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Challenges of evaluating recurrent patellofemoral instability in a skeletally immature child and the use of roux Goldwaithe procedure case of a “slipping knee cap”: Rare case report

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Abstract

Background: Recurrent Patellofemoral instability (PFI) is a significant disability in the childhood and structural adolescent population. It is mainly due to the high-risk activities involved and the variants of the patellofemoral joint. Numerous surgical procedures to address this instability have been described in skeletally immature patients, with variable outcomes. This has led to considerable confusion in the literature on how to treat patellofemoral problems in children. Here, we present a unique case of a 14-year-old skeletally immature female with recurrent patellofemoral instability. We would like to discuss the challenges in diagnosing the condition and the treatment protocols followed while proposing a unique diagnostic workup protocol to evaluate and decide on surgical intervention for a case of patellofemoral instability.

Case Report: The case is of a 14-year-old skeletally immature female patient with complaints of ‘slipping of the knee caps’. A systematic diagnostic work up was done for evaluating the exact cause of patellar instability along with determination of the pathological structure. The diagnostic work up included a unique chart to document the soft tissue and bony structure status. The diagnostic workup revealed ‘No osseous cause, soft tissue pathology included MPFL tear, Medial retinacular tear, contracted lateral structures and Patella alta. Based on the results of the work up treatment planned was Lateral retinacular release, medial imbrication, Roux goldwaithe procedure and medial femoral epiphysiodesis. Patient was clinically evaluated considering relapse, pre- and postoperative range of motion (ROM), Kujala score, and modified Lysholm score.

Result: The patient was followed up for two years. No relapse of dislocation and an improved ROM was noted. The Kujala score showed significant improvement from a preoperative value of 39 to a mean postoperative value of 92 at the final follow-up and the modified Lysholm score improved from preoperative 55 to postoperative 94. Radiographs performed at the latest follow-up showed a tendency to normalization of all the parameters considered, with a restored patellofemoral congruence and trochlear groove shape.

Hence, the Roux-Goldthwaite procedure is a valid surgical option for the treatment of patellar dislocation in children with only soft tissue pathologies.

Keywords: Recurrent Patellofemoral instability (PFI), childhood and structural adolescent population, slipping knee cap

Introduction

Recurrent Patellofemoral instability (PFI) is a significant disability in the childhood and structural adolescent population [6]. It is mainly due to the high-risk activities involved and the variants of the patellofemoral joint [7]. Numerous surgical procedures to address this instability have been described in skeletally immature patients, with variable outcomes [1]. This has led to considerable confusion in the literature on how to treat patellofemoral problems in children. In a skeletally immature patient, MPFL is the primary passive restraint in the first 20 degree of knee flexion and hence is the main pathological structure [2].

Here, we present a unique case of a 14-year-old skeletally immature female with recurrent patellofemoral instability, who underwent a modified Roux-Goldthwaite procedure along with the release of contracted lateral structures respectively. We would like to discuss the challenges in diagnosing the condition and the treatment protocols followed while proposing a unique diagnostic workup protocol to evaluate and decide on surgical intervention for a case of patellofemoral instability.

Case Report

The case is of a 14-year-old skeletally immature female patient who came with complaints of right knee pain due to an alleged history of trauma that happened two years back. She complains of 'slipping of the knee caps'. She had multiple

episodes of trivial injury to the right knee in the last two years and hence was referred to our hospital from a peripheral hospital. Clinically, J sign, patellar maltracking, and positive apprehension test were noted (Fig 1). All of the necessary radiological investigations were carried out.



Fig 1: 'Slipping knee caps'- Elicitation of J sign in flexion to extension arc

Radiologically the Right patella was defined as a Wiberg type 2. There was significant lateral subluxation of the Right patella noted on Merchants view (Fig 2 and Fig 3). No

significant trochlear dysplasia was noted. For further evaluation, an MRI evaluation was also done along with CT cuts.



