PATELLOFEMORAL PAIN SYNDROME IN ATHLETES : A 5.7-YEAR RETROSPECTIVE FOLLOW-UP STUDY OF 250 ATHLETES

L. BLØND, L. HANSEN

Two hundred fifty athletes from a sports clinic, 122 (49%) females and 128 (51%) males (mean age 21.1 years), who were diagnosed as having patellofemoral pain syndrome (PFPS) and were instructed to practice vastus medialis training, returned a completed questionnaire after an average of 5.7 years' follow-up. Sixty-eight (27%) were pain-free for an average of 8.1 months : 17 (25%) women and 51 (75%) men. As to the remaining 182 (73%) who were still suffering, 95 (52%) had experienced a decrease in pain, 64 (35%) were unchanged and 23 (13%) had experienced an increase in pain. Sixty-eight (37%) described the pain as being mild, 88 (48%) as moderate, and 26 (15%) as severe. Athletic activity was affected in 184 (74%) of the cases, employment in 16 (6%) cases. The prognosis was not correlated with a history of trauma or with age. Athletes with a hypermobile patella had a less good prognosis ($r = 0.23$, $p = 0.04$). For about half of the athletes the prognosis was good, although the other half obtained an inadequate result, using a self-training program.

Keywords : patellofemoral ; sports ; chondromalacia patellae ; vastus medialis ; rehabilitation ; anterior knee pain.

Mots-clés : sport ; chondromalacie de la rotule ; vaste médial ; rééducation ; douleur antérieure du genou.

INTRODUCTION

Anterior knee pain, retropatellar pain or patellofemoral pain syndrome (PFPS) are all medical terms for a complex clinical entity affecting the knee joint, including many subgroups (24). The etiology is still an unsolved problem, but several biomechanical factors appear very likely. The symptoms are pain behind the patella, frequently aggravated by sitting (movie sign), stair climbing, and vigorous activity. Complaints of crepitus, effusions, a sense of insecurity, or giving-way are reported, and some patients also complain of intermittent catching while extending.

Many predisposing factors have been noted (10, 12, 14, 18, 20, 26, 27, 32, 33, 37), including peripatellar tenderness, tightness of the lateral retinaculum, quadriceps insufficiency, increased Q-angle, increased femoral anteversion, external torsion of the tibia, hyperpronation of the foot, patella dysplasia and rotation of the patellae, but the findings can be restricted to peripatellar tenderness (28). The diagnosis still relies mainly on the history and the symptoms, and sometimes it can be difficult to distinguish from an arching plica (34).

Kannus and Niittymäki (18) found age to be the only predictive parameter for the outcome of conservative treatment ; Doucette et Goble (7) found no predictive parameter.

Knowledge of the natural history of the PFPS is of substantial importance, especially when evaluation of scientific articles without a group of controls is considered.

The natural history of the disorder has been investigated by several authors (1, 5, 6, 15-17, 19, 30, 31, 35). The majority of these have made conclusions which conflict with the common opin-

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ion that PFPS is a self-limiting condition (2, 7, 8, 16, 17, 31). The studies have varied in design and are generally difficult to compare. Doubts can be raised regarding several studies on the natural history of PFPS as to whether they examined the real natural history, because the patients were often given some kind of treatment. To the best of our knowledge, only two studies had a follow-up period of more than 2 years and took patient gender into consideration (15, 17). According to Jensen et Albrektsen (17), only 16% had moderate to severe pain after 12 years, while Hvid et al. (15) found that only 27% had improved after 5.7 years. Karlson (19) followed for 5.1 years 71 male conscripts whom he found suitable for conservative treatment. He found that 23% still experienced considerable trouble, 63% slight trouble and 14% were pain-free.

Based on these somewhat conflicting observations, we have acknowledged the necessity for a more profound study. The objective of our efforts has therefore been to follow a larger number of patients for a longer period of time than any other study. Attempting to select a large group of patients receiving the least possible treatment, we found athletes from a sports clinic who received only a self-training program to be the most suitable.

MATERIALS AND METHODS

This is a retrospective study of 292 consecutive athletes all diagnosed as having PFPS, who attended the National Olympic Committee and Sports Confederation of Denmark, the Clinic of Hillerød during the period January 1984 to December 1993. The athletes were all members of a sports club, but were performing at different levels of activity. The diagnosis of PFPS was made by the same examiner, who is an orthopedic surgeon. For the diagnosis to be made the patients must have anterior knee pain with at least 2 of the following complaints :

- Pain while sitting
- Pain during activity
- Pain during stair climbing
- Painful crepitus
- Pseudolocking

In addition to the above the examiner had to find at least patellar tenderness provoked in various ways and the athletes had to recognize this tenderness as the same as that from which they were complaining.

