

Prognosis of patellofemoral pain in adolescents: a case report

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ABSTRACT

Introduction: Patellofemoral pain is a common condition in adolescents and may significantly impact their activities of daily living. **Methods:** A literature search was performed using the PubMed database including the terms “knee pain,” “patellofemoral pain syndrome,” “patellofemoral pain,” and “anterior knee pain” combined with “prognosis” and “natural history.” Three relevant articles were identified including individuals aged 13-18 years. **Case presentation:** An active 14-year old female presented to the chiropractic clinic after being diagnosed with this condition by her general practitioner. The family wanted to know the long-term prognosis of the condition and if anything could be done, as the general practitioner had suggested that the condition would resolve on its own. **Intervention:** Home exercises were prescribed along with advice to temporarily suspend participation in physical education classes and consider orthotics. Soft tissue therapy and mobilizations of the knee joint were also applied. **Outcomes:** Despite these efforts, this patient continued to suffer from these complaints, though with reduced intensity, three years after the onset. **Discussion:** Three prospective studies examining the prognosis of this condition in a young population exist. Though heterogeneous in design, the evidence suggests that the course of patellofemoral pain in adolescents and young adults does not appear to be self-limiting in nature and its prognosis appears to be worse than that of other non-traumatic knee conditions. **Conclusion:** Early intervention appears to improve the chances of recovery, therefore chiropractors should be aware of this condition’s unfavorable prognosis and the urgency of initiating treatment in a timely manner.

Key Words: Patellofemoral pain syndrome, adolescent, knee pain.

Introduction

Knee pain is a common reason for which adolescents visit primary care providers,¹ with patellofemoral pain affecting approximately 6-7% of adolescents, and accounting for almost half of adolescent knee complaints.² The diagnosis of patellofemoral pain is made with peripatellar or retropatellar anterior knee pain of insidious onset provoked by activities such as long periods of sitting, kneeling, squatting, running and stair climbing.³

Traditionally, patellofemoral pain in adolescents has been regarded as a benign, self-limiting condition.^{4,5} However, one longitudinal study of female adolescents with patellofemoral pain showed that 78% continued to suffer from knee pain even after a long mean follow-up time of 16 years,⁶ indicating that the prognosis might not be as good as previously believed.

This work presents the case of an adolescent female presenting with patellofemoral pain, with consideration for the most recent evidence surrounding the prognosis of this condition in adolescents.

Methods

A search of the literature was performed using the PubMed

database. The following search terms were used: “knee pain,” “patellofemoral pain syndrome,” “patellofemoral pain” and “anterior knee pain” combined with the terms “prognosis” and “natural history.” Filters were used to limit the search to human studies of adolescents (ages 13-18 years). Hand searching of reference lists of relevant articles was also performed to identify additional relevant literature. Inclusion criteria included English language, publication between the years 2000 and 2019 and a prospective study design. Studies of a solely adolescent population were scarce, so it was decided that those including a young adult population (older than 18 years of age) along with adolescents (13-18 years of age) would not be excluded. In total, three relevant articles were identified.

Case Presentation

A 14-year old female presented with a new complaint of severe pain localized to the retropatellar area of her right knee at a consultation previously planned for maintenance care and monitoring of a scoliosis. There was no history of trauma, but the patient was highly active, cycling approximately 40 kilometers every school day and swimming recreationally once per week.

Approximately four weeks after the onset, mother had con-

sulted their general practitioner, who told them her pain was related to growth and would simply resolve on its own, not offering any further treatment options. At their next planned chiropractic appointment approximately two weeks after consulting the general practitioner, the family wanted to know whether chiropractic treatment could be of benefit for these complaints and whether the general practitioner's opinion about the complaints was correct.

Evaluation

No swelling or redness was visible, and pain was reproduced with patellar compression and palpation of the medial articular surface of the patella. An obvious pes planus deformity was present, with slight adduction and internal rotation of the thighs when standing.

Intervention and Outcomes

As a first step in approaching her complaint, the patient was provided with home exercises for her quadriceps, with particular focus on strengthening of the vastus medialis muscle. Since her transport to school required cycling, advice was given to stop participation in physical education classes for at least the next two weeks in order to allow some of the irritation to subside. A subsequent visit was scheduled at the usual interval of care, two months later, with the expectation that the knee pain would have diminished by then. At that moment, no obvious reason seemed present to lead one to expect that her complaint might become chronic.

