



Original article

Results of operative 4-in-1 patella realignment in children with recurrent patella instability



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ABSTRACT

Purpose: Recurrent patellar instability is a cause of knee dysfunction, limitation and pain for children. If non-operative treatment fails to stabilise the patella, operative realignment and stabilisation have been advocated. Operative techniques in the paediatric population must preserve physeal growth while ensuring stability. We aimed to determine the outcome of children and adolescents who underwent a 4-in-1 patellar realignment (lateral release, medial reefing, Insall tube realignment and Roux-Goldthwaite patella ligament transfer).

Methods: Consecutive skeletally immature patients operated in our institution were included in the study. A total of 16 operated knees in 12 patients were recruited. All patients underwent the same procedure after attempting a minimum period of 6 months of non-operative treatment with unsatisfactory results. The main outcome measured was recurrent dislocations. Functional outcomes were assessed using the Kujala score and the Paediatric form of the International Knee Documentation Committee Subjective Knee Form (Pedi-IKDC).

Results: Patients were followed up for a minimum of 3 years. None of the patients sustained further patella dislocations following the operation. In 3 cases, minor patellar maltracking was noted post-operatively but all 3 remained asymptomatic. Three patients had a small area of numbness lateral to the operative incision, which coincided with hypertrophic scarring. There was one case of superficial wound infection. The mean Kujala score was 83.4 ± 11.47 and the mean Pedi-IKDC was 79.5 ± 12.56 at the latest follow-up (minimum of 36 months).

Conclusions: The 4-in-1 patellar realignment is a good procedure in paediatric and adolescent patients with recurrent patella instability. Satisfactory results were observed with a minimal complication and redislocation rate in our series.

1. Introduction

Patellar dislocations are common knee injuries in the paediatric and adolescent population with a reported annual incidence of 0.04% in those younger than 16 years of age.^{1–6} Sequelae following a first episode of acute patellar dislocation may include anterior knee pain, decreased activity level, and recurrent instability.^{6–7}

Recurrent instability is defined as a patellar dislocation that occurs more than once. According to a recent study, up to 38.4% of paediatric and adolescent patients with acute patella dislocation will experience recurrent dislocations.⁸ Another study by Cash and Hughston found a recurrence rate of 60% in patients younger than 14 years, which suggests a higher risk in young active individuals.⁹

The treatment of choice for acute patellar dislocations continues to be non-operative except for specific circumstances including osteochondral fractures, grossly malaligned patella, or patients that fail to improve with appropriate rehabilitation.^{5,6} In these cases, operative

realignment and stabilisation of the extensor knee mechanism have been advocated.¹⁰ Many techniques have been described for surgical management of this condition although there is no consensus as to which one is best. A proximal “tube” realignment was described by Insall with good results in the paediatric population.¹¹ The Roux-Goldthwait procedure and modifications of the original technique have also yield good outcomes in children.^{12,13} Numerous methods of the medial patellofemoral ligament (MPFL) reconstruction have been described^{14–16} including anatomic reconstruction sparing the physes in children.¹⁷

The rates of recurrent dislocation are unacceptably high (67%–71%) when performing only lateral release, with or without direct repair of the medial structures.⁵ To overcome the risk of redislocation in children who generally present with predisposing factors we believe that, in addition to proximal realignment, a distal patellar tendon transfer should be included in the procedure. To the best of our knowledge, the outcome of a 4-in-1 technique in children has not been reported in this

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present form including lateral release, medial reefing, Insall tube realignment and Roux-Goldthwait patella ligament transfer.

The aims of this study were to examine the results of the 4-in-1 procedure performed in a tertiary centre and to assess any complications. We provide a detailed description of the procedure as it is performed in our centre to minimize the risk of technical complications.

2. Materials and methods

This study included a cohort of consecutive skeletally immature patients with recurrent patella instability operated on by the senior author (MR) in our institution between October 2009 and April 2014. The patients underwent a 4-in-1 procedure for patellar realignment (lateral release, medial reefing, Insall tube realignment and Roux-Goldthwait patella ligament transfer). The Local Audit and Clinical Effectiveness Committees approved this study, and written informed consent to use the data was obtained from parents or guardians of the children.

The study included a total of 16 knees in 12 children and adolescents who have experienced at least two episodes of patella dislocation. Eleven of the knees were cases of habitual dislocation in which the patella moves in and out of its normal position in the trochlear groove whenever the knee is flexed or extended. (Fig. 1A–C) No patient had a history of trauma associated with dislocation and three had previous knee operations. Only one of these had undergone a previous failed patella stabilisation procedure (Roux-Goldthwait) at another institution. The other two procedures were a knee arthroscopy with meniscectomy plus osteochondral defect drilling at the lateral femoral condyle, and a hemiepiphysiodesis using growth guided plates for genu valgum.

Prior to being offered surgical intervention, all patients had attempted a minimum period of 6 months of non-operative physiotherapy treatment with unsatisfactory results and ongoing symptomatic dislocations.

All patients showed patella maltracking on examination and generalised ligamentous laxity was scored according to the classification of Beighton.¹⁸ All patients had open knee physes as identified on plain knee radiographs (anteroposterior, lateral and skyline patella views). Radiographs were evaluated for evidence of patella alta and baja as defined by Insall and Salvati (Table 1).^{19,20} We found a considerable number of dysplastic trochleas (13 cases – 81%). All patients underwent knee magnetic resonance imaging (MRI) and these findings are detailed in Table 2.

2.1. Surgical technique. The 4-in-1 procedure

At the time of surgery, every patient's knee is examined under anaesthesia and the patellar tracking evaluated.

Patients are placed in the supine position with a thigh tourniquet (mean tourniquet time 69 min, range 50 to 82 min). A midline longitudinal 10 cm incision is performed centred over the patella down to the fascia.

Table 1
Demographics.

Characteristic	n = 16
Age at operation – years (range)	12.6 (9–16)
Male sex – no. (%)	4 (33%)
Side – no. (%)	
Right	5 (42)
Left	3 (25)
Bilateral	4 (33)
Insall-Salvati Index – mean	1.2
Patella alta (%)	3 (19)
Patella baja (%)	3 (19)
Normal (%)	10 (63)
Preop pain at rest – no. knees (%)	12 (75)
Beighton score	3.4
Sports activity – no. (%)	
Football	4 (33)
Cricket	2 (17)
Judo	1 (8)
Multiple	4 (33)

Table 2
MRI findings pre-operatively.

Findings	Cases – no. (%)
Dysplastic trochlea	13 (81)
Subluxated patella	7 (44)
Patellar facet chondropathy	5 (31)
Dislocated patella	3 (19)
Dysplastic femoral condyle	2 (13)
Femoral condyle chondropathy	2 (13)
Dysplastic tibial plateau	1 (6)
Absent abnormalities	0 (0)

Suprafascial dissection is carried out to release the adhesions that extend along the lateral intermuscular septum. A lateral release of the lateral patello-femoral ligament (LPFL) and lateral patellar retinaculum is performed continuing proximally at the insertion of the quadriceps tendon. Care must be taken to protect the capsule and to avoid accidental synovial breach.

The interval between the capsule and the vastus medialis obliquus was developed to expose the medial patello-femoral ligament (MPFL). The medial border of the quadriceps tendon is incised dividing it in thirds. This incision will continue into a medial parapatellar arthrotomy to expose the knee joint. (Fig. 2) The chondral surfaces of the trochlea and patella are carefully examined. In cases of osteochondral lesions, individualized treatment is carried out simultaneously (Fig. 3).

Vastus medialis is sutured to the free edge of vastus lateralis, forming a “tube” as described by Insall.¹¹ The tube realignment of the quadriceps tendon is performed using absorbable sutures. Using the same sutures, medial reefing of the capsule and MPFL is undertaken.

The patellar tendon is split longitudinally in halves and the medial band de-inserted from the tibial tuberosity. This portion is subsequently



Fig. 1. A–C. Patient with bilateral habitual dislocation of the patella. Right knee post-operatively after the 4-in-1 procedure; left knee pre-operatively with evidence of dislocated patella in flexion of the knee.

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