

A RARE CASE OF HABITUAL DISLOCATION OF PATELLA OPERATED WITH 4 IN 1 QUADRICEPS TUBEPLASTY

Orthopaedics

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ABSTRACT

Habitual dislocation of the patella (HDP) is a rare developmental condition in children characterized by repetitive, painless lateral displacement of the patella during knee flexion. This case report describes a 9-year-old girl with longstanding gait abnormalities, frequent falls, and knee instability, eventually diagnosed with HDP due to soft tissue imbalance and quadriceps contracture, without underlying bony deformity. Given her skeletal immaturity, a growth-preserving "Four-in-One Quadriceps Tubeplasty" was performed, consisting of lateral retinacular release, Roux-Goldthwait patellar tendon hemitransfer, modified Insall's quadriceps tubeplasty, and quadriceps slide lengthening. These components addressed all contributing factors to the dislocation, including soft tissue tethering, malalignment, and extensor mechanism shortening. Postoperative recovery was uneventful, with progressive rehabilitation initiated after cast removal. At six months, the patient demonstrated full extension, over 130 degrees of flexion, excellent patellar tracking, and a normalized gait without recurrence or complications. This case highlights the effectiveness of Four-in-One Quadriceps Tubeplasty as a comprehensive and physal-sparing surgical solution for complex HDP in skeletally immature patients. By targeting both static and dynamic malalignment through soft-tissue realignment, the technique ensures durable correction, joint stability, and functional restoration, reducing the risk of recurrence and avoiding the growth-related risks of bony procedures.

KEYWORDS

INTRODUCTION

Habitual dislocation of the patella (HDP) is a rare orthopedic condition, particularly in adolescents and young adults, characterized by the repetitive and often painless lateral displacement of the patella during knee flexion. Unlike recurrent dislocations, which are typically post-traumatic, HDP is often congenital or developmental in origin and associated with soft tissue contractures, hypoplasia of the lateral femoral condyle, or malalignment syndromes.¹ This chronic instability can significantly impair knee function and quality of life if left untreated.

Surgical correction is indicated when conservative management fails or when anatomical abnormalities predispose the joint to dislocation. Traditional methods include lateral release, medial plication, or tibial tuberosity transfer. However, in complex cases involving fixed or habitual dislocations, more extensive procedures such as the "4-in-1 Quadricepsplasty" have shown promising outcomes. This technique involves quadriceps lengthening, medialization, capsular tightening, and patellar tendon realignment, providing a comprehensive approach to restore patellar tracking.²

The innovation of combining quadriceps tubeplasty with this 4-in-1 method provides additional structural support by reinforcing the extensor mechanism using the quadriceps tendon itself, a technique that has found growing acceptance, especially in revision surgeries or in cases where the traditional medial patellofemoral ligament (MPFL) reconstruction is inadequate. Tubeplasty, which involves folding and reattaching portions of the quadriceps tendon to enhance medial support, complements the 4-in-1 approach by stabilizing the patella dynamically throughout the range of motion.³

Case Presentation:

A 9-year-old female child was brought to the orthopaedic outpatient clinic by her parents with longstanding concerns regarding an abnormal gait and frequent episodes of knee instability, particularly affecting her left lower limb. The parents noted that since she had started walking independently during toddlerhood, she experienced repeated falls, unsteadiness while running, and difficulty climbing stairs, all of which gradually worsened with age. These persistent mechanical symptoms, in the absence of trauma or inflammatory joint disease, raised early suspicion of a congenital or developmental musculoskeletal anomaly. The child's gait was visibly abnormal, exhibiting a valgus alignment of the knee along with lateral deviation of the patella during flexion. Despite the lack of pain, she displayed a pattern of recurrent, painless lateral patellar dislocations during active

knee movement, which spontaneously relocated during extension-clinically diagnostic of habitual patellar dislocation. On physical examination, patellar apprehension and J-sign were positive, confirming lateral tracking, while the patella could be manually subluxed laterally without discomfort. (Figure 1)



Figure 1: Preoperative clinical photograph showing lateral displacement of the left patella with valgus knee alignment during passive extension in a 9-year-old child with habitual patellar dislocation.

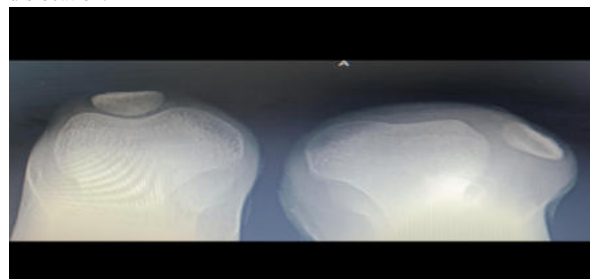


Figure 2: Skyline (Merchant) radiographic view showing lateral displacement of the left patella with a shallow trochlear groove, indicative of trochlear dysplasia associated with habitual patellar dislocation.

