Original Clinical Article

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Current practice trends in the surgical management of patellofemoral instability: a survey of the Paediatric Research in Sports Medicine (PRiSM) Society

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Abstract

Purpose: Patellofemoral instability (PFI) in young athletes presents both diagnostic and management dilemmas for which consensus often does not exist. The purpose of this study was to identify trends in management of PFI in children and adolescents in the United States and nationwide.

Methods: A 27-question multiple choice survey was distributed in 2018 to the members of the Pediatric Research in Sports Medicine (PRiSM) Society regarding treatment of PFI in paediatric and adolescent patients.

Results: In all, 56 of the respondents who were orthopaedic surgeons that manage patellar instability in children and adolescents and had performed PFI surgery more than five times in the past year completed the entire survey. A total of 41% of respondents reported that surgery for fragment refixation or loose body removal was indicated when a loose body or osteochondral fragment was evident, regardless of fragment size. Overall, 74% reported that if surgery was performed for an osteochondral loose body, primary repair (36%) or reconstruction (38%) of medial patellofemoral ligament (MPFL) was also completed. A total of 89% of members reported MPFL reconstruction in the absence of alignment or rotational abnormalities, tibial tubercle lateralization or trochlear dysplasia in skeletally immature patients; 59% reported performing the MPFL reconstruction with hamstring allograft, while 30% prefer autograft (hamstring, quadriceps). For patients with significant trochlear dysplasia, 87% reported no surgical management of trochlea in first-time or in revision surgery.

Conclusion: There is a lack of consensus regarding optimal diagnostic and treatment algorithms in the management of PFI, however, consistent trends have emerged among paediatric sports medicine surgeons.

Level of Evidence: Level V – survey of expert opinion and experience

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Introduction

Patellofemoral instability (PFI) accounts for approximately 3% of all clinical representations involving the knee, with approximately 70% of patella dislocations happening during sports.[1] As youth sports continue to progress in intensity and participation, PFI is now commonly seen in the paediatric and adolescent population. PFI occurs during sports where the leg internally rotates relative to a fixed foot, however, it may also occur from direct trauma to the medial patellar surface.[2] Following this injury, treatment of PFI can be either surgical or non-surgical. A randomized clinical trial of nonoperative and operative treatment of primary acute patellar dislocation supported a non-surgical approach for a first-time dislocation.[3] Following a second dislocation, however, a repeat episode of PFI increases by 50%.[1,4] Stabilization procedures typically indicated for patients who have recurrent PFI despite attempted non-surgical management including physical therapy, bracing and activity modifications.[5]

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Although surgical treatment is common for PFI, there are a variety of surgical techniques that continue to make the management of this condition non-standardized and complex. Preference of techniques will also vary among surgeon regardless of existing treatment algorithms. This study aims to understand current trends in the management of PFI in the paediatric and adolescent patient, with a special focus on surgical technique considerations.

Materials and methods

A survey was created to assess the experience of paediatric orthopaedic surgeons' treatment of PFI in paediatric and adolescent patients. Questions were created by members of the Paediatric Research in Sports Medicine Society (PRiSM) Patellofemoral Instability Research Interest Group (PFI RIG). The 27-question multiple-choice online survey (carried out using SurveyMonkey (One Curiosity Way, San Mateo, CA) was distributed via email to orthopaedic surgeon members of PRiSM in 2018 (see supplementary material). The survey was sent via email three times over a six-week time span after which the survey was closed. Members were asked about clinical and imaging evaluation, methods of nonoperative treatment, surgical indications and surgical techniques when treating PFI. The first two questions were created as 'op in/out' questions to ensure surveys were being answered by surgeons that take care of adolescents with patellofemoral disorders. Some questions were allowed only one response, while other questions allowed multiple options to be chosen.

Results

Of the 65 PRiSM members, 56 (86%) were orthopaedic surgeons that manage patellar instability in children and adolescents and who had performed PFI surgery more than five times in the past year responded and completed the entire survey.

Osteochondral fragment treatment

Overall, 89% reported obtaining a MRI in addition to standard radiographs (48% for trace knee effusion on exam, 21% if an osteochondral fragment is apparent on the radiograph, 20% for all patients regardless).