The findings were varied, and most frequently retropatellar crepitus, tenderness with the patella grinding test, tightness of the lateral retinaculum and m. vastus medialis atrophy were seen, but some athletes also had effusion, tenderness on patellar compression, patella alta, hypermobility (both lateral and medial) and increased Q-angle.

Any history of direct trauma or suspicion of overuse was recorded. Athletes with a history of patellar luxation and/or a history of knee sprain were excluded. Patients with patellar subluxation and a tendency to knee effusions were included. On clinical examination, other pathology of the knee-joint, such as meniscus tears, synovial plica, tendinitis, apophysitis, osteoarthritis, osteochondritis dissecans, neuroma, reflex dystrophy and fat pad impingement, were excluded as far as possible, without resorting to arthroscopy or MR-scanning. All patients were advised to wear a knee brace (Genutrain, Bauerfeind Co., Germany). They were given a short verbal introduction to vastus medialis exercises. In addition written and illustrated instructions were given by the examiner, and they were told that the pain generally would disappear over time. The program consisted of three phases, starting with nonloaded exercises in phase 1, continuing with loaded exercises in phase 2 and finishing with the return to the main athletic activity in phase 3. If the pain relapsed, the athlete should return to the previous phase. The exercises were evenly distributed open and closed kinetic chain exercises, concerning both the extensor and the flexor knee mechanism, and were mainly of the inner range type.

In the course of 1996 all patients were sent a multiple-choice questionnaire concerning duration, grade and frequency of their knee pain, and were asked about various symptoms. Two hundred sixty-six *(91%)* questionnaires were returned. The questionnaire included enquiries regarding knee pain, as well as consequences for job and sports. The patients were questioned as to the use of a knee brace or tape and whether they had sought other treatment, including surgery. When an operation had been performed, the chart was examined. Trying to establish some predictors, we correlated the clinical findings from the initial examination to the outcome and to the symptoms. Only the athletes seen in the Clinic from 1991 to 1993, i.e. 112 probands, were included in this part of the study, because several records from previous years lacked complete information regarding all of the clinical findings. The study was approved by the regional scientific

ethics committee for Frederiksborg County. The data were analyzed in a statistical software package named Statistica ver. 4.0. A Pearson Chi-square test was used for evaluation of the hypothesis that the distributions under observation were equal. All tests were performed as two-tailed tests with a 5% level of significance. Conventional methods were used for calculation of median, mean and standard deviation.

RESULTS

From the case records, fourteen patients had to be excluded, seven of whom had had a rupture of the anterior cruciate ligament verified arthroscopically (one was characterized as partial and one had certainly occurred after the initial examination), three had been successfully operated for a plica synovialis, two for osteochondritis dissecans, one for Sinding-Larsens disease ; osteoarthritis was found in another patient. Two patients refused to participate in the investigation.

The remaining 250 patients were presumed to have PFPS, 122 (49%) females and 128 (51%) males, with a mean age of 21.1 years (median 18, SD 9.6, range 10 to 51 years) at the time of diagnosis. The average duration of symptoms before the initial examination was 11.8 months (SD 19.5, range 1 to 252 months). Thirty-four (14%) patients had a history of trauma, 12 (5%) a history of overuse. We followed these 250 patients for an average of 5.7 years (SD 2.2, range 3.2 to 12.1 years).

Sixty-eight (27%) patients, 17 (25%) females and 51 (75%) males, stated that the pain had disappeared. Apart from 10 patients who did not state when the pain disappeared, and 11 who received additional treatment besides our recommendations, the pain disappeared on an average of 8.1 months (fig. 1). Twenty (8%) patients who had been symptomatic for more than 12 months became pain-free using no other treatment than the one recommended in the clinic.

Among the remaining 182 (73%) patients still complaining, 95 (52%) had experienced decreased pain, 64 (35%) stated that the pain was unchanged and 23 (13%) claimed an increase in pain. In 101 patients, the pain was bilateral and for 81 patients unilateral. Referring to the most painful knee, 68 (37%) described the pain as mild, 88 (48%) as moderate and 26 (15%) as severe.

Sixty-seven (42%) stated that they were able to cope with the pain.

Table I lists the pain frequency and fig. 2 illustrates the symptoms.