Further imaging evaluation included standard anteroposterior and lateral radiographs (Figure 2), as well as skyline (Merchant) views, which demonstrated lateral displacement of the patella and trochlear dysplasia with a shallow femoral groove. There were no signs of patella alta, patella baja, or bony derangements of the tibial tuberosity. Magnetic Resonance Imaging (MRI) provided a more detailed assessment, revealing a hypoplastic lateral femoral condyle, contracted lateral retinaculum, and, importantly, a significantly

shortened quadriceps tendon mechanism with associated soft tissue tethering. Given the absence of bony abnormalities and the patient's young age, it was evident that the underlying pathology was predominantly soft-tissue in nature. A diagnosis of habitual dislocation of the patella due to soft tissue imbalance and extensor mechanism contracture was confirmed.

Taking into account the child's skeletal immaturity, open physes, and the complexity of the soft tissue pathology, a decision was made to proceed with a **Four-in-One Quadriceps Tubeplasty**, a well-established, growth-preserving surgical approach designed to realign and stabilize the patellofemoral joint without disrupting future bone growth. This multifaceted procedure addresses the structural and dynamic factors contributing to patellar instability by correcting maltracking, rebalancing muscular forces, and restoring functional alignment.

The surgery consisted of four key components, performed sequentially in a single operative session. First, a lateral retinacular release was performed to relieve the tightness and contracture of the lateral capsule and retinaculum, which were tethering the patella and preventing medial movement. Second, a Roux-Goldthwait patellar tendon hemitransfer was done by longitudinally splitting the patellar tendon and transferring its lateral half medially beneath the intact medial half, thereby re-directing the vector of patellar pull to counteract lateral dislocation tendencies. Third, a modified Insall's proximal tube realignment was carried out, wherein the quadriceps tendon was tubularized and centralized over the trochlea to ensure that the patella remained well-aligned during the arc of motion. Lastly, a quadriceps slide lengthening was performed to correct the muscular contracture that was contributing to the superior and lateral tension on the patella, thus allowing improved patellar excursion and preventing recurrence of instability.(Figure 3)



Figure 3: Intraoperative images demonstrating sequential steps of the Four-in-One Quadriceps Tubeplasty. *Top left:* Exposure of the patella and quadriceps mechanism. *Top right:* Lateral retinacular release. *Bottom left:* Roux-Goldthwait patellar tendon hemitransfer. *Bottom right:* Quadriceps slide lengthening with tubularization to centralize patellar tracking.

The procedure was completed uneventfully under general anesthesia. Intraoperatively, the patella was noted to track centrally throughout the knee's range of motion after realignment, without any sign of tilt or instability. The knee was then immobilized in a well-molded, cylindrical plaster cast in full extension to maintain soft tissue position and facilitate healing. Postoperative management involved strict non-weight bearing for the first two weeks, followed by progressive mobilization. The cast was removed after six weeks, at which point the patient began a structured and supervised physiotherapy program. The initial focus was on passive and active-assisted range of motion exercises, followed by progressive quadriceps strengthening, proprioceptive training, and gait re-education.

Over the course of rehabilitation, the child showed steady improvement, regaining confidence in ambulation and physical activities. At six months follow-up, clinical evaluation revealed full extension, over 130 degrees of flexion, and excellent patellar tracking without evidence of subluxation or apprehension. The patient was able to walk and perform weight-bearing activities without pain, instability, or mechanical symptoms. There were no signs of extensor lag,

stiffness, or postoperative complications such as infection, hardware failure, or growth disturbance. The child's gait pattern normalized, and she returned to her daily activities with no restrictions.(Figure 4)



Figure 4: Postoperative clinical image at 6-month follow-up showing full active straight leg raise with no extensor lag and restored knee function following Four-in-One Quadriceps Tubeplasty.

This outcome validates the use of Four-in-One Quadriceps Tubeplasty as an effective, anatomically corrective, and function-preserving procedure in pediatric patients with complex habitual patellar dislocation. By addressing all dynamic and static contributors to patellar malalignment through soft-tissue realignment, the technique provided robust and stable functional recovery without compromising the integrity of the growing skeletal structures.

DISCUSSION:

Habitual dislocation of the patella (HDP) presents a particularly complex surgical challenge in skeletally immature patients due to the multifactorial pathoanatomy involving soft tissue contractures, extensor mechanism malalignment, and trochlear dysplasia. The present case involving a 9-year-old female successfully treated with "Four-in-One Quadriceps Tubeplasty" aligns with a growing body of evidence supporting this technique as a comprehensive and effective surgical strategy. The management of habitual patellar dislocation (HDP) in skeletally immature patients poses a multifaceted challenge owing to the complex interplay of muscular, capsular, and skeletal abnormalities. HDP is typically a developmental condition often presenting in early childhood, characterized by lateral patellar displacement during flexion, and frequently associated with a shortened quadriceps mechanism, lateralized tibial tubercle, trochlear dysplasia, and soft tissue imbalance.² In the present case, the use of a comprehensive surgical strategy—4-in-1 quadriceps tubeplasty—allowed for correction of all contributing factors, consistent with the contemporary shift toward multicomponent procedures in pediatric patellofemoral instability. One of the key components of the 4-in-1 quadricepsplasty is the Roux-Goldthwait patellar tendon hemitransfer, a technique that has demonstrated reliable correction of lateral patellar tracking, especially in skeletally immature patients where bony procedures are contraindicated.⁴ In a cohort of 54 children treated with this component along with quadricepsplasty, Hung et al. observed significant improvement in dynamic patellar alignment and range of motion, with minimal recurrence. This finding supports its inclusion in the present case. The lateral retinacular release, another integral aspect of the technique, has long been debated due to its variable standalone success. However, when performed in conjunction with realignment procedures, it improves medial tracking and releases tethering forces contributing to lateral subluxation. Shen et al. reported that combining proximal and distal realignment procedures, including lateral release, in adults with habitual dislocation yielded stable patellofemoral joints in over 90% of cases.⁵

The quadriceps slide lengthening corrects the shortened extensor mechanism, a hallmark in children with congenital and habitual dislocations. According to Hire and Parikh, quadriceps slide provides not only increased mobility to the patella during flexion but also allows better positioning of the transferred tendons during the tubeplasty phase.³ This realignment reduces excessive lateral forces and permits early functional rehabilitation post-operatively. Furthermore, modified Insall's proximal realignment using tubeplasty helps secure the patella within the femoral trochlea throughout the range of motion. Matar et al. described a similar technique in adult patients undergoing revision total knee arthroplasty and emphasized the biomechanical superiority of quadriceps tubeplasty in restoring extensor function and medializing the patella.³ Although the indication differs, the principle

translates well into pediatric patellofemoral pathology. In pediatric populations, preserving growth potential while ensuring joint stability is paramount. Several authors have emphasized the importance of soft-tissue-based procedures for managing HDP in skeletally immature patients. Gao et al. conducted a systematic review identifying that multicomponent tendon transfers were significantly more effective than isolated procedures in achieving long-term stability, especially in children under the age of 12.⁶

A contrasting technique, the Stanislavljjevic quadriceps transposition, has shown suboptimal outcomes. Camathias et al. reported poor long-term results, with recurrent instability and extensor lag observed in nearly half of their pediatric cohort following this method.⁷ This contrast reinforces the rationale for using the 4-in-1 quadricepsplasty, which addresses both dynamic and static instability more effectively.

The importance of patient selection and comprehensive pre-operative planning is highlighted in MRI-based evaluations of patellofemoral alignment. Kobayashi et al. showed that assessing the cross-sectional area and alignment of the quadriceps can aid in determining the severity of soft tissue contractures and guide surgical customization.⁸ The presence of a significantly short quadriceps in our case justified the use of the slide component. Regarding post-operative protocols, immobilization followed by progressive physiotherapy has been recommended to ensure patellar stability while promoting quadriceps strengthening. Lee et al. in a recent meta-analysis compared conservative and surgical treatments for acute patellar dislocation in children and noted that surgical correction followed by structured rehab had lower recurrence rates and better functional outcomes.⁹

In terms of recurrence, Batra and Arora observed that incomplete soft tissue realignment and under-correction of quadriceps contractures were primary risk factors for redislocation, which underscores the need for multi-layered procedures like 4-in-1 quadricepsplasty.¹ Their review of 45 cases indicated that stand-alone lateral releases or medial plications were insufficient in severe cases. MRI-based realignment indicators also play a role in outcome prediction. Shen and colleagues emphasized that proximal and distal realignment should be supported by imaging evidence to ensure adequate tracking through the arc of motion, especially in habitual dislocations with associated trochlear dysplasia.⁵ Hung et al. further elaborated that early intervention in pediatric cases prevents compensatory gait abnormalities and secondary joint changes, which become harder to reverse in adolescence.⁴ This supports timely surgical correction such as in our case, where a 9-year-old child benefited from early structured repair. Overall, the multidimensional nature of HDP necessitates a surgical approach that targets all levels of anatomical derangement. The 4-in-1 quadriceps tubeplasty stands out in the literature for its comprehensive correction of dynamic and static malalignments, particularly in growing children, where it avoids the complications associated with osteotomies and prosthetic constraints.

CONCLUSION:

The “Four-in-One Quadriceps Tubeplasty” represents a comprehensive and effective surgical approach for treating habitual dislocation of the patella in skeletally immature patients. By simultaneously addressing soft tissue contractures, malalignment of the extensor mechanism, and patellar tracking abnormalities, this technique offers a physseal-sparing solution that reduces the risk of recurrence and promotes functional recovery. The successful outcome in the presented case, consistent with findings from recent literature, underscores the procedure's utility in managing complex patellar instability where isolated interventions such as MPFL reconstruction may be insufficient. Early recognition and individualized surgical planning remain critical to optimizing long-term joint stability and gait restoration in pediatric populations affected by this rare condition.

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