A total of 89% reported that surgery was indicated if an osteochondral fragment is apparent on imaging in a first-time patellar dislocation (41% anytime there is evidence, 32% if fragment size is large enough to be problematic, 16% urgently even if greater than three weeks after injury). In all, 74% reported that if surgery is performed for an osteochondral loose body, primary repair (36%) or reconstruction (38%) of the medial patellofemoral ligament (MPFL) was also completed.

In the absence of an osteochondral fragment in first-time traumatic patellar dislocations, 87% reported nonoperative management that included immobilization using a knee immobilizer (32%) and bracing which included patellar stabilization braces (30%) and hinged knee braces (25%). Nonoperative immobilization and bracing was used for one week (11%) to up to four weeks (16%), with the most common reported time being two weeks (34%). In total, 18% of members reported immediate physical therapy and no immobilization.

Moreover, in the absence of an osteochondral fragment, 50% of members indicated the need for surgical intervention for patients who remain symptomatic despite physical therapy and activity modification regardless of number of prior patellar instability or dislocation events, while 30% indicated it for patients with two or morepatellar instability events (Table 1).

Preoperative assessments

Radiographs (81%) were preferred over CT and MRI (12%) for preoperative assessment of patella height. Full length hips to ankles was ordered by 39%, regardless of the physical examination, and 54% reported ordering one when the physical examination suggested an angular anomaly. Evaluation of rotational profile was most commonly assessed solely by the physical exam (52%), and tibial tubercle lateralization was preferably assessed on MRI (89%). Trochlear dysplasia was assessed through MRI (82%) and additional lateral (52%) and sunrise (43%) radiographs were frequently ordered as well. The Beighton scoring system was most commonly used (82%) to asses ligamentous laxity, and skeletal maturity was assessed by evaluating physes around the knee via knee radiographs (75%) or MRI (30%) or by utilizing the Greulich and Pyle atlas via a hand and wrist radiograph (54%).

MPFL reconstruction: indication and surgical details

In all, 89% of members reported MPFL reconstruction in the absence of alignment or rotational abnormalities, tibial tubercle lateralization or trochlear dysplasia in skeletally immature patients, of which 49% reported using a different technique from skeletally mature patients for patients with open growth plates and 12% reported performing an MPFL reconstruction using the quadriceps turndown technique and soft-tissue fixation at the femur. The most common graft used for MPFL reconstructions was hamstring allograft (59%) followed by hamstring autograft (23%) and quadriceps allograft (11%).

The most common graft fixation technique for skeletally immature children at the femur was an interference screw (52%) followed by suture anchor fixation (26%) and fixation without the use of hardware (15%). For graft fixation on the patella, suture anchor fixation (54%) was the

Table 1 Osteochondral fragment treatment

Treatment	Percentage (%)
Imaging obtained:	
Standard radiographs and MRI	*89*
1+ knee effusion on exam	*48*
Osteochondral fragment is apparent on radiograph	*21*
All patients regardless	*20*
Surgical treatment if:	
Presence of osteochondral fracture on imaging and first-time patellar dislocation	*89*
Any time there is evidence	*41*
Fragment size is large enough to be problematic	*32*
Urgently even if greater than 3 wks after injury	*16*
If surgery was completed for osteochondral loose fragment, MPFL surgery was also completed:	
MPFL repair	*36*
MPFL reconstruction	*38*
No additional procedures to address patellar instability	*27*
In the absence of osteochondral fragment:	
Nonoperative treatment	
Physical therapy (no bracing)	*18*
Immobilization using knee immobilizer	*32*
Patella stabilization brace	*30*
Hinge brace	*24*
Duration of bracing:	
1 wk	*11*
2 wks	*34*
Up to 4 wks	*16*
Surgical treatment still required if:	
Patient remains symptomatic despite physical therapy and activity modification	*50*
2+ patellar instability events	*30*

MPFL, medial patellofemoral ligament

most common. Interference screw fixation and fixation without implants (both 18%) were also reported.