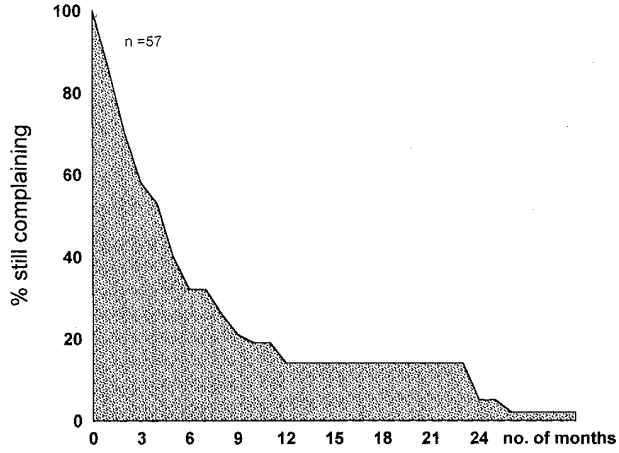

Fig. 1. — Kaplan-Meier plot showing the proportion of 57 athletes becoming pain-free versus time in months.

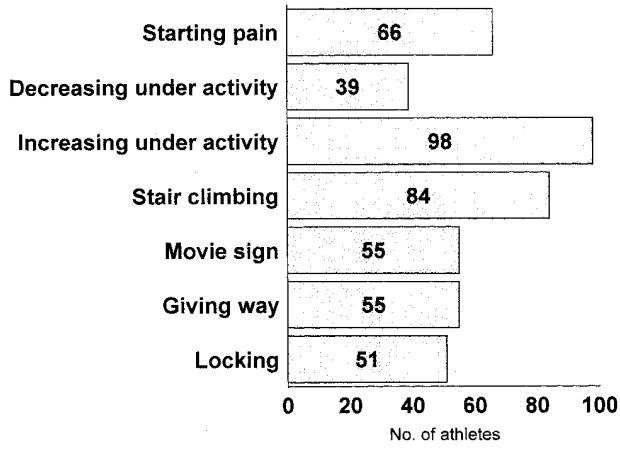

Fig. 2. — The distribution of pain-giving activity at follow-up among 182 (73%) athletes still with complaints.

Table I. — The frequency of symptoms at follow-up among 182 *(73%)* athletes still with complaints

Frequency	Number (%)
All the time	3 (1.6)
Daily	37 (20.4)
Weekly	21 (11.5)
Monthly	4 (2.2)
Periodic	117 (64.3)

Sixteen patients (6%) stated that the disorder had influenced their occupation ; 13 of them had been forced to change their employment to a less physically demanding one.

Athletic activity was affected in 185 (74%) cases : 58 (23%) took a break, 57 (23%) were forced to compete at a lower level, 19 (8%) had to change to another type of athletic activity, and 50 (20%) were forced to stop.

Table II shows a more detailed distribution referring to prognosis, frequency of symptoms and consequences for job and sport.

One hundred five (58%) patients still experienced pain used various patella-stabilizing braces, mostly Genutrain and Rehband, but generally the specifications of the types were imprecise. Seven (4%) used tape. Fifty-one experienced a positive effect of a brace, while 27 experienced a minor effect only ; 27 did not state their opinion.

Figure 3 shows the distribution of various types of treatment. Among the patients still complaining of pain, 80 (44%) only received the treatment recommended initially by the sports clinic.

Table III shows correlations between the persistence of pain and different parameters. Patients with bilateral pain reported less pain ($p = 0.002$). Compared with patients having bilateral pain, patients with unilateral pain stated more frequently that they had learned to live with the pain ($p = 0.0004$).

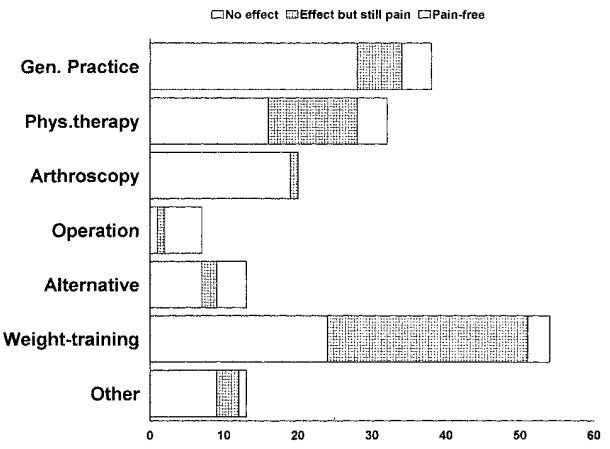

Fig. 3. — The selections of treatment (s) among the 133 out of 250 athletes with PFPS who sought other kinds of treatment after the visit to the sports clinic. Thirty-four athletes had more than one type of treatment, whereas 117 did not seek treatment.