Fig 2: Ap and Lateral View of Right Knee

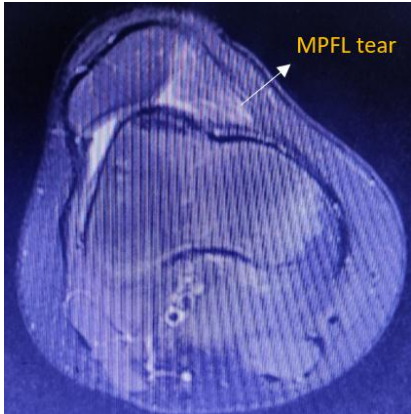
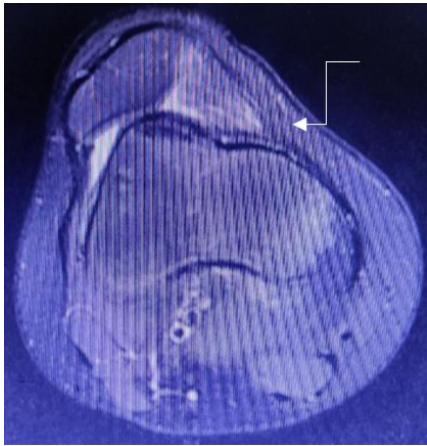

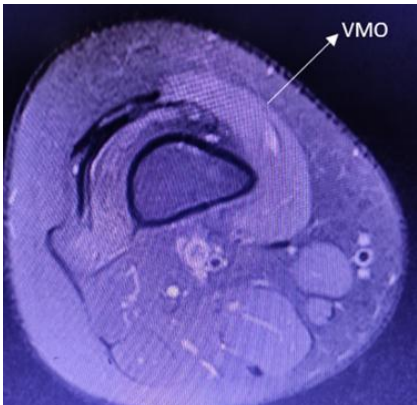


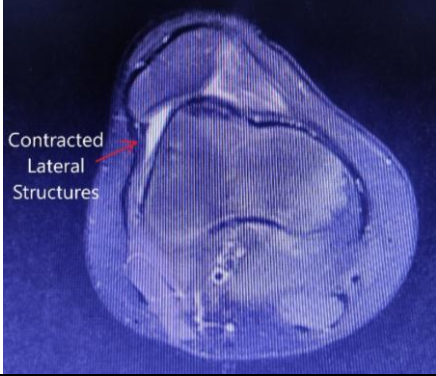
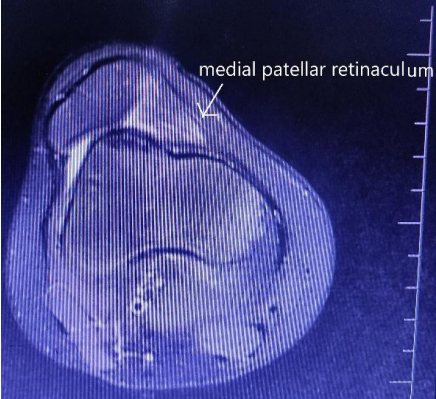
Fig 3: Skyline View Right Knee Showing Lateral Subluxation of ight Patella

