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Treatment of Patella Alta in Patients with Episodic Patellar Dislocation: A Systematic Review

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Abstract

Purpose—While there are numerous anatomic contributors to patellar instability, the role of patella alta has been traditionally under-appreciated. The goal of this systematic review is to identify the described techniques for treating patella alta in skeletally mature patients with episodic patellar dislocation (EPD) and review their published results.

Methods—A comprehensive literature review was performed to identify published surgical techniques and their results. Tibial tubercle distalization is the primary described treatment for patellar alta in patients with EPD and five studies reporting results of this procedure were reviewed.

Results—Tibial tubercle distalization was generally successful in normalizing patellar height and preventing recurrent patellar dislocation. Physical examination tests for instability such as patellar apprehension remained positive in 15 to 33% of patients. Patient-reported outcomes were rarely reported and difficult to interpret given the lack of pre-operative values or comparison groups.

Conclusion—Tibial tubercle distalization is an effective technique for correction of patellar height and preventing recurrent patellar dislocations. More comparative studies are required to evaluate patient-reported outcomes of this technique, the effect of an associated tubercle medialization, and the results of supplementing distalization with procedures such as MPFL reconstruction.

Keywords

Patella alta; Patellar instability; Tibial tubercle osteotomy

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Introduction

Numerous anatomic factors have been shown to contribute to episodic patellar dislocation (EPD), including injury to the medial patellofemoral ligament (MPFL),[10] trochlear dysplasia,[6, 7] increased tibial tubercle-trochlear groove (TT-TG) distance,[9] and patella alta.[8, 18, 20, 25] Traditionally an underappreciated contributor to patellar instability, patella alta (defined as a Caton- Deschamps index greater than 1.2) has been noted to be present in 24% of patients with EPD but in only 3% of normal controls.[7] Perhaps more importantly, patella alta has been shown to be a strong predictor of recurrent instability in patients with EPD following conservative treatment[14] or treatment with isolated MPFL reconstruction.[23]

The reason for the association between patella alta and EPD is not entirely clear and is likely multifactorial. Patella alta has been shown to cause decreased contact between the patella and trochlea,[15, 22, 24] contributing to decreased resistance to lateral translation of the patella in these patients.[21, 25] Increased patellar tendon length itself may be the culprit, with increased length allowing a pathologic increase in coronal plane motion of the patella.[18] One study identified increased patellar tendon length (greater than 52 mm) rather than a “too proximal” position of the tibial tubercle in patients with patella alta and EPD.[18]

Despite the large role patella alta may have in the development and recurrence of patellar instability, there has been relatively little published in regards to its treatment. The goal of this systematic review is to identify the described techniques for treating patella alta in skeletally mature patients with EPD and review their published results. Specifically, we will focus on 1) Restoration of normal patellar height, 2) Recurrence of EPD and 3) Patient-reported outcome scores.

Material and Methods

Literature Review

A comprehensive literature review was undertaken to identify clinical series reporting results of surgical treatment of patients with EPD in the setting of patella alta. Studies were excluded if they were basic science studies without clinical data, animal studies, purely imaging studies, studies related to patellofemoral pain rather that dislocation, or studies related to the treatment of patellofemoral osteoarthritis or treatment with arthroplasty.

A MEDLINE literature search performed to identify all publications from January 1, 1966 through October 1, 2012 containing the term “patella alta” yielded 192 results. The title and abstract of these publications were reviewed by a single author and 158 were excluded, including review articles without original data (17); basic science papers (4); imaging studies (31); animal studies (6); studies related to patellofemoral pain (7), osteoarthritis (3), and arthroplasty (6); as well as 83 articles unrelated to patella alta. Full text copies of the remaining 34 articles were obtained and reviewed. Twenty-six articles were excluded because they were not focused on operative treatment of patella alta (14), reported on a mixed population of patients without separating out those with patella alta (8), or were review articles (4). Of the remaining eight articles, one was noted to be a duplicate

publication in English[5] of an article previously published in French.[4] The original French version was used for this review. Two articles that described treatment of patellar alta in skeletally immature patients were also excluded,[1, 2] yielding a total of five articles utilized in this review.[4, 16, 17, 19, 20]

A search of additional databases was undertaken to ensure that no other potentially informative studies were missed. A search for “patella alta” was undertaken in CINAHL, the Cochrane Library, and Scopus. These searches identified no additional studies meeting inclusion and exclusion criteria for this review. Finally, a review of the references of each included study was undertaken and no other potential studies were identified for inclusion.