At the next visit, the complaints had not resolved. Since the pain remained quite intense and an obvious pes planus deformity was present, a suggestion was made to consider having orthotics made by another practitioner. Soft tissue therapy for the vastus medialis and popliteus muscles and mobilizations of the knee joint were also applied. Due to other circumstances, her next appointment took place five months later. While it was hoped that physical rest during the summer vacation might have helped in her recovery, not much progress had been made. She admitted to very rarely doing her home exercises, but said that this was because the exercises were too painful to complete. As a result, more emphasis was put on proximal exercises for the hip musculature, which have been found to be effective in

more recent studies⁷ and were less painful for her to complete. (See Table 1.)

Her mother was also encouraged to try to monitor the home exercises. These changes resulted in greater compliance with the home exercise program and ultimately a decrease in the patient's subjective pain level. While able to continue participating in swimming, she also admitted that she limited the intensity with which she took part as a result of the pain. At follow-up three years after her initial presentation with this complaint, the patient reported some remaining symptoms, though these were mild in frequency and severity.

Discussion

The identified evidence is clear that while some patients with patellofemoral pain recover, a large proportion of affected adolescents and young adults continue to experience pain and disability in the long term and that the prognosis for patellofemoral pain tends to be worse than for other non-traumatic knee conditions.^{8,9,10} (See Table 2, pages 1532-1533).

When followed over a two-year period, adolescents with patellofemoral pain had a significantly higher risk of continued pain than subjects with other types of knee pain (Relative risk (RR) of knee pain at follow-up=1.26 (95% CI, 1.05-1.50)).¹⁰ They also reported more frequent and intense pain at follow-up than the subjects with other types of knee pain, though all types of baseline knee pain raised the risk of knee pain at follow-up (RR=4.51 (95% CI, 3.15-6.45)).¹⁰ Similarly, a longitudinal study of adolescent and young adult patients showed a worse prognosis for patellofemoral pain patients, with 40% experiencing persistent symptoms and only 19% of patients with unspecified knee symptoms experiencing persistent pain six years after study.⁹ Therefore, the evidence does not appear to support the assertion that patellofemoral pain is self-limiting. Rather, it suggests a high risk of chronicity for this condition.

Evidence also exists to suggest that the largest improvements in pain and functional outcomes for patellofemoral pain tend to occur during the first three months of follow-up^{8,9} which suggests that if patients are likely to recover ei-

Treatment Strategy	Challenge Encountered
Quadriceps strengthening exercises (particular emphasis on vastus medialis)	Too painful to complete, low adherence
Orthotics suggested	Costly
Relative reduction of use of knee	Commute to school required almost daily cycling
Proximal exercises (hip abduction strength)	Compliance/motivation to complete exercises doubtful

Table 1. Strategies Implemented in Treatment of Female Adolescent with Patellofemoral Pain and Associated Challenges

ther spontaneously or with treatment, that it will generally occur at an early stage. These findings point to the existence of a critical period in which interventions might have a better chance of success. Unfortunately, patients with non-traumatic onset of pain are known to be less likely to seek care.¹⁰ This, along with the erroneous belief that the condition is benign and self-limiting, are possibly barriers to the delivery of appropriate care and recovery.

When considering the relevant literature and the patient in this case, it did not appear that the information and advice that this family had received from their general practitioner was consistent with the current best evidence. Rather, the evidence seemed to suggest that early intervention was appropriate, rather than a “watch and wait” management style which would be indicated if this condition were truly self-limiting. A longer history of knee pain at baseline (more than two months of pain) has been identified as the most consistent predictor of poor outcome^{8,12} supporting the notion that early intervention may be desirable in order to attempt to avoid chronicity. Considering this knowledge, it seems that more frequent chiropractic appointments were probably indicated in the period following this patient’s presentation with this new complaint.

Exercise therapy is generally recognized as the mainstay of conservative treatment for patellofemoral pain, though the evidence for its efficacy is not of particularly high quality and focuses mainly on adults.^{13,14} Quadriceps exercises with a particular emphasis on the vastus medialis muscle, have traditionally been the most commonly used exercise approaches.¹⁵ Such exercises had been initiated with this patient. However, considering that her complaints had been present for a relatively long period before they were mentioned at a chiropractic appointment, this delay in initiating treatment might have negatively impacted her clinical outcome.

The response to exercise therapy in adolescents also seems to differ from that in older patients. One randomized trial using a physical therapy intervention demonstrated that 81% of patients aged 18-40 years reported moderate to marked improvement at 12 month follow-up on a global rating scale¹⁶ while similar interventions in a trial including patients aged 15-19 years resulted in only 38% self-reported recovery at 12 months.¹⁷ Adolescents have also been found to comply poorly with treatment recommendations. Low participation rates in supervised training sessions and low compliance rates with recommendations for home exercises were observed in the Rathleff (2015) trial, even though the study setting had significant supports in place to encourage compliance.¹⁷ However, those adolescents with the best home exercise adherence were found to have markedly better rates of clinical improvement (Odds ratio = 4.04, 95% C.I. 1.42 to 11.55).¹⁷ Clinicians may therefore need to find

innovative ways to improve adolescent adherence to treatment, which could involve strategies such as involving parents in monitoring home exercises, restricting screen time until exercises are completed, scheduling more frequent in-office visits or using time in physical education classes to do exercises.