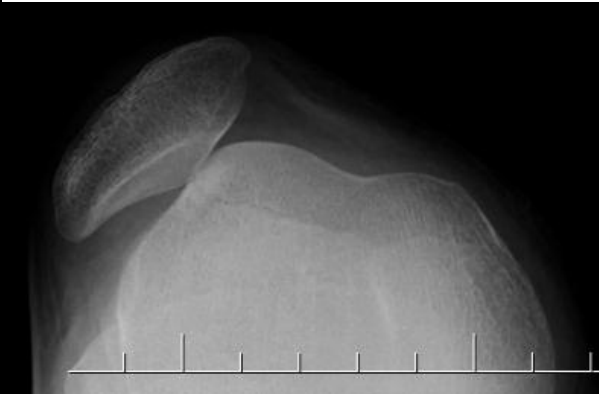
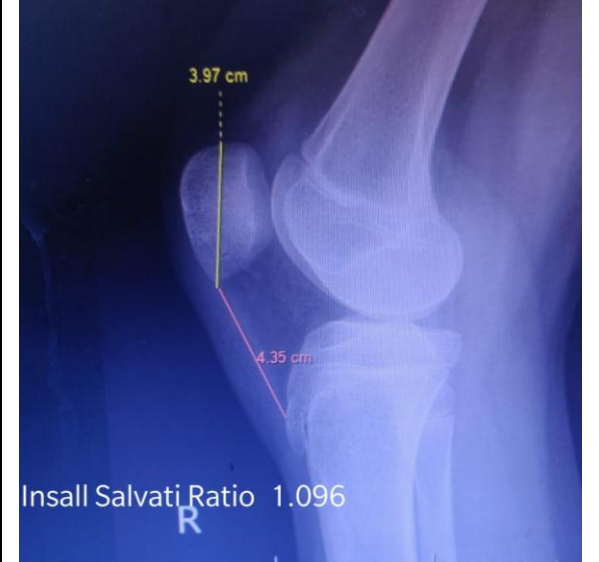
A systematic diagnostic work up was done for evaluating the exact cause of patellar instability along with determination of


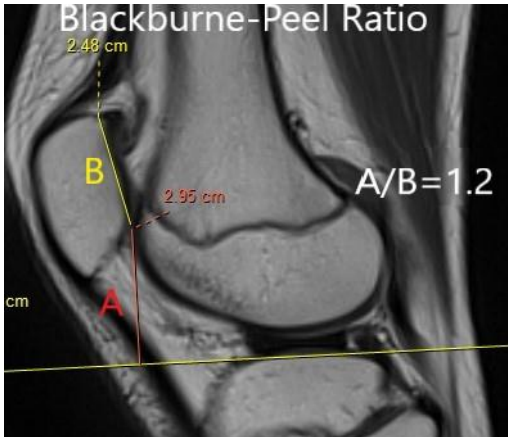
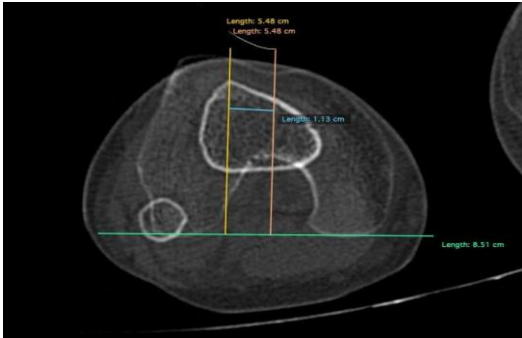
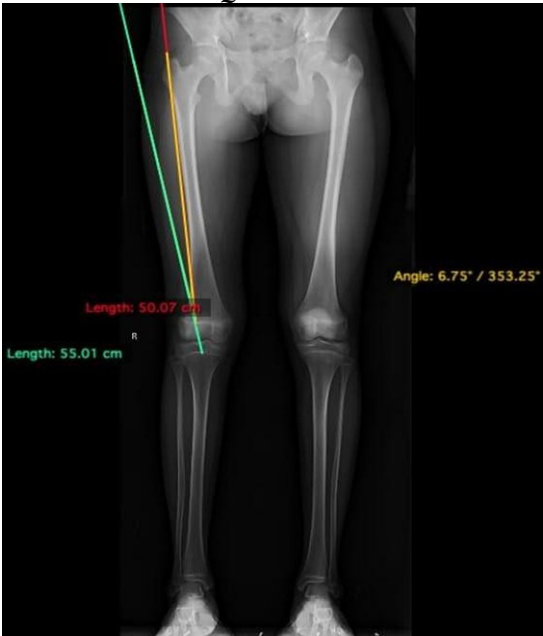
the pathological structure.