The most common graft fixation technique for skeletally mature patients at the femur was the interference screw (76%) followed by suspensory fixation (11%) and suture anchor fixation (9%). For graft fixation on the patella, suture anchor fixation (54%) was the most common followed by interference screw fixation (20%) and fixation with bone tunnels (16%).

The femoral tunnel location was determined by using a combination of anatomical inspection, fluoroscopy and isometry (53%), or by using fluoroscopy on lateral knee radiograph (44%) in both skeletally mature and immature patients.

Additional procedures: indications

Members reported performing a tibial tubercle anteromedialization procedure based on tibial tuberosity-trochlear groove (TT-TG) distance alone (34%), when TT-TG exceeded 15 mm (13%) or 20 mm (27%), and by axial MRI assessment (16%). A lateral release was indicated when the patient's patella could not be reduced back to a neutral translated and tilted central position in the trochlea exam (33%) and along with the MPFL reconstruction if there is preoperative patellar tilt on exam or imaging (22%). Rarely, and only when indicated, was lateral lengthening performed instead of a lateral release (16%). Angular deformity correction was reported based on radiographs and performed as a staged procedure (21%), and in patients with significant trochlea dysplasia, no surgical management was the most common answer (87%).

Discussion

The treatment of paediatric and adolescent PFI continues to change for orthopaedic surgeons. The rate of PFI occurs in 29 to 43 per 100 000 patients between ten and 17 years of age.[1,6] Our respondent data demonstrated that there continues to be discrepancies in surgical practice patterns that exist.

For a nonoperative approach, patients that are skeletally immature and sustain an initial, acute patellar dislocation have been shown to not benefit from surgery.[3,7] If a patient has no ostechondral loose body in a first time patellar dislocation, none of our participants chose the option for surgery for patellar stabilization. Nietosvaara et al[6] found that the redislocation rates were similar between nonoperative (71%) and operative groups that underwent a primary MPFL repair and concomitant lateral release (67%). Moreover, a study conducted by Lewallen et al[8] that included 222 knees reported early operative treatment for 24 knees (10.8%) and nonoperative treatment for the remaining cases (89.2%). Operative treatment primarily consisted of an arthroscopy and loose body removal with or without chondroplasty (nine) or arthroscopy, loose body removal and open MPFL repair (ten). Of the 24 cases treated with initial surgery, 33% (eight) had recurrence of PFI. In the nonoperative group there was

a 38.4% recurrence of PFI, of which 51.3% went on to have surgical intervention.[8] Functional outcomes remain equal between the two treatment options following a first-time dislocation.[9,10] However, a previous randomized trial demonstrated improved clinical and patient-reported outcomes with MPFL reconstruction compared to nonoperative treatment. The operative group reported no recurrences or subluxations and mean Kujala score of 88.9. In contrast, the nonoperative group presented 35% recurrence and subluxations and a mean Kujala score of 70.8 at a minimum two-year follow-up, making the surgical technique used another important factor to consider before attempting surgical intervention.[11]

Although there is a lack of concordance in the literature regarding nonoperative treatment of PFI, standard of care treatment includes activity restriction (immobilization), physical therapy and patellar bracing.[12] These options are in line with the answers that we received. There was a wide variability regarding the type of immobilization which included knee immobilizer, knee hinge brace or patellar stabilization brace rather than knee immobilization. The general consensus is to proceed with nonoperative treatment for a first time patellar dislocation, ultimately assessing patient symptoms, comfort level and desire to return to their sports.

Surgical intervention is an appropriate option if the patient continues to have recurrent patellar dislocations, remains symptomatic and has exhausted all options for nonoperative treatment. Due to the complexity of patellar instability, challenges may arise when deciding surgical treatment techniques. After non-surgical management, recurrent instability continues to be common in the paediatric population.[13] A study done in 2000 found that following primary patellar dislocation, 58% of patients proceeded to have limitations with activity and 55% did not return to sports.[14] In the current literature, there seems to be an awareness that there is a high rate of re-dislocations following nonoperative treatment.

