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ORIGINAL STUDY

A surgical algorithm for the treatment of recurrent patellar dislocation. Results at 5 year follow-up

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Several options exist for the treatment of recurrent patellar dislocation. In our institution a specific treatment algorithm for patellofemoral maltracking, depending on skeletal maturity and the recognition of local risk factors has been in use for several years. The aim of our study was to evaluate the overall results of using this algorithm and to compare the outcome of the different subgroups. A total of 110 patients were studied with an average follow-up of 5.3 years. The patients were classified into 6 groups depending on the surgical treatment they had received.

Eighty-seven percent of patients remained free of dislocation at final follow-up, and 66% of patients no longer experienced any patellar instability or subluxation.

There was no statistically significant difference between skeletally mature and immature patients in the incidence of redislocation or recurrent instability, nor in functional or clinical outcome scores.

Skeletally immature patients who underwent isolated medial retinacular imbrication experienced the highest redislocation rate (29%), whereas skeletally mature patients who were treated with combined proximal and distal realignment procedures demonstrated the lowest redislocation rate (6%). Skeletally mature patients with combined proximal and distal procedures reached lower clinical and functional outcome scores.

Based upon the results from this study we believe that our surgical algorithm can serve as a model for the treatment of recurrent patellofemoral dislocation.

Keywords : recurrent patellofemoral dislocation ; treatment algorithm.

INTRODUCTION

Several surgical options exist for the treatment of recurrent patellar dislocation, each with different success rates (*3*). Most surgeons decide on which surgical technique to use according to their perception of the patient's individual profile and the severity of the underlying predisposition towards recurrence of patellar instability.

Although there is abundant literature on outcome of specific procedures, no data are however available on the general strategic approach towards the problem of recurrent patellar dislocation. Many surgeons therefore continue to struggle to choose a specific procedure for each specific patient. In our institution we developed a specific treatment algorithm which has been in use for several years now. It is based upon the differentiation of patients depending on skeletal maturity and specific risk factors for patellar maltracking (*22*) (Fig. 1).

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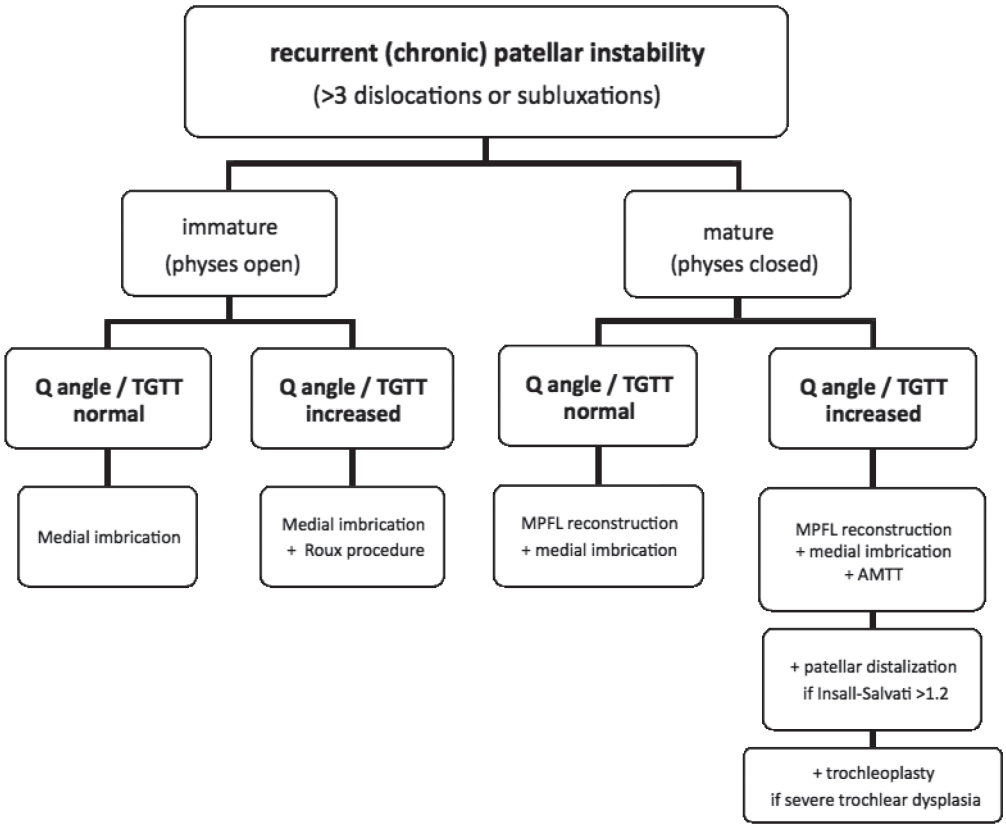

Fig. 1. — Treatment algorithm for recurrent patellar dislocation

A patient is considered as having recurrent patellar instability when he or she has sustained more than 3 patellar dislocations or subluxations.