Further concern about this patient’s situation arose from the existence of some evidence suggesting that patellofemoral pain may have more serious long-term consequences. One theory suggests that anterior knee pain in early life may lead to osteoarthritis of the knee in adulthood¹⁸ with a retrospective study showing a strong relationship between anterior knee pain in young adulthood and development of patellofemoral osteoarthritis later in adulthood.⁴ A systematic review failed to identify sufficient high-quality evidence for a causal relationship, but concluded that the two conditions might at least have some shared biomechanical risk factors including alignment issues in the lower limb, patellar tracking issues and muscular dysfunction¹⁹ making it conceivable that this theory might be applicable at least in certain individual cases.

Some research suggests that there is cause for concern about the long-term effects of this pain condition on adolescent females in particular. Altered pain processing mechanisms resulting in higher sensitivity to pain have been found in patients with patellofemoral pain, suggesting that altered central or peripheral pain processing mechanisms may play a role in this condition, particularly in female.^{20,21} This is of concern, due to the potential of this mechanism to contribute to other generalized pain conditions.

Other important effects of knee pain have been recognized including lower health-related quality of life scores in the adolescent and pre-adolescent population²¹ and decreased activity levels in participation in sport.^{10,23} Adolescents suffering from patellofemoral pain are more likely to reduce their participation in sports than patients with other forms of knee pain.¹⁰ The risk of low physical activity levels may be of particular concern in the female adolescent population. Females are affected by knee pain at higher rates than males^{3,11} and girls tend to be less active than boys throughout childhood and adolescence, with rates of activity declining faster in girls than boys during the teenage years.²⁴ This may have significant short and long term effects, as inactive teens may not achieve the activity levels required for them to reap the many recognized positive benefits on their physical and mental health.²⁵ Furthermore, levels of physical activity in early life tend to track into adulthood, possibly leading to adult sedentariness which may raise the risk of chronic conditions like obesity, osteoporosis, cardiovascular disease and diabetes.²⁶