Sixty-two percent of the patients reduced their athletic activity and this group differed from the group of patients (38%) who did not reduce their athletic activity, by experiencing more pain ($p = 0.002$), more frequent pain ($p = 0.006$), giving way ($p = 0.03$) and locking ($p = 0.02$). Among the correlations we found between findings and symptoms, a tight lateral retinaculum and a movie sign correlated slightly ($p = 0.04$) ($n = 112$).

Table II. — The distribution of four different pain levels at follow-up among 250 athletes presumed to have PFPS, compared with prognosis, frequency of pain and how it influenced employment and sports (having to compete at a lower level, to change sport or to discontinue)

	None (n = 68)	Mild (n = 95)	Moderate (n = 64)	Severe (n = 23)
Evolution				
Better		57	10	1
Unchanged		34	39	15
Worse		4	15	7
Frequency				
Daily		7	21	12
Weekly / Monthly		11	11	3
Periodic		77	32	8
Influence				
Job	1	3	10	2
Sport	16	50	45	16

Table III. — Correlations between different parameters and the outcome *pain* / (no pain). For the first four parameters n = 250 ; for the last nine parameters n = 112

Predictors	r	P
Gender	- 0,30	0,00009
Age	- 0,11	0,11
Duration of symptoms in months	0,14	0,04
History of trauma	0,03	0,61
Increased Q-angle	0,16	0,06
Grating	0,04	0,66
Peripatellar Tenderness	0,11	0,20
Tight Lateral Retinaculum	0,04	0,71
Patella Grinding	0,14	0,08
Effusion	- 0,15	0,08
Patella Alta	- 0,02	0,76
Hypermobile Patella	0,23	0,042
Vastus Medialis atrophy	- 0,15	0,07

DISCUSSION

Our findings concerning symptoms, frequency and prognosis are, in many ways, comparable with the results of Karlson (19), Hvid *et al.* (15), Devereaux and Lachmann (6) and Sandow and Goodfellow (31). In short, PFPS affects both sexes, and is frequently periodic. With self-training alone, approximately 25% become pain-free, a further 25% remain slightly affected and almost 50% remain considerably affected.

We have to point out that we did not inquire about the compliance with self-training, so whether the outcome was caused by the training or was a spontaneous improvement, we cannot say, but this could be an element for further investigation. In comparison to Yates and Grana (41), who in a corresponding study found the patients to be non- or partially compliant in about two-thirds of the cases, it seems likely that the compliance in our study has been low too. If this is true, the data from our study would approximate the natural course of PFPS in athletes fairly well.

Regarding previous and future studies without groups of controls, it is important to note that we found 20 patients with more than a year of symptoms who became pain-free without any additional treatment. Furthermore it is important to recall that 64% were only troubled by periodic pain, meaning there is a considerable risk of coincidental improvement, if the period of observation is too short.

Some new investigations have been undertaken, and in an athletic population, PFPS affected an equal number of males and females. With respect to becoming pain-free, the prognosis for males was more than twice as good compared to females, but no further differences were found between the sexes. Regarding the pain, athletes with a hypermobile patella seem to have a less good prognosis (table III, $r = 0.23$ $p = 0.04$). It seems that athletes with a tight lateral retinaculum have complaints more often of the movie sign. Contrary to Kannus and Niittymäki (18) we did not find a correlation between age and the outcome.

Patients with unilateral problems reported more pain, but on the other hand, a larger number of these patients accepted living with the pain, compared with patients suffering bilateral pain. Not surprisingly, patients with moderate to severe pain complained more frequently of locking and movie sign (but not of giving way or pain climbing stairs). They were also forced to discontinue athletic activities more frequently than patients with mild pain. Sixteen athletes stopped having pain and 49 athletes experienced a decrease in pain when the activity was reduced, which points to a relationship between the level of activity and PFPS ; this is in line with previous studies (1, 3, 9, 11, 27, 33). It must be noted however that in 78 cases, the pain was unchanged or worse in spite of a reduction in activity.

In our study, only 14% presented a history of trauma. This figure is on the low side compared with other studies (4, 5, 19, 30) which found an incidence between 30 and 50%.

If one considers that only 16 (6%) patients mentioned interference between the disorder and their employment, this leads to the conclusion, that PFPS affects daily living only to a minor degree. However, when considering the sensation of pain and its influence on sports activities, many patients are severely troubled. Even in the category of patients with a decrease to only mild pain or periodic pain, 41% indicated that they were forced to discontinue or change their athletic activities,

or to compete at a lower level. The same situation applies to 27% of the athletes who became pain-free. According to fig. 3, the highest percentage of withdrawal from sports was seen in the cutting disciplines, such as soccer, handball and ice hockey.