The therapeutic approach in our algorithm depends on whether the growth plates are still open or closed. Patients with open physes have a greater risk for recurrence of patellar dislocation compared to skeletally mature patients (*22*). At the same time the operative treatment options for these younger patients are restricted to soft tissue procedures that do not interfere with the growth plates. These are usually considered as less effective in comparison to bony procedures. Osseous procedures can indeed achieve more drastic anatomic and biomechanical effects on patellar tracking and stability, but are obviously only possible when the risk of iatrogenic damage to the physis and consequent growth disturbance is absent or minimal and they are to be reserved for full-grown patients (*11*).

The patient with open physes and recurrent patellar instability is in our algorithm treated with a medial retinacular imbrication procedure. We use a slightly modified version of the technique originally described by Insall, including advancement of the vastus medialis obliquus muscle fibers (*9*). Releasing the lateral retinaculum is performed when required to correct obvious lateral tilt and to attain correct patellar tracking. Lateral release is however not routinely associated to the medial imbrication, and in fact it is usually not necessary (and often even obsolete) according to the authors' opinion.

In case the skeletally immature patient has an increased Q angle or tibial tubercle to trochlea groove offset (TTTG), a Roux-Goldwaith patellar tendon hemitransfer is combined with the procedure (*7*).

The mature patient with closed physes and recurrent patellar instability is in our algorithm treated with a formal medial patellofemoral ligament

(MPFL) reconstruction combined with a medial retinacular imbrication. Our preferred technique for MPFL reconstruction is a double loop gracilis autograft reconstruction using interference tunnel fixation in the patella and femur (*15*).

In case the patient also has an increased Q angle or tibial tubercle to trochlea groove offset (TTTG), an (antero) medial transfer of the tibial tubercle according to Fulkerson is combined with the procedure (*8*).

In case the Insall-Salvati (IS) index exceeds 1.2 (patella alta), the tibial tuberosity is distalised as well, aiming at an IS index of 1.0.

Finally, in case of severe trochlear dysplasia, a trochleoplasty as described by Dejour is additionally performed (*5*).

The aim of our study was to evaluate the overall results of this algorithm and to compare the outcome of the different subgroups.

Results are presented as functional knee scores (Tegner activity rating scale, Knee injury and osteoarthritis outcome score (KOOS), Western Ontario and McMaster Universities Arthritis Index (WOMAC) and Lysholm scale), incidence of residual patellofemoral disorders, re-surgery rate and complication rate (*1,10,17,20*).

MATERIAL AND METHODS

After approval of the study protocol by the ethical committee of our institution, 110 consecutive patients who had surgery for recurrent patellofemoral dislocations according to our algorithm were identified from our institutional database.

All patients were operated between April 1998 and December 2011. The medical records were reviewed for clinical and functional outcome, recurrence of patellar dislocation, subluxation or patellofemoral instability, and complication rate. Patients were contacted and 62 filled in a questionnaire allowing evaluation of the clinical and functional outcome with KOOS, WOMAC, Lysholm and Tegner activity score. The data available in the follow-up files were analyzed for patients who did not respond to the questionnaire.

Table I shows the demographic details of all patients studied. The mean follow-up was 5 years and 3 months. The mean age at time of surgery was 18 years and 7 months. Forty-one of the 110 patients were male, 69 were female.

All patients were classified into one of six groups according to the treatment algorithm (Fig. 1).

Group 1 was treated with a medial imbrication (17 cases). Group 2 was treated with a combined medial imbrication and Roux-Goldwaith procedure (14 cases). Group 3 was treated with a combined MPFL reconstruction plus medial imbrication (46 cases). Group 4 was treated with a combined MPFL reconstruction, medial imbrication and anteromedialisation of the tibial tuberosity (AMTT) (40 cases). Group 5 was treated with a combined MPFL reconstruction, medial imbrication, AMTT as well as patellar distalisation (5 cases). Group 6 was treated with a combined MPFL reconstruction, medial imbrication, AMTT and additional trochleoplasty (4 cases).