Contrary to what the evidence suggested, there was little

Study Title	Study Design	Study Results	Conclusion
<p>Rathleff et al. 2016, Is Knee Pain During Adolescence a Self-limiting Condition? Prognosis of Patellofemoral Pain and Other Types of Knee Pain</p>	<p>Population-based cohort study. Initial population of 2846 Danish high school students screened for knee pain using a questionnaire. Those meeting inclusion criteria, invited for a clinical examination by an experienced rheumatologist (to diagnose specific knee condition). At 2-year follow-up, the 504 adolescents (16-18 years of age) with knee pain who had successfully been contacted at study initiation and 252 randomly selected individuals (acting as controls) from the initial cohort were invited to answer an online questionnaire</p> <p>Inclusion criteria: history of anteriorly located knee pain of at least monthly frequency and insidious, non-traumatic onset</p> <p>Exclusion criteria: concomitant injury, pain from the hip, lumbar spine or other knee structures, self-reported patellofemoral instability, knee joint effusion</p> <p>Outcomes measured at intake: Location of pain throughout body; Frequency of pain — as a surrogate for pain severity (rarely, monthly, weekly, more than once per week, almost daily); participation in leisure-time sport outside of school physical education (days per week), EuroQoL 5-Dimensions (age specific health-related quality of life measure)</p> <p>Outcomes measured at 2-year follow-up:</p> <p>Primary outcome: worst pain in the last week as measured on visual analog scale (VAS).</p> <p>Secondary outcomes: leisure-time sport participation per week, Knee Injury and Osteoarthritis Outcome Score (KOOS), Physical Activity Scale (PAS) and EQ-5D.</p>	<p>77% of initial population responded to questionnaire. 670/2200 respondents reported knee pain at least monthly, 504/670 were successfully contacted to assess eligibility. 180/204 invited for clinical examination accepted invitation and 172 were examined. 153 were diagnosed with patellofemoral pain (PFP) and 121 adolescents with a mean age of 17 years were enrolled in a randomized cluster trial. 351 adolescents with other causes of knee pain (traumatic and non-traumatic) were not included in the randomized trial. -79.6% completed the follow-up questionnaire with dropout analysis showing no significant differences between those who completed and those who did not.</p> <p>-55.9% of adolescents reporting knee pain at baseline also reported pain at 2-year follow-up, while 12.8% of those without knee pain at baseline reported pain at follow-up. Risk of continued pain was higher in those with PFP than other types of knee pain (Relative Risk (non-adjusted)= 1.26 [95% CI, 1.04-1.50]; RR (adjusted for age, sex and BMI)=1.24 [95% CI, 1.04-1.49])</p> <p>Risk of continued pain was higher for all patients with knee pain compared with those without knee pain (RR unadjusted=4.51 [95% CI, 3.15-6.45]; RR (adjusted)=4.47 [95% CI, 3.11-6.43])</p> <p>Those with PFP at baseline had higher frequency of daily knee pain (33% vs. 24%) and knee pain several times per week (22% vs. 13%) and 13 mm higher median pain intensity on VAS at follow-up when compared to those with other types of knee pain.</p> <p>PFP affected knee pain patients had higher rates of reduced or discontinued sport participation (71% vs. 52%) compared to patients with other types of knee pain. In those without knee pain, 55% reduced or discontinued participation during the same period</p> <p>EQ-5 ratings were not significantly different between groups with knee pain at follow-up, though knee pain patients had significantly lower EQ-5 ratings than those without at follow-up.</p> <p>Univariate model was used to examine prognostic factors and found: female adolescents not participating in sports with low EQ5D scores, high frequency of pain and long-standing knee pain at baseline were those at highest risk of continued pain at 2-year follow-up.</p>	<p>PFP seems to have a worse prognosis than other types of knee pain. History of frequent knee pain also significantly raises the risk of knee pain at follow-up.</p> <p>The evidence from this study does not support the conclusion that PFP is a self-limiting condition.</p>
<p>Kastelein, M. et al. 2015, The 6-year trajectory of non-traumatic knee symptoms (including patellofemoral pain) in adolescents and young adults in general practice: a study of clinical predictors</p>	<p>Prospective, observational cohort study of 1068 consecutive patients presenting to the general practitioner (GP) with a new episode of knee pain. Initial follow-up period was 1 year, but extended to 6 years due to findings of a high rate of persistent symptoms.</p> <p>Inclusion criteria: patients aged 12-35 years, consulting GP for with a new episode (defined as presenting to GP for the first time or recurrent knee symptoms for which the GP had not been consulted in the past 3 months) of non-traumatic knee pain (further classified as either “unspecified knee symptoms” or “patellofemoral knee symptoms” by GP)</p> <p>Exclusion criteria: Knee symptoms requiring urgent medical attention (fracture, infection, malignancies, neurological disorders etc.) and patients incapable of understanding ramifications of study participation</p> <p>Outcome measures: Self-report questionnaire at baseline, 3,6 and 9 months and 1 and 6 year follow-up collecting demographic data, history of other knee injuries, and information on symptoms, sick leave days, level of physical activity, pain level on numerical rating scale (NRS) At 1 and 6 years, experienced recovery or worsening of symptoms were also rated (measured on 7-point Likert scale).</p> <p>Functional disability and pain assess with Western Ontario and McMaster Universities Osteoarthritis Index</p>	<p>172 patients were included (74 patients with a mean age of 23.7 years for PFP and 98 patients with a mean age of 25.1 years for unspecified knee pain (UKP))</p> <p>Loss to follow-up was sizeable with only 55.1% of UKP patients and 60.8% of PFP patients available at 6 years (compared to 86.7% and 87% at 1 year). No significant differences between baseline characteristics or perceived recovery were found between those initially recruited and those available at 1 and 6 year follow-up</p> <p>There were also no significant differences in perceived recovery at 1 year between the groups available at 1 and 6 years of follow-up. In both knee pain groups, greatest improvements on mean pain, Lysholm knee score and mean WOMAC index occurred in the first 3 months of follow-up.</p> <p>In UKP group: At 1 year follow-up, 41% reported persistent knee symptoms with mean pain severity on NRS 3.6 (SD 2.2), mean Lysholm knee score 71.6 (SD 17.4) and mean WOMAC 16.1 (SD 16.9). At 6 year follow-up, 19% reported persistent knee symptoms, with 40% being the same knee symptoms</p> <p>In PFP group: At 1 year follow-up, 57% reported persistent knee symptoms with mean pain severity on NRS 3.7 (SD 2.3), mean Lysholm</p>	<p>Many patients with non-traumatic knee symptoms (including PFP) continue to experience pain 6 years after diagnosis.</p> <p>The prognosis for PFP seems worse prognosis than for other types of non-traumatic knee pain.</p>

