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Functional outcome following modified Elmslie–Trillat procedure

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Abstract

The aim of this study was to evaluate the mid- and long-term outcome of the modified Elmslie–Trillat procedure, as well as to detect factors affecting it. Thirty-eight patients (44 procedures) with a mean age of 31 years were included in this study. The reason for operation was patellar instability in 10 cases, anterior knee pain with malalignment of the extensor mechanism in 15 cases and a combination of both in 19 cases. Patients were followed for an average of 40 months (range = 18–130 months).

The functional outcome was very satisfactory or satisfactory for 73% of patients. According to Cox's criteria it was excellent in 13 cases (30%), good in 18 (41%), fair in 7 (16%) and poor in the remaining 6 (13%). Patients scored an average of 3.5 (range = 2–8) in their Tegner Activity Scale, while their score in Activities of Daily Living Scale of the Knee Outcome Survey ranged from 43 to 98 (average = 76). Result analysis revealed a better functional outcome when the operation was performed for patellar instability, as well as in the absence of grade 3 or 4 chondral changes in the patellofemoral joint at the time of operation.

Elmslie–Trillat procedure satisfactorily restores patellofemoral stability and offers a very good functional outcome, especially in the absence of significant chondral changes in the patellofemoral joint at the time of operation.

Keywords: Patellofemoral dysfunction; Elmslie–Trillat procedure; Arthroscopy

1. Introduction

Patellofemoral problems are probably the most common type of knee complaint in adolescents and adults. They can manifest as anterior knee pain, patellar instability, or a combination of both. The vague and general term "chondromalacia patellae" has been widely used in the past to describe retro-patellar pain and instability [1]. Lately, however, significant progress has been made in the accurate diagnosis and in-depth evaluation of a number of conditions leading to anterior knee pain and instability [2–5]. This has subsequently led to significant changes in the rationale of surgical treatment of these conditions.

The Elmslie–Trillat procedure aims to restore patellofemoral alignment and is one of the most commonly used operations for the treatment of patellofemoral dysfunction [6–14]. It involves a combination of soft tissue and bony procedures: namely lateral release and medial capsular reefing, as well as a tibial tubercle osteotomy and medial displacement over a distal periosteal pedicle. Most authors today use modifications of this procedure, omitting medial capsulorrhaphy [9,12,13,15–17]. Our aim was to evaluate the mid- and long-term functional outcome, as well as to detect factors affecting it in patients who underwent a modified Elmslie–Trillat procedure.

2. Materials and methods

2.1. Patient data

Between October 1993 and February 2003 a modified Elmslie–Trillat procedure was performed in 57 cases for patellofemoral dysfunction (50 patients, seven bilateral procedures). Eight patients were not available on

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final follow-up and a further four (five cases) were excluded because the Elmslie–Trillat procedure was combined with autologous osteochondral grafting (OATS procedure) for a concomitant osteochondral defect in the weight-bearing area of their knee. Therefore, a total of 38 patients (44 procedures) were included in this study. Of these patients 8 were male and the remaining 30 female; their mean age was 31 years, ranging from 19 to 56 years. The reason for operation was patellar instability (recurrent subluxation or dislocation) in 10 cases (23%), anterior knee pain with extensor mechanism malalignment in 15 cases (34%) and a combination of both in the remaining 19 cases (43%). Six patients had previously undergone a soft tissue operation (lateral release) 1 to 9 years prior to the Elmslie–Trillat procedure.

2.2. Clinical and radiological evaluation

A detailed clinical assessment was performed on all patients including testing of dynamic patellar tracking for signs of extensor mechanism malalignment, assessment of mediolateral patellar mobility and Fairbank's apprehension test. Preoperative radiological examination included anteroposterior, lateral and Merchant's views. All patients underwent a 4- to 6-monthly course of physiotherapy including quadriceps and vastus medialis obliquus strengthening and proprioception exercises, as well as patellar taping, before surgical treatment was decided.

2.3. Intraoperative selection criteria

Assessment of patellar tracking was repeated with the patient under anesthetic, followed by knee arthroscopy, during which the knee joint was also assessed for chondral lesions and other coexisting pathology. Patellar tracking was evaluated from a superolateral arthroscopy portal after draining the joint from fluid. If significant maltracking and lateral patellar overhang was found, an arthroscopic lateral release was performed. In the cases included in this study, arthroscopic lateral release failed to fully rectify lateral maltracking and was followed by an open Elmslie–Trillat tibial tubercle transfer.

2.4. Surgical technique

The procedure was carried out through an 8- to 10-cm midline incision starting just above the tibial tubercle and extending about 5 cm distally to it. Following elevation of the periosteum parallel osteotomies were performed with a saw to develop a 6- to 7-cm-long, 1.5-cm-wide and 6- to 8-mm-thick tibial crest fragment that was subsequently medialised by 1 cm over an intact distal periosteal pedicle. Osteotomies were chamfered by 10°–15° bilaterally resulting in a trapezoid bone fragment, which, when medialised, effectively led to elevation of the transposed tibial tubercle by 2–3 mm. The osteotomy was fixed with two 4.5 mm fully threaded AO screws with washers (Synthes Ltd, Welwyn Garden City, UK) inserted with a gliding screw principle and offering very satisfactory osteotomy site fixation in all cases (Fig. 1A, B). The knee was taken through a full range of movements and patellar tracking was reassessed arthroscopically. If it was satisfactory the wound was closed in layers over a drain. Seven patients had to undergo an additional medial plication, because their medial structures were attenuated and the combination of lateral release and tibial tubercle transfer failed to fully correct patellar malalignment. All procedures were carried out by or under the supervision of the two senior authors (DJAL and MAG).

2.5. Postoperative management and evaluation

Postoperatively patients started partial weight bearing with the knee protected in an extension splint as soon as pain allowed. The splint was intermittently removed and isometric quadriceps exercises as well as passive flexion exercises were undertaken. Six weeks postoperatively the splint was discarded, active flexion and muscle strengthening exercises were commenced and patients gradually progressed to full weight bearing.

Patients were followed for a minimum of 18 months (average = 40 months, range = 18–130 months). All patients were examined on final follow-up by the same reviewer (DK). They underwent clinical evaluation of patellar tracking and were examined radiologically with anteroposterior, lateral and Merchant's views. Subjective functional evaluation was also

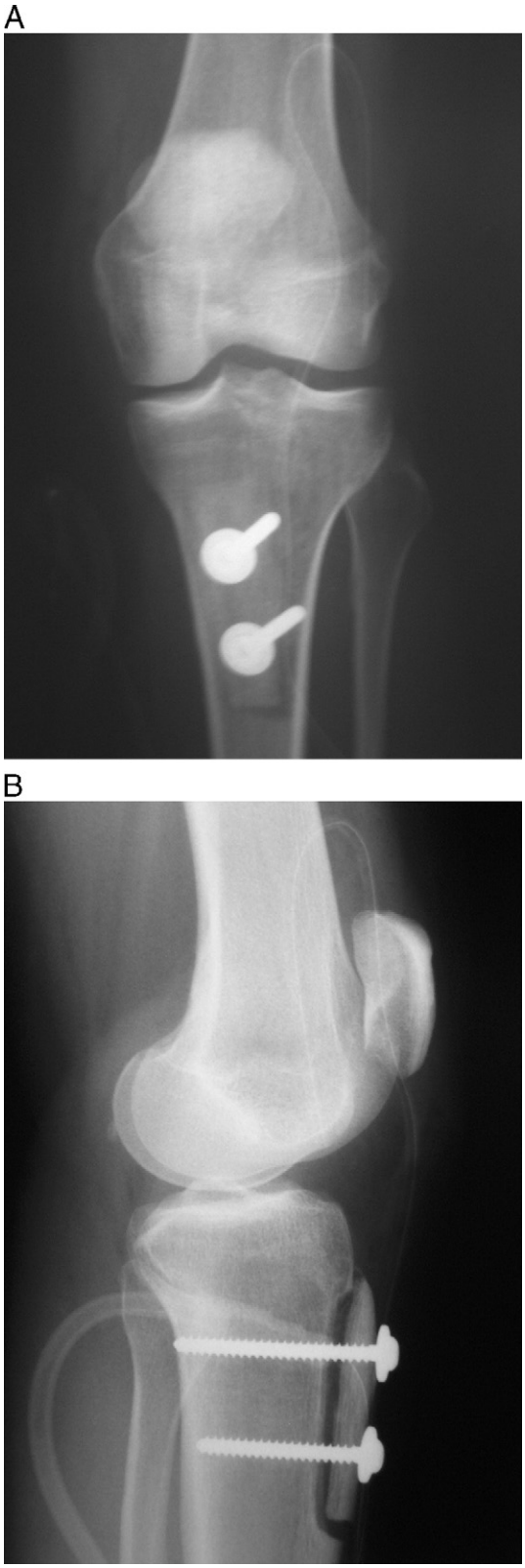

Fig. 1. (A) Anteroposterior radiograph immediately post Elmslie–Trillat procedure. (B) Lateral radiograph immediately post Elmslie–Trillat procedure.

Table 1
Results of Cox's score

Cox's score	Overall ($n=44$)	Presence of PF joint lesions		Reason for surgery		
		No PF joint OA ($n=22$)	Grade 3/4 PF joint lesion ($n=22$)	Instability ($n=10$)	Pain/Instability ($n=19$)	Pain ($n=15$)
Excellent	13 (30%)	8 (36%)	5 (23%)	3 (30%)	7 (37%)	3 (20%)
Good	18 (41%)	10 (45%)	8 (36%)	5 (50%)	8 (42%)	5 (33%)
Fair	7 (16%)	3 (14%)	4 (18%)	1 (10%)	3 (16%)	3 (20%)
Poor	6 (13%)	1 (5%)	5 (23%)	1 (10%)	1 (5%)	4 (27%)
		χ^2-test: $p=0.0374$	χ^2-test: $p=0.0374$	χ^2-test: $p=0.1582$	χ^2-test: $p=0.0723$	χ^2-test: $p=0.0004$

undertaken by questionnaires recording patient satisfaction and using Cox's criteria, the Tegner Activity Scale and the Activities of Daily Living Scale of the Knee Outcome Survey [6,18]. It is believed that a variety of outcome measures and measurement techniques significantly contribute in obtaining a global view on the patient's functional status following surgery for patellofemoral dysfunction [19].

2.6. Statistical analysis

An unpaired Student's t-test was used to compare quantitative variables while a χ^2-test was employed to compare non-quantitative data. Statistical significance was set at $p<0.05$.

3. Results

3.1. Functional assessment

Patients were hospitalised for an average period of 3 days (range 2–5 days). Table 1 shows that the functional outcome according to Cox's criteria was excellent in 13 cases (30%), good in 18 (41%), fair in 7 (16%) and poor in the remaining 6 (13%). Table 2 summarises patient satisfaction on final follow-up. Patients were very satisfied with the outcome in 15 cases (34%), satisfied in 17 cases (39%), while they were moderately satisfied and dissatisfied in 6 cases (13.5%) each (Table 2). As described in Table 3, patients scored an average of 3.5 (range=2–8) in their Tegner Activity Scale, while their score in Activities of Daily Living Scale of the Knee Outcome Survey ranged from 43 to 98 with an average of 76.

Result analysis did not reveal significant correlation between patient age at operation and scores in the Tegner Activity Scale and in the Activities of Daily Living Scale of the Knee Outcome Survey ($R=-0.434$ and $R=-0.558$, respectively). As regards the reason for operation, patients who underwent the Elmslie–Trillat procedure for patellar instability or a combination of patellar instability and pain had a better functional outcome according to Cox's criteria and better patient satisfaction than patients who had this procedure for anterior knee pain alone (Tables 1 and 2).

In cases where grade 3 or 4 chondral changes were already established in patients' patellofemoral joints at the time of the index procedure ($n=22$) the functional outcome was significantly worse compared to the subgroup of patients where no or minor chondral changes were present ($n=22$). Namely, the score in Activities of Daily Living Scale of the Knee Outcome Survey was 82 and 71, respectively, in the two subgroups (t-test: $p=0.0314$) (Table 3). Furthermore, the functional outcome as evaluated with Cox's criteria and patient satisfaction demonstrated significantly better results in the absence of grade 3 or 4 changes in the patellofemoral joint (χ^2-test: $p=0.0374$ and $p=0.0175$, respectively) (Tables 1 and 2).

3.2. Radiological assessment

The congruence angle was within normal limits in 16 out of 44 cases preoperatively (36%) and abnormal in the remaining 28 (64%). Postoperatively the congruence angle was found within normal limits in 37 out of 44 cases (84%). No correlation was found between congruence angle correction and the functional outcome.

3.3. Complications

Although passive knee mobilisation and partial weight bearing were commenced as soon as pain allowed no problems with osteotomy site healing were encountered. No major complications or further incidences of lateral patellar instability were recorded postoperatively. One patient developed a wound haematoma that was drained successfully and two further patients had a superficial wound infection that was treated with oral antibiotics. Localised tenderness over prominent screw heads was a problem in 17 cases (39%) – 14 patients, 13 of which were female. In all these cases implants were removed as a day procedure, 9–12 months postoperatively, leading to complete symptom resolution. A 54-year-old female patient with a grade 4 patellofemoral lesion resulting from patellar maltracking had no improvement following her realignment procedure and therefore had a patellofemoral joint replacement 21 months later. A 31-year-old patient with a grade 3/4

Table 2
Patient satisfaction

Patient satisfaction	Overall ($n=44$)	Presence of PF joint lesions		Reason for surgery		
		No PF joint OA ($n=22$)	Grade 3/4 PF joint lesion ($n=22$)	Instability ($n=10$)	Pain/Instability ($n=19$)	Pain ($n=15$)
Very satisfied	15 (34%)	9 (36%)	6 (27%)	4 (40%)	8 (42%)	3 (20%)
Satisfied	17 (39%)	10 (45%)	7 (32%)	5 (50%)	7 (37%)	5 (33%)
Moderately satisfied	6 (13.5%)	2 (14%)	4 (18%)	– (0%)	3 (16%)	3 (20%)
Dissatisfied	6 (13.5%)	1 (5%)	5 (23%)	1 (10%)	1 (5%)	4 (27%)
		χ^2-test: $p=0.0175$	χ^2-test: $p=0.0167$	χ^2-test: $p=0.0003$	χ^2-test: $p=0.1148$	χ^2-test: $p<0.0001$

Table 3
Results of Tegner Activity Scale and Activities of Daily Living Scale

	Overall (n=44)	Presence of PF joint lesions		Reason for surgery		
		No PF joint OA (n=22)	Grade 3/4 PF joint lesion (n=22)	Instability (n=10)	Pain/Instability (n=19)	Pain (n=15)
Tegner Activity Scale	3.5	3.7	3.3	3.6	3.6	3.3
Activities of Daily Living Scale	76	82*	71*	79	79	70

* t-test: p=0.0314.

patellar lesion on index procedure had ongoing anterior knee pain and opted for a patellectomy 20 months following his Elmslie–Trillat procedure. It should be noted that the above patient had already undergone a patellectomy in his contralateral knee 7 years prior to the index procedure for severe anterior knee pain and was satisfied with the functional outcome.

4. Discussion

Patellofemoral dysfunction is a common source of complaints and patients can present with anterior knee pain, patellar instability or a combination of both as their predominant symptom. Several factors such as trochlear dysplasia, extensor mechanism disequilibrium, patella alta and insufficiency of passive stabilisers have been shown to contribute towards a "favourabe environment" for patellar instability [3], an entity more common in female patients [20]. Anterior knee pain on the other hand has been associated with muscular imbalance, overuse, patellofemoral joint wear, increased intraosseous pressure and patellar maltracking leading to uneven patellofemoral joint loading [21].

Non-operative treatment of patellofemoral dysfunction includes muscle stretching, quadriceps and more specifically vastus medialis obliquus strengthening exercises, as well as patellar taping. It bears satisfactory results in the majority of patients, including patients following acute traumatic patellar dislocation [20,22,23]. Surgical options should be considered for those patients who do not respond to conservative management.

In cases where patellofemoral dysfunction is combined with a degree of patellar malalignment, extensor mechanism realignment is a reasonable option [9,11,24]. Elmslie–Trillat procedure is one of the most widely used methods for extensor mechanism realignment and a number of authors have reported very satisfactory results using it in the treatment of patellofemoral dysfunction [6–14,24]. This procedure has originally been described as a combination of lateral release, medial capsulorrhaphy and medial displacement of the tibial tubercle. However, most authors today prefer a modified version omitting medial capsule plication without an apparent adverse effect on its clinical efficacy [12,25]. It was felt that this part of the operation increases the risk for intra-operative damage of the saphenous nerve and may significantly lengthen the rehabilitation period due to postoperative wasting of the vastus medialis obliquus [9,12]. Although the use of medial capsulorrhaphy in itself has progressively been limited, a number of recent reports draw attention to the role of the medial patellofemoral ligament as a primary soft tissue restraint to lateral patella displacement and suggest that its anatomical repair or reconstruction is important in restoring patellar stability [2,26–31].

Despite of the fact that the overall results of the Elmslie–Trillat procedure are satisfactory, careful analysis shows that this procedure is very effective in resolving patellar instability, but it is not as successful for patients whose main complaint is anterior knee pain [9,25]. Its clinical results are believed to deteriorate with time, with a concomitant increase in the incidence of patellofemoral joint arthritis [32]. It has also been suggested that results are more favourable in younger patients and in the absence of significant OA changes at the time the procedure is carried out [9,11,25].

Aderinto et al. [33] have successfully used arthroscopic lateral release in patients with symptomatic patellofemoral osteoarthritis for temporary pain relief. Our results, however, suggest that the outcome of realignment procedures is significantly better in the absence of substantial patellofemoral arthrosis. This is also corroborated by the findings of Wang et al. who conclude that severe preoperative damage of the articular cartilage is associated with a worse clinical outcome [25].

We appreciate that the present study is a retrospective review of the functional outcome of a modified Elmslie–Trillat procedure in a patient series and therefore conclusions should be reviewed in light of this limitation. Our results suggest that the above procedure is very successful in treating patellar instability, but less so in treating anterior knee pain with an element of patellar maltracking. Unlike other authors, we did not find a significant correlation between patient gender, age at operation, congruence angle correction and the functional outcome.

In conclusion, modified Elmslie–Trillat procedure remains a good option for the treatment of patellar dysfunction. It appears though that careful patient selection is of paramount importance for a successful outcome. Patients suffering from symptomatic patellar instability have a better functional outcome, especially if the operation is carried out before the advent of significant chondral damage in the patellofemoral joint.

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