Correlative comparison of the incidence of redislocation and residual patellar instability and subluxation between the different treatment groups was evaluated using the chi-square test for comparison. The one-way ANOVA (analysis of variance) was used to compare the functional results between the different treatment groups.

RESULTS

Eighty seven percent of the 110 patients remained free of dislocation at final follow-up, and 66% of patients no longer experienced patellar instability or subluxation (Table II).

No statistically significant differences were noted between skeletally mature and immature patients in the incidence of redislocation, recurrent instability, functional as well as clinical outcome scores.

Skeletally immature patients who were treated with isolated medial imbrications experienced the highest redislocation rate (29%).

Skeletally mature patients who were treated with proximal realignment procedures demonstrated higher redislocation rates than those that underwent combined proximal as well as distal realignment procedures (15% of redislocation in contrast to 6%, $p = 0.149$). Skeletally mature patients with combined proximal as well as distal procedures were however associated with lower clinical and functional outcome scores ($p = 0.020$) (Table II).

Nine complications were noted (Table III). All occurred in the skeletally mature patients. Seven patients required a manipulation under anaesthesia for postoperative flexion deficit. One patient sustained a peroneal nerve palsy which recovered

Table I. — The clinical details of 110 patients

	Medial imbrication	Medial imbrication+ Roux procedure	Medial imbrication+ MPFL reconstruction	Medial imbrication+ MPFL rec+ AMTT	+ Patellar distalization	+Trochleoplasty
Number of patients	12	12	40	38	4	4
Number of knees	17	14	46	40	5	4
Men - Women	3\9	3\9	18\22	16\23	0\4	1\3
Right - Left	6\11	9\5	21\27	17\24	2\3	3\1
Returned questionnaires	4	7	24	22	3	2
Age at operation (yrs)†	12 ± 4	13 ± 3	23 ± 7	24 ±6	21 ± 6	19 ± 2
Amount of follow-up consults †	7 ± 6	6 ± 3	4 ± 2	6 ± 2	7 ± 3	3 ± 1
Age at investigation (yrs)†	21 ± 5	20 ± 4	33 ± 7	33 ± 6	26 ± 6	25 ± 3
Resurgery rate	1/17 (6%)	2/14 (14%)	1/48 (2%)	5/41 (12%)	1/5 (20%)	0/4 (0%)
Mean follow-up time (yrs)	3.2	5	5.9	5.9	5.3	1.1

†The values are given as the mean and the standard deviation.

Table II. — Clinical outcome

	Medial imbrication	Medial imbrication+ Roux procedure	Medial imbrication+ MPFL reconstruction	Medial imbrication+ MPFL rec+ AMTT	+ Patellar distalization	+Trochleoplasty
Tegner†	5.25 ± 2,0	3.5 ± 1.8	5 ± 2.1	4 ± 2.2	5.3 ± 1.1	4.5 ± 0.7
KOOS†						
Pain	98.5 ± 1	84.5 ± 20	81 6 ± 18	71.5 ± 17	92.7 ± 4	86 ± 11
Symptoms	84.7 ± 17	70.1 ± 23	68 ± 17	69 ± 14	84.3 ± 11	61 ± 9
ADL	100 ± 0	91.1 ± 13	83.1 ± 21	78.3 ± 18	94.7 ± 4	91 ± 0
Sports	85 ± 13	51 ± 33	57.1 ± 24	26.8 ± 21	51.7 ± 32	57.5 ± 10
QOL	70.5 ± 5	56.3 ± 18	52.6 ± 17	45.6 ± 19	60.3 ± 13	50 ± 8
WOMAC†						
Pain	100 ± 0	91.6 ± 10	88 ± 17	82.7 ± 15	91.7 ±10	95 ± 7
Stiffness	96.8 ± 6	89.6 ± 14	83 ± 20	80.7 ± 17	100 ± 0	68.7 ± 8
Function	99.25 ± 1	90.8 ± 13	91.1 ± 15	85.2 ± 13	96.4 ± 3	95 ± 2
Lysholm †	92.7 ± 6	70.1 ± 17	71.3 ± 17	62.4 ± 17	84.7 ± 4	69 ± 12
Patient satisfaction	100% (4 of 4)	71% (5 of 7)	87% (21 of 24)	82% (18 of 22)	100% (3 of 3)	100% (2 of 2)
Redislocation rate	29% (5/17)	7% (1/14)	15% (7/46)	7% (3/40)	0% (0/5)	0% (0 of 4)
Feeling of recurrent instability/ subluxation	12% (2/17)	50% (7/14)	17% (8/46)	22% (9/40)	20% (1 of 5)	0% (0 of 4)
Regained activity to pre-injury level	75% (3 of4)	57% (4 of 7)	71% (17of 24)	59% (13 of 27)	67%(2 of 3)	0% (0/2)