Diagnostic Work up

Soft tissue evaluation	Inference
Generalized laxity Brighton Score	No Generalized Laxity
Status of MPFL 	Partial MPFL Tear Noted
Patellofemoral and Patellotibial ligament evaluation 	Medial Patellofemoral Ligament Tear Mainly Inferior Fibres
Obers Test 	Negative No Iliotibial Band Tightness
Status of VMO 	No Vmo Hypoplasia

<p style="text-align: center;">Lateral Structures</p> 	<p style="text-align: center;">Contracted Lateral Structures</p>
<p style="text-align: center;">Medial Structures</p> 	<p style="text-align: center;">Medial Patellar Retinaculum Tear Noted</p>

Bony Evaluation	Inference
<p style="text-align: center;">Trochlear Status</p> 	<p style="text-align: center;">No trochlear Dysplasia noted</p>
<p style="text-align: center;">Insall Salvati Ratio</p> 	<p style="text-align: center;">Patella Alta Noted</p>

<p style="text-align: center;">Caton Deschamps Ratio</p> 	<p style="text-align: center;">Patella Alta Noted</p>
<p style="text-align: center;">Blackburne Peel Index</p> 	<p style="text-align: center;">Patella alta noted</p>
<p style="text-align: center;">Rotational Limb Alignment TT:tg RATIO-</p> 	<p style="text-align: center;">Tt:tg ratio normal No rotational Abnormality</p>
<p style="text-align: center;">Axial Limb Alignment Q ANGLE</p> 	<p style="text-align: center;">No genu valgum or other axial limb deformity</p>

<p>Sulcus Angle</p> 	<p>Normal</p>
<p>Patellar Dysplasia</p> 	<p>Wimberg type 2 patella</p>

Inference of diagnostic work

Result	No osseus cause Mpfl tear + Medial patellofemoral ligament tear + Medial retinacular tear + Lateral structures contracted + Patella ALTA
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Decision on surgery

Even though there is no consensus on the best surgical technique to use, surgical management is deemed necessary.

Considering skeletal immaturity, the surgical procedure should regard only soft tissues.

Structures Damaged	Management
Contracted lateral structures	Lateral retinacular release
Medial structures torn Mpfl partial tear	Medial imbrication
Patellar dysfunction Patella Atla Patellar instability	Roux Goldwaihte procedure
To prevent possibility of medial femoral epiphysal over growth	Medial femoral Epiphysiodesis

Surgical Procedure



Fig 1: Palpation and marking of anatomic landmarks including the patella, patellartendon and tibial tubercle anteriorly with a planned 12 cm midline incision.



Fig 2: Patellar tendon is marked along the centre and longitudinally with a 10 no. Scalpel



Fig 3 and 4: The lateral half is whip-stitched and passed infero-medially to form a Roux pattern, flap in pes anserinus to burry translated half of patellar tendon with free end sutured to periosteum

The patient was operated on under general anaesthesia and an incision size of 7-8 cm was made over the right knee. The lateral tendon release was done in addition to medial advancement of vastus medialis obliquus (VMO) along with medial imbrication of the patella (**Roux-Goldthwaite procedure**) and epiphysiodesis. Post-surgery, an above-knee slab application was carried out, which was converted to an above-knee cast application on suture removal. The cast was removed after one month. (*Fig 1, 2,3, 4*)

Post operative protocol

The postoperative protocol consisted of knee fixed casting for three weeks; and post cast removal, a knee splint was applied for a further three weeks, with 0–30° of motion allowed and then removed for active movement exercises. After three weeks, patients were allowed to progress from partial to full weight-bearing. On regaining full range of movement, a progressive return to normal activities was allowed with the protection of a patellar brace for another four weeks.