	(WOMAC) at baseline and 1-year follow-up, Knee Injury Osteoarthritis Outcome Score (KOOS) at 6 year follow-up, Knee Society Score (KSS) function questions, Medical Outcomes Study Short Form 36 Health Survey (SF-36), Lysholm Knee Scoring Scale and Tampa Scale for Kinesiophobia (only at baseline).	knee score 75.3 (SD 15.4) and mean WOMAC 16.2 (SD 15.4) At 6 year follow-up, 40% reported persistent knee symptoms, with 78% of these being the same knee symptoms.	
Collins, N.J. et al. 2013, Prognostic factors for patellofemoral pain: a multicenter observational analysis	Data was extracted from two separate RCTs investigating the effectiveness of conservative therapies for PFP, including data from 179 participants from RCT#1 and 131 from RCT#2 (both with 12-month follow-up). Subjects in the RCT#1 received prefabricated foot orthoses, flat shoe inserts, multimodal physiotherapy or foot orthoses with physiotherapy while those in RCT#2 received exercise therapy or "usual care" with both groups receiving education on the condition and advice to avoid aggravating activities. Inclusion criteria: Age of participants varied (RCT#2 required a minimum age of 14 years while RCT#1 required a minimum age of 18 year). Insidious onset of anterior knee or retropatellar pain with a duration longer than 6 weeks aggravated by a minimum of 2 of the following that load the patellofemoral joint (prolonged sitting, kneeling, squatting, running, cycling and stair climbing). Exclusion criteria: other defined knee pathology such as osteoarthritis, patellar tendinopathy, Osgood-Schlatters disease and a history of a physiotherapy intervention in the last year. Outcome measures assessed at 3 and 12 month follow-up: pain severity (on a 100 mm VAS scale), function (assessed by the Anterior Knee Pain Scale and the Functional Index Questionnaire) and global recovery assessed dichotomously (favorable or unfavorable recovery, extracted from two different Likert scales used in the two RCTs)	Participants in RCT#2 were significantly younger than RCT#1 (mean age of 29.3 vs. 24.0 years), participated in significantly more sport (p=0.022) and had a lower BMI (p<0.05). Method of recruitment also differed significantly with more from RCT #2 having been recruited by health professionals (p<0.002). Participants in RCT#2 also had a shorter duration of complaints (p<0.001) and worse symptoms on the Anterior Knee Pain scale. -55% of participants reported unfavorable outcome at 3 month follow-up and 40% reported an unfavorable outcome at 12 months. -Fewer than 40% of the subjects had been randomized to minimal intervention or control arms of the study, suggesting that this condition is not self-limiting (at least not within 12 months of follow-up). -Mean pain severity decreased from 35/100 to 26/100 between 3 and 12 months (60.9/100 at baseline). The largest improvements on pain severity as well as AKP and FIQ appear to occur in the first three months of follow-up, with only modest change observed thereafter. -The following baseline predictor values were found to be associated with unfavorable recovery at 12 months: symptom duration greater than 2 months, baseline AKP scale score <70/100 and pain severity greater than 35/100 (usual pain/at rest) or greater than 60/100 (during worst pain/physical activity).	PFP does not appear to be self-limiting in this population and its prognosis is not favorable in all patients, even with intervention. Largest improvements in symptoms appear to occur in the first 3 months of follow-up. Only a portion of the variance in outcomes could be accounted for with the predictors studied, suggesting that other factors must be involved in determining prognosis.

Table 2: Prospective Studies Examining the Prognosis of Patellofemoral Pain in Populations Which Included Adolescents.

risk of low physical activity levels in this case, as eliminating her bicycle commute to school was not an option for this family.

The most widely accepted theory proposes that patellofemoral pain is caused by patellofemoral maltracking, causing increased stress on the patellofemoral joint, with various causes of patellar tracking issues proposed, generally involving muscular weakness or alignment issues in the lower limb.^{7,15} It seemed that a decrease in activity might actually be indicated in this patient's situation, in order to limit irritation at the patellofemoral joint. As a result, advice was given to temporarily stop participating in physical education classes and where possible, abstain from other

activities which aggravated her pain, while continuing her home exercises.

Conclusion

Treatment of patellofemoral pain in adolescents presents unique challenges and even with good quality treatment, it seems that the risk of chronicity remains great. Ideally, treatment aims to strike a balance between encouraging healthy movement and optimizing participation in sport and other physical activity while avoiding excessive irritation of the knee. Clinicians should be aware of the potential long-term effects of these types of complaints and attempt to tailor their treatment to the patient's individual situation to achieve the best possible outcome.

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