† The values are given as the mean and the standard deviation.

Table III. — Postoperative complications

	Medial imbrication	Medial imbrication+ Roux procedure	Medial imbrication+ MPFL reconstruction	Medial imbrication+ MPFL rec+ AMTT	+ Patellar distalization	+Trochleoplasty
Number of patients	12	12	40	38	4	4
Number of knees	17	14	46	40	5	4
Infection problem: debridement	0/17 (0%)	0/14 (0%)	0/46 (0%)	1/40 (2%)	0/5 (0%)	0/4 (0%)
Flexion deficit: MUA*	0/17 (0%)	0/14 (0%)	0/46 (0%)	6/40 (15%)	1/5 (20%)	0/4 (0%)
Postop. dropfoot	0/17 (0%)	0/14 (0%)	1/46 (2%)	0/40 (0%)	0/5 (0%)	0/4 (0%)

*Mobilisation under anaesthesia.

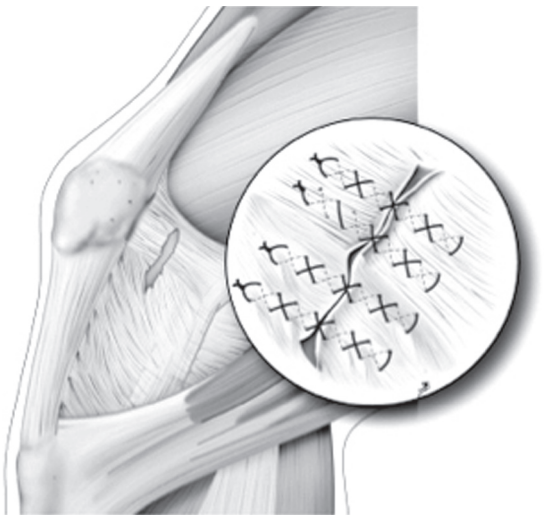

Fig. 2. — Medial retinacular imbrication procedure

Fig. 3. — Roux-Goldwaith procedure

spontaneously. One patient developed a postoperative knee infection requiring open lavage and debridement.

At final follow-up, 85% of the patients reported to be satisfied with the treatment they had received.

DISCUSSION

The aim of our study was to investigate the results of a specific surgical algorithm on the treatment of recurrent patellofemoral dislocation. The algorithm was successful in the sense that it resulted in 87% of patients remaining free of dislocation at an average follow-up of 5 years. Thirteen percent of the patients reported recurrence of dislocation, and 21% of the patients additionally reported some degree of residual patellar instability.

Review of studies in the literature allows comparison with the results on specific procedures as used in our algorithm.

In our study, the percentage of skeletally immature patients with redislocation and recurrent patellar instability without dislocation following treatment by medial imbrication was 29% and 12% respectively. Palmu *et al* reported a much higher redislocation rate of approximately 70% after medial imbrication for the treatment of acute patella dislocation in children (*14*). Nikku *et al* reported a

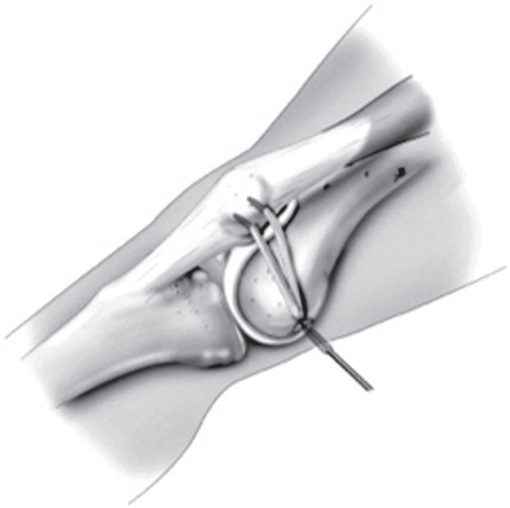

Fig. 4. — MPFL reconstruction

Fig. 5. — AMTT procedure

redislocation rate of 17% and instability rate of 25% after medial repair for a first-time patella dislocation (*13*).