Range of motion

	Pre-op	Post-op (3 Week)	Post-op (6 Weeks)
Lateral patellar deviation (mm)	6.5mm	0mm	0mm
J sign	Positive	Negative	Negative
Knee flexion	100 degree	Could not be assessed	120 degree

Knee extension	10 degree	Could not be assessed	 <p style="text-align: center;">Full range</p>
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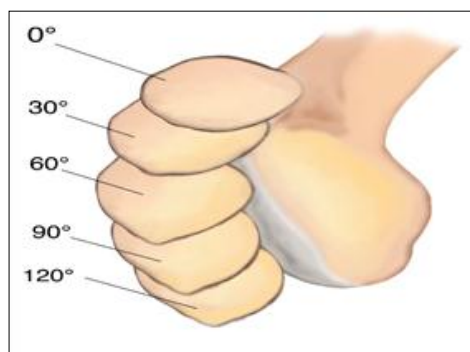
Post-op X-ray



Fig 5 and 6: post-op x-ray of knee showing distal femoral epiphysiodesis done. (The screw is in turn removed after 3 months)

Discussion

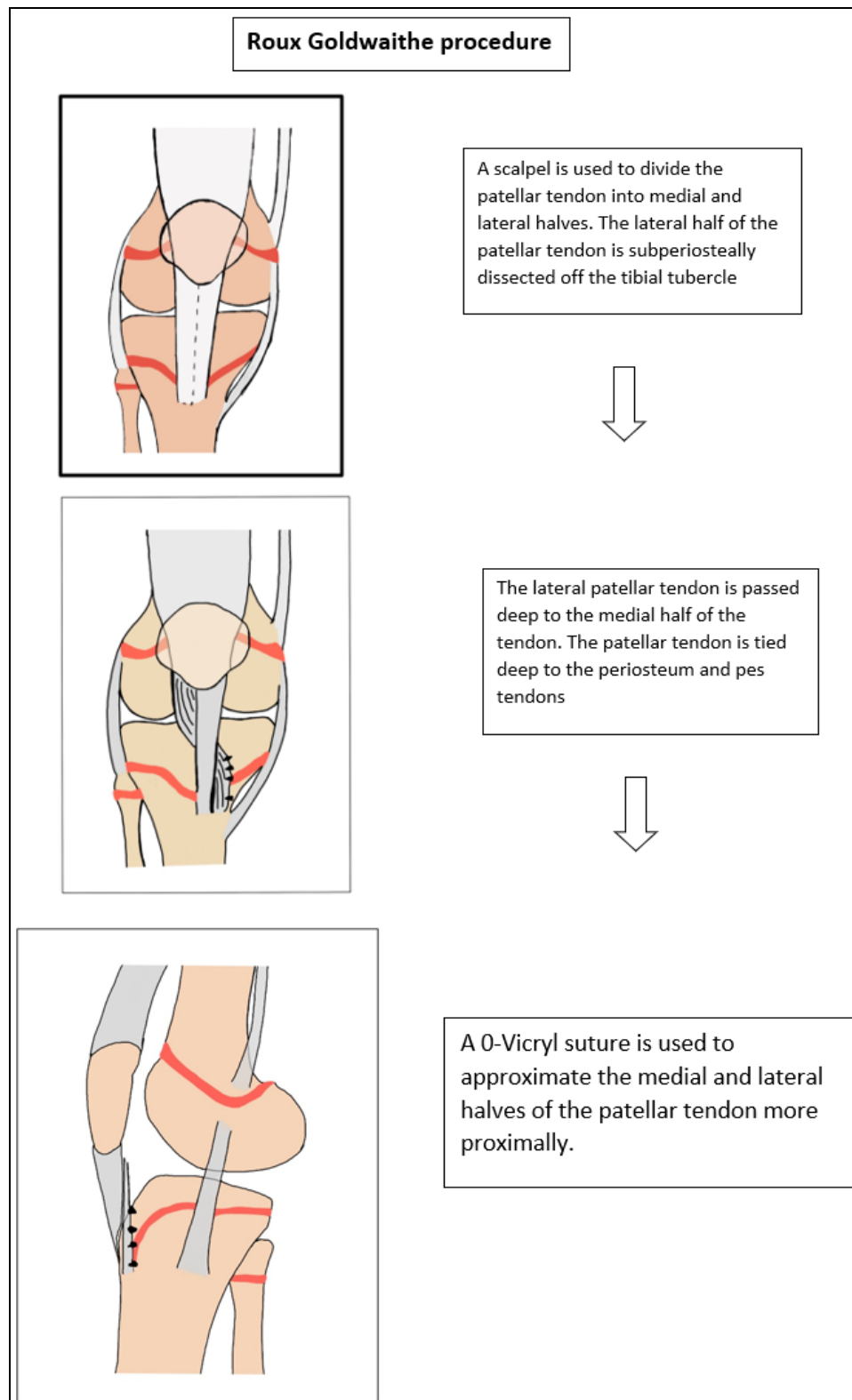
- Among children and adolescents, patellar dislocation is the most common acute knee disorder. The challenges faced in treating patellar instability in a skeletally immature patient are due to the open physis. Due to concerns for physeal damage, surgical techniques to treat PFI in skeletally immature patients rely primarily on soft tissue procedures. Patellofemoral dislocation is common in the pediatric population occurring at the rate of 29 per 1 lakh patients between the ages of 10 and 17 years. Previous patellar dislocation, ligamentous laxity, open physis, and trochlear dysplasia all represent risk factors for recurrence with rates as high as 69%.