Radiographs are often essential when diagnosing a paediatric patient with PFI. Anteroposterior views are best to evaluate overall lower extremity alignment while lateral views are best to assess for trochlear dysplasia. Overall, most of our participants (89%) would order a MRI in addition to a standard knee radiograph series, however, the indication for ordering an MRI differed. When planning for surgery, MRI is useful in detecting avulsion fragments, structure of the MPFL, assessing articular cartilage and patellar and trochlear dysplasia. If an osteochondral defect is noticed in imaging (radiograph or MRI), surgical intervention is often required. Loose osteochondral fractures pose difficulty from a mechanical standpoint and can lead to early chondral wear.[15] If a loose body is identified, a surgical indication to treat the MPFL is also considered as it is commonly stretched or torn in dislocation events.

If surgery was performed for osteochondral loose fragment treatment, most of our respondants performed a concomitant MPFL surgery (74%). Interestingly, the surgical technique used was split, consisting of either a reconstruction (38%) or a repair with the medial retinacular structures (36%). Although MPFL repair poses minimal risk of femoral physeal injury, studies have shown that repair shows weakness in biomechanical tests compared with patients who underwent reconstruction.[15,16] Moreover, a recent study conducted by Pedowitz et al[17] revealed that children have a 61% recurrent instability rate following an MPFL repair alone, while MPFL reconstruction retrospective series have demonstrated low failure rates with favourable clinical outcomes and return to sports rates.[17-19] If the surgeon chooses to go with reconstruction, they must also choose whether autograft or allograft will be used. When the surgeons in our population were asked about their MPFL reconstruction techniques, they were split between a hamstring allograft and hamstring autograft. One study compared patient outcomes in both hamstring allograft and hamstring autograft tendons and found that there were no significant differences in return to play activity, pain score changes and incidences of failure.[20] This retrospective study and our survey results continue to lean toward the trend of surgeon and patient preference.

Patients with recurrent PFI often have a risk factor for trochlear dysplasia and can often result in further subluxation or recurrent dislocation. Indications for trochleoplasty are variable and the procedure is questionable in skeletally immature patients because of the concern for potential injury to the distal femoral physis. It is unsurprising that our respondents reported not performing surgery of the trochlea dysplasia in first time surgery (46%) or revision (41%). Literature has shown that there are different procedures for trochlear dysplasia, however, they are also associated with technical demands and potential complications resulting in poor clinical outcomes.[21-23] Further research and education for surgeons should be initiated to outline technical steps of trochleplasties, as this is an expanding area of interest among surgeons and researchers.

This study proved to be limited by having participants self-report leading to recall and low sample size. We were unable to compare our results with the results of another study to assess the trends in management of PFI over a time period. However, our survey reached the acquired target population; paediatric orthopaedic surgeons with a clinical focus in sports medicine who are actively practicing. The survey was taken by surgeons across the country, gathering interesting trends in the treatment of PFI. Future high quality studies should aim to prospectively and longitudinally look at different surgical treatment groups and should enquire about specific elements and risk factors that contribute to PFI. This specific patient population

should be followed to identify if there are any demographics that may cause an increase in PFI and overall outcomes after returning to sports.

This study demonstrates that there are differences in treatments nationwide regarding PFI. The results discussed convey the management and treatment of the PRiSM PFI RIG, experts in this field. However, this study makes no comparative claims of one treatment over the other. Patient differences cannot be fully defined in survery thus reporting different preferences only allows for better understanding of the surgical technical considerations and will help better understand current trends in the management of PFI.

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COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval: This article does not contain any studies with human participants performed by any of the authors. This study was carried out with approval from the Institutional Review Board of our institution.

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AUTHOR CONTRIBUTIONS

CDV: Study design, Created survey questions, Edited the manuscript for publication.
JLP: Study design, Created survey questions, Edited the manuscript for publication.
JR: Study design, Created survey questions, Edited the manuscript for publication.
DWG: Study design, Created survey questions, Edited the manuscript for publication.
NS: Completed data gathering, Analyzed the data, Drafted the manuscript.
SHP: Completed data gathering, Analyzed the data, Drafted the manuscript.

SUPPLEMENTAL MATERIAL

Supplemental material is available for this paper at https://online.boneandjoint.org.uk/doi/suppl/10.1302/1863-2548.15.210084

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