How much time is necessary for a recovery using only self-training ? Twenty-four percent of the patients became pain-free with the conservative approach, and apart from 7 of them, this occurred within one year (see fig. 1). Two-thirds were cured after only 6 months. We believe that if the treatment is initiated with a self-training program and there is no improvement after about 3 to 6 months, a more active approach is appropriate, particularly in the group characterized by moderate pain, periodic, or more frequent pain. This finding supports Fulkerson (13), who recommends various types of physiotherapy after 4 to 6 weeks of self-training. If there is still no improvement, a more intensive exercise program should be initiated (23, 35, 38-40), although a more thorough examination including x ray or MRI must be considered, and the diagnosis must be questioned once again.

The chance of becoming pain-free was less when a history of more than four months of pain was present. Therefore, when a patient presents with a long history of pain, a more active approach could be indicated initially.

Figure 3 presents the epidemiological behavior of the PFPS patient, and for a number of reasons no conclusion should be made based upon the differences in success between these treatments. Fifty-six percent of the patients have gone elsewhere for treatments. An explanation for this rather high figure could be that this group of patients often lacks information regarding etiology, treatment and prognosis of their knee pathology, and only few professionals seem to be able to give this information in a convincing fashion. In addition some patients search for a more precise diagnosis, to which they can better relate, as for example, a meniscal lesion.

Apparently more than 50% of the patients used a knee brace or tape, and many experienced a positive effect, despite the conflicting results regarding the use of knee braces in some previous studies (3, 11, 20-22, 29, 35, 36, 40).

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SAMENVATTING

L. BLØND, L. HANSEN. Femoropatellaire pijn in atleten : een 5,7 jaar retrospectief nazicht.

Bij 250 atleten gezien in de sportkliniek (49% vrouwen en 51% mannen) met de diagnose van femoropatellaire pijnsyndroom (PFPS) werd een vastus medialis training aangeleerd.
Zij stuurden een ingevulde vragenlijst na een gemiddelde van 5,7 jaar terug.
68 (27%) waren zonder pijn na een gemiddelde van 8,1 maand.
Bij de 182 anderen, hadden 52% een duidelijke vermindering van pijn, 35% hadden geen verandering en bij 13% was er zelfs een toename qua pijn.
Bij 37% werd de pijn als licht, bij 48 als matig en bij 15% als ernstig geëvalueerd. De sportactiviteit werd bij 74% der gevallen beïnvloed door dit pijnprobleem, tewerkstelling slechts in 6%.
De prognose was niet gecorreleerd met een voorgaand trauma of met de leeftijd. Atleten met een hypermobiele patella hadden een minder goede prognose.
Voor ongeveer de helft van de atleten was de prognose goed, alhoewel de andere helft slechts een onvoldoende resultaat met deze zelftrainingsprogramma's kon bekomen.

RÉSUMÉ

L. BLØND, L. HANSEN. Les douleurs antérieures du genou chez les athlètes : étude rétrospective de 250 athlètes avec un recul de 5,7 ans.

Deux cent cinquante athlètes — 122 (49%) de sexe féminin et 128 (51%) de sexe masculin — ont été suivis dans une clinique du sport avec un diagnostic de syndrome douloureux antérieur du genou ; ils ont reçu comme instruction de pratiquer un renforcement du vaste médial ; ils ont répondu à un questionnaire après un suivi moyen de 5,7 ans. Soixante-huit (27%) ne ressentaient plus de douleur depuis en moyenne 8,1 mois : 17 femmes (25%) et 51 hommes (75%). Parmi les 182 autres (73%) qui avaient encore des plaintes, 95 (52%) avaient noté une diminution de leur douleur, 64 (35%) n'avaient noté aucun changement et 23 (13%) avaient noté une augmentation de leur douleur. Soixante-huit (37%) décrivaient la douleur comme légère, 88 (48%) comme modérée et 26 (15%) comme importante. L'activité athlétique était affectée dans 184 cas (74%), l'activité professionnelle dans 16 cas (6%). Aucune relation n'a été notée entre le pronostic et un antécédent traumatique ou l'âge. Le pronostic était moins bon chez les athlètes qui avaient une rotule hypermobile ($r = 0,23$; $p = 0,04$). Le pronostic était bon pour la moitié environ des athlètes, mais le programme d'autotonification musculaire a donné un résultat décevant dans près de la moitié des cas.