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Medial rotational tibial osteotomy for patellar instability secondary to lateral tibial torsion

F. Server[1], **R. C. Miralles**[1], **E. Garcia**[1], **and J. M. Soler**[2]

[1] Orthopaedic Department of the Hospital of Sant Joan and the School of Medicine, Universitat Rovira i Virgili, Reus, Spain
[2] Hospital Germans Trias, Badalona, Spain

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Summary. *We report 35 medial rotational osteotomies in 25 patients with chronic disability suggesting patello-femoral subluxation secondary to lateral tibial torsion. None had responded to conservative measures or soft tissue operations. The osteotomy was transverse in 17 and oblique in 18. The follow up averaged 4.3 years (range 1 to 8 years). The alignment of the limb was assessed clinically, and by radiographs and CT scans. The results were good or excellent in 88.5%, fair in 5.7% and poor in 5.7%. Twenty-three patients were satisfied and 2 were not. The overall results have been satisfactory in athletes and those leading an active life.*

Résumé. *Ce rapport est basé sur une série de 35 ostéotomies tibiales de rotation interne chez 25 malades avec une instabilité chronique du genou liée à une subluxation patello-fémorale secondaire a une hypertorsion tibiale externe. Aucun malade n'a répondu au traitement conservateur ni à celui d'une correction chirurgicale au niveau des parties molles. L'ostéotomie a été transversale dans 17 cas et plane oblique dans 18 cas. Le suivi a varié entre 1 et 8 ans avec une moyenne de 4.3 années. Le morphotype a été évalué cliniquement, radiographiquement et avec scanner. Les résultats indiquent que les effets du traitement ont été excellents dans 88.5% des cas, moyens dans le 5.7% des cas et mauvais dans le 5.7%. L'évaluation subjective pour chaque malade nous indique que 23 d'entre eux sont largement satisfaits du résultat et que 2 ne le sont pas. Les résultats globaux ont été satisfaisants aussi bien chez les sujets sportifs que pour ceux qui mènent une vie active.*

Reprint requests to: F. Server, Orthopaedic Department, Hospital Sant Joan, C/Sant Joan, S/N, E-43201 Reus, Spain

Introduction

Many operations have been proposed for the treatment of patellar subluxation [1, 4, 5, 9, 15, 16, 18, 19, 20, 23, 31]. The recently introduced concept relating rotatory abnormalities to patello-femoral disorders could explain the failure of some of these techniques.

Torsion is defined as the turning of a bone about its longitudinal axis so that its upper and lower ends are not in the same plane. Hence, femoral torsion is the inclination of the axis of the femoral neck relative to the transcondylar plane of the distal femur. The mean value in normal adults is $14 \pm 7°$ [13, 26]. Tibial torsion is the angular difference between the transmalleolar and bicondylar