- All the necessary investigations were carried out and the patient was diagnosed to have a lateral subluxation of the patella with patella alta with a tear of the inferior fibers of

MPFL and medial patellar retinaculum. The patellar alta or high-riding patella is clinically associated with patello-femoral dysfunction and is considered a predisposing factor for the development of patello-femoral instability. It is a positional fault defined most simply as the superior displacement of the patella within the trochlear groove of the femur. It is hypothesized that one of the causes of patella alta is abnormally long patellar tendons (>52mm). With radiograph measurements, patella alta is defined as a Caton-Deschamps index (CDI) of > 1.2 to > 1.3, an insall-salvati index (ISI) of > 1.2, a Blackburne-peel index (PBI) of > 1.0. A large tibial tuberosity to trochlear groove distance (TT-TG) implies a large quadriceps vector (Q angle) and greater lateral displacement force on the patella during knee motion. A TT: TG of greater than 20 mm measured on computed tomography is a significant cutoff associated with recurrent patella dislocations and is thus an indication for surgical interventions.

- In the pediatric population, when considering a multitude of available surgical techniques, a thorough understanding of the distal femoral and proximal tibial physes, as well as the TT apophysis, is critical. Distal realignment procedures include the modified Roux-Goldthwait, Galeazzi, and Nietsvaara techniques. These procedures are often combined with proximal realignments, including medial imbrication and lateral retinacular release. In this particular case, we have used a modified Roux-Goldthwait procedure for distal realignment by detaching the lateral half of the patellar tendon from the TT and passing it medially under the patellar tendon. The tendon was sutured to the medial tissues and periosteum at the junction of the medial TT and pes anserine insertion. But the increased rotation and tilt of the patella remained uncorrected with this procedure.
- Temporary epiphysiodesis which aims in maximizing growth potential was performed for the same patient in order to avoid osteotomies after growth is complete. Genu valgum is a known risk factor for patellar instability and hence correction of genu valgum in isolation or in addition to medial soft tissue procedures decreases the risk of recurrent instability.



Conclusion

The patient was followed up for two years. No relapse of dislocation and an improved ROM was noted. The Kujala score showed significant improvement from a preoperative value of 39 to a mean postoperative value of 92 at the final follow-up and the modified Lysholm score improved from preoperative 55 to postoperative 94. Radiographs performed at the latest follow-up showed a tendency to normalization of all the parameters considered, with a restored patellofemoral congruence and trochlear groove shape.

Hence, the Roux-Goldthwait procedure is a valid surgical option for the treatment of patellar dislocation in children with only soft tissue pathologies.

MPFL: Medial patellofemoral ligament

VMO: Vastus Medialis Obliquus

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