFPS (muscular imbalance (strength)

Treatment of muscular imbalance should include exercise therapy with combined hip- and knee-targeted exercises to reduce pain and improve patient-reported outcomes and functional performance in short, medium, and long term (hip-targeted exercise therapy should target poster lateral hip musculature; knee-targeted exercise therapy includes either weight-bearing (resisted squats) or non–weight-bearing (resisted knee extension) exercise, as both exercise techniques target knee musculature; preference to hip-targeted exercise over knee-targeted exercise may be given in early stages of treatment of PFP. Overall, a combination of hip- and knee-targeted exercises is to be preferred over solely knee-targeted exercises.

Combined interventions in case of profile 4 PFPS (mobility restrictions)

Treatments like blood flow restriction plus high-repetition knee exercise therapy while monitoring for adverse events for those with limiting painful resisted knee extension are well recommended. Therapeutical interventions like exercise, foot orthoses, taping, manual therapy, result in superior outcomes compared with no treatment, as well as flat shoe inserts, or foot orthoses alone in short and medium term. Exercise therapy is a critical component and should be focus in any combined intervention approach. Interventions to consider combining with exercise therapy include foot orthoses, patellar taping, patellar mobilizations, and lower limb stretching.

Not recommended treatment options

According to Wallis[5] and Willy[2] taping applied with the aim of enhancing muscle function is not recommended. Neither is EMG-based biofeedback on medial vastii activity to augment knee-targeted (quadriceps) exercise therapy, visual biofeedback on lower extremity alignment during hip- and knee-targeted exercises and ultrasound, cryotherapy, phonophoresis, iontophoresis, electrical stimulation, and therapeutic laser.[5]

Furthermore manual therapy (in isolation), including lumbar, knee, or patellofemoral manipulation/mobilization is not recommended

as well as the use of dry needling. Acupuncture to reduce pain may be applied. However, caution should be exercised with this recommendation, as superiority of acupuncture over placebo or sham treatments is unknown.

Summary and recommendations

Wallis et al.,[5] summarised in his review of four clinical practice guidelines most recommended interventions. Recommended were exercise therapy, foot orthoses, patellar taping, and patient education and combined interventions. Not recommended were manual therapy (in isolation), dry needling, patellar bracing, and electrotherapeutic modalities.

To assess and monitor treatment outcomes Willy[2] recommended the use of validated PROMs as an important component of the physical therapist management of patellofemoral pain. This recommendation is consistent with physical therapy organizations and international initiatives recommending the collection of PROMs to evaluate the effectiveness of physical therapist management.

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Conflicts of interest

The author declares that there are no conflicts of interest.

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