Data Extraction

A templated literature review form was utilized to assist in data collection. Extracted data included patient demographics, surgical treatment utilized, preoperative and post-operative patellar height measurements and patellar tendon lengths, pre-operative and post-operative patient-reported outcome scores, the incidence of recurrent patellar dislocation following treatment, and the incidence of patellofemoral osteoarthritis at final follow-up. Two authors extracted data independently and discrepancies were resolved by consensus.

Results

Surgical Techniques

The primary described techniques for addressing patella alta in skeletally mature patients is tibial tubercle distalization with or without patellar tendon tenodesis. Tibial tubercle distalization involves the performance of an osteotomy of the tibial tubercle, distalization of the tubercle, and reattachment of the tubercle to the tibia with screws, effectively lowering the patellar height. [4, 16, 17, 19, 20] A concurrent medialization of the tubercle is also frequently performed if the TT-TG distance is increased. One can consider tenodesing the patellar tendon into the initial location of the tibial tubercle to effectively shorten the patellar tendon as well.[17] Other associated procedures were frequently performed in association with tubercle osteotomy in the patients in these series, including advancement of the vastus medialis (three studies) and more recently reconstruction of the medial patellofemoral ligament (one study). Decreasing patellar height through advancement of the patellar tendon insertion has also been described in the pediatric population; however, this review focuses on treatment options in skeletally mature patients.[2]

Outcomes

There are five published series of tibial tubercle distalization for recurrent patellar instability currently in the literature.[4, 16, 17, 19, 20] The studies were retrospective and included between 15 and 80 knees. Combined, the studies include 203 knees in 168 patients. Mean follow-up ranged from 4.5 to 9.6 years, with followup rates above 80% when reported.

Radiographic Evaluation of Patellar Height and Patellofemoral Osteoarthritis

The five studies each focused on patients with patellar alta as determined with either the Caton-Deschamps index[3] or the Insall-Salvati ratio.[13] All five studies demonstrated that

tibial tubercle distalization is an effective means of normalizing patellar height (Table 3). Several cases of over-correction to an index of less than 1.0 were reported in each series; however, no patients were reported below the defined threshold for patella infera in these series. Radiographic evidence of patellofemoral osteoarthritis was noted in less than 15% of patients at follow-up, while the incidence of patellofemoral osteoarthritis at the time of surgery was not generally reported.

Recurrent Dislocation and Persistent Patellar Apprehension

Each of the five studies reported very low risk of recurrent patellar dislocation (range 0% to 4.9%; overall risk: 1.75%). Each of the three studies that reported the incidence of patellar apprehension at final follow-up noted it to be significantly higher than the risk of recurrent dislocation. Apprehension was noted in 15 to 33% of patients in each series (overall risk: 26.3%) (Table 4).

Patient-Reported Outcome Scores

Only three studies included patient-reported outcome score at final followup. Mayer et al reported a mean subjective IKDC score of 75.6,[17] while Marteau et al noted KOOS subscores that ranged form 70 to 97 (Table 4).[16] Prtisch reported Lysholm scores in the good to excellent range in 72.5% of patients.[19] Unfortunately, no studies reported pre-operative scores for comparison.

Complications

Reported complications in the studies in this series include tibial tubercle nonunion (0.6%), proximal tibia fracture (0.6%), infection (1.2%), phlebitis (0.6%), and deep vein thrombosis (0.6%).

Discussion

This review assesses contemporary treatment options for and results of treatment of patella alta in skeletally mature patients with EPD. Patients undergoing treatment for EPD should undergo a careful assessment of their anatomy with attention to all predisposing factors for dislocation as has been described in detail by H. Dejour et al.[7] Those with significant patella alta (defined by a Caton- Deschamps index[3] greater than 1.2) should be considered for tibial tubercle distalization as a part of their treatment plan. It is important to note that tibial tubercle distalization is not indicated to restore patellar stability in the absence of patellar alta and could results in symptomatic patella infera.

The studies demonstrate that tibial tubercle distalization reliably normalizes patellar height as determined by the Caton-Deschamps index or Insall-Salvati ratio, but does have potential to result in overcorrection and to mild patella infera. It should be noted that as classically defined, the Insall-Salvati ratio is the distance from the tip of the patellar to the tibial tubercle divided by the length of the patella. Distalization of the tibial tubercle should therefore not change this measurement. This limitation of the Insall-Salvati ratio is not mentioned in these studies; however, the post-operative values they report must represent a modification of the Insall- Salvati ratio, likely reflecting the initial position of the tubercle

rather than its distalized position. The Caton-Deschamps Index is not subject to such limitations and we recommend its use in assessing patellar height when tibial tubercle distalization is considered.

Risk of recurrent patellar dislocation are low; however, subtle persistent patellar instability is much more common, as evidenced by a positive patellar apprehension test. The relatively high risk of persistent feelings of instability may be influenced by the choice of proximal soft tissue procedure at the time of surgery. MPFL reconstruction using standard techniques was not typically performed. Instead, either no concomitant soft tissue procedure or an advancement of the vastus medialis obliquus muscle was performed.[11, 12] The impact of soft tissue management on outcome is not certain, but it may contribute to the relatively high rate of persistent patellar apprehension noted in the studies in this review.

Clinical outcome measures were only reported in three of the studies. Good clinical results are possible, but persistent symptoms were reported in the majority of patients. Whether these symptoms stem from persistent feelings of instability without dislocation or the effects of the early osteoarthritis noted in several of the papers is unknown. Unfortunately, the timing of patients' development of osteoarthritis is unknown.

There are several limitations of this review. As with all systematic reviews, the conclusions are limited by the available data. Heterogeneity in the patient populations and treatment techniques between studies and the use of different outcome measures preclude pooling of the data. Further, none of the included studies feature control groups or comparisons to other treatments, nor do any of them report pre-operative patient-reported outcome scores or radiographs for comparison to the post-operative findings. In spite of these limitations, the available data demonstrate tibial tubercle distalization to be an effective tool for correction of patellar height and preventing recurrent patellar dislocation.

Conclusion

Tibial tubercle distalization is an effective technique for correction of patellar height and preventing recurrent patellar dislocations. More comparative studies are required to evaluate patient-reported outcomes of this technique, the effect of an associated tubercle medialization, and the results of supplementing distalization with procedures such as MPFL reconstruction.

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Table 1

Study Demographic Data

Author	Year	Journal	Mean Patient age (Years)	Sex	Initial Cohort	Length of Follow-up (Years)	Percent Follow-up
Mayer	2012	AJSM	20.4 (14–30)	9 male: 16 female	31 knees, 25 patients	9.6 (6–14)	27/31 (87.1%)
Marteau	2011	OTSR	28.2 (16–47)	5 male, 8 female	16 knees, 13 patients	7.5 (2–17)	14/16 (87.5%)
Pritsch	2007	KSSTA	21 (15–54)	26 male, 40 female	80 knees, 66 patients*	6.2 (2–13)	69/80 (86.2%)
Simmons	1992	CORR	12.7 (17–31)	6 male, 8 female	15 knees, 14 patients	4.5 (3–7)	15/15 (100%)
Caton	1990	RCO	17 (13–20)	10 male, 40 female	61 knees, 50 patients	6.2	NR

AJSM = American Journal of Sports Medicine
OSTR = Orthopaedics and Traumatology: Surgery and Research
KSSTA = Knee Surgery, Sports Traumatology, and Arthroscopy
CORR = Clinical Orthopaedics and Related Research
RCO = *Revue* de *Chirurgie Orthopédique* et Traumatologique
NR = Not Reported

*Cohort includes 63 knees with patellar instability at 17 with anterior knee pain

Table 2

Surgical Details

Author	Year	Number Distalized	Distalization (mean)	Number Medialized	Medialization (mean)	Associated Procedures	Complications
Mayer	2012	31/31 (100%)	9 mm (6–16)	22/31 (71.0%)	7 mm (2–11)	VMO advancement and reefing Patellar tendon tenodesis	2 superficial wound injection 1 osteotomy nonunion
Marteau	2011	16/16 (100%)	10 mm (5–20)	14/16 (87.5%)	10 mm (5–20)	MPFL reconstruction via gracilis transfer	1 phlebitis
Pritsch	2007	72/80 (90%)	9 mm (0–18)	80/80 (100%)	16 mm (5–25)	NR	1 osteotomy nonunion 1 proximal tibia fracture
Simmons	1992	15/15 (100%)	20 mm	NR	NR	VMO advancement	1 deep vein thrombosis
Caton	1990	31/61 (50.8%)	7 mm (5–20)	61/61 (100%)	9.5 mm (5–15)	Plasty of the medial retinaculum 3 trochleoplasties	NR

VMO = Vastus Medialis Obliquus
MPFL = Medial Patellofemoral Ligament
NR = Not reported

Table 3

Radiographic Results

Author	Year	Length of Follow-up (Years)	Patellar Height Measurement Method	Pre-op	Post-op	Percent with PF OA
Mayer	2012	9.6 (6–14)	Caton-Deschamps Index	1.22 ± 0.17	0.95 ± 0.22	0/27 (0%)
Marteau	2011	7.5 (2–17)	Caton-Deschamps Index	1.3 (1.2–1.5)	1.03 (0.81–1.17)	2/14 (14.3%)
Pritsch	2007	6.2 (2–13)	Insall-Salvati Ratio	1.26	1.01	NR
Simmons	1992	4.5 (3–7)	Insall-Salvati Ratio	1.58 (1.2–2.1)	1.08 (0.90–1–14)	NR
Caton	1990	6.2	Caton-Deschamps Index	1.34 (1.2–1.66)	1.03 (0.69–1.20)	5/61 (8.2%)

NR = Not Reported

Table 4

Clinical Results

Author	Year	Length of Follow-up (Years)	Recurrent Patellar Dislocation Rate	Positive Apprehension Test	Patient-reported Outcome score	Pre-op	Post-op
Mayer	2012	9.6 (6–14)	0/27 (0%)	9/27 (33.3%)	Subjective IKDC	NR	75.6 ± 9.5 (55.2 to 98.9)
Marteau	2011	7.5 (2–17)	0/14 (0%)	4/14 (28.6%)	SF-36 KOOS-Symptoms KOOS-Pain KOOS-ADL KOOS-Sport/Rec KOOS-QOL	NR	81 (43–88) 93 (39–96) 97 (47–100) 97 (60–100) 70 (35–100) 81 (31–100)
Pritsch	2007	6.2 (2–13)	0/54 (0%)*	8/54 (14.8%)*	Lysholm		72.5% Good/Ex
Simmons	1992	4.5 (3–7)	0/15 (0%)	NR	NR	NR	NR
Caton	1990	6.2	3/61 (4.9%)	20/61 (32.8%)	NR	NR	NR

IKDC = International Knee Documentation Committee
NR = Not Reported
SF-36 = Short Form 36
KOOS = Knee injury and Osteoarthritis Outcome Score
KOOS-ADL = Activities of Daily Living subscale
KOOS-Sport/Rec = Sports and Recreation Function subscale
KOOS-QOL = Knee Related Quality of Life subscale

*Reported only among patients with pre-operative patellar instability