The rate of redislocation and recurrent patellar instability without dislocation for the skeletally immature patient who received a medial imbrication and Roux-Goldwaith procedure in our study was 7% and 50% respectively. The functional and subjective results of these patients were rather moderate. Contrary to our study, Endres *et al* reported a rate of only 5% of recurrent instability after the Roux-Elmslie-Trillat procedure for patellofemoral instability (*6*). Fondren *et al* reported a 6% patella redislocation rate after a Roux-Goldwaith procedure for recurrent patella dislocation. They did however provide no data on recurrent patella instability, and the mean age of their patients was also somewhat older (20 years) (*7*).

The rate of redislocation and recurrent patellar instability without dislocation after surgical reconstruction of the MPFL in our study was 15% and 17% respectively. This is similar to the studies by Ronga *et al* and Schottle *et al*, who reported 11% and 13% of patella redislocation after MPFL reconstruction for recurrent patellar dislocation (*16,18*). Deie *et al* found no recurrent patella dislocations in 46 knees followed for a mean of 9.5 years after MPFL reconstruction for patella dislocation (*4*). Steiner *et al* also had a 0% redislocation rate after reconstruction of the MPFL in patients who had lateral patella instability in association with trochlear dysplasia (*19*).

Caton *et al* reported residual instability in 23% of cases after AMTT (*2*). Nakagawa *et al* performed an Elmslie-Trillat procedure (medial transfer of the tibial tubercle) in 45 knees for the treatment of recurrent dislocation of the patella. They reported a 13% redislocation rate after an average follow-up of 161 months (*12*). In our study we noted a 7.5% redislocation rate and 22.5% recurrent instability rate without dislocation after AMTT.

The outcome in the 4 patients treated with additional trochleoplasty was excellent in terms of preventing redislocation, but was also associated with the poorest functional outcome, a finding which has also been noted in other studies on trochleoplasty (*3*). Van Knoch *et al* reported the largest study on trochleoplasty. In their study, trochleoplasty and medial reefing with or without reconstruction of the medial patellofemoral ligament was performed in 45 knees followed for a mean of 8.3 years. They reported a 0% patellar redislocation rate. Although the trochleoplasty was effective in preventing patellar dislocations, it did not halt the progression of patellofemoral arthritis. At the time of the latest follow-up, 43% of the knees had consequently worsening of preoperative patellofemoral pain (*21*).

In our study the immature patients who were treated with a medial imbrication and a Roux-Gold-

waith procedure had the highest rate of recurrent patella instability. The functional and subjective results of these patients were however good to very good. The high rate of recurrent patella instability and subluxation in the immature patients can be explained by the specific risk factors for patella instability in this group (increased Q-angle and/or TGTT) in combination with the limitations of soft tissue procedures (*20*).

Patients treated with an (antero) medialisation of the tibial tubercle, patellar distalisation or trochleoplasty had a low rate of redislocation, but their functional results were only fair. We believe that such is the consequence of the fact that longstanding maltracking based on definite structural anomalies, had finally caused irreversible arthritic changes that bony procedures were unable to correct as successfully as patellar tracking and stability, leading to a tempered subjective and functional outcome.

It is important to note that our algorithm is intended for the treatment of recurrent patellar dislocation or subluxation, not for patients with more subtle patellar maltracking including mild patellar laxity or patellar tilting.

Those patients are in our centre treated with a conservative, non-surgical approach consisting of muscular strengthening exercises, lateral patellar stretching, supportive taping or bracing, as well as other conservative measures aiming at optimization of patellar tracking and patellar stability. In our experience, surgery is only seldom necessary in these cases and should be reserved only for patients with frank recurrent patellar dislocation or instability.

In conclusion we believe that our surgical algorithm can serve as a model for the treatment of recurrent patellofemoral dislocation. When using the decision process as outlined in our algorithm, 87% of the patients remained free of dislocation at final follow-up, and 66% of patients did no longer experience any patellar instability or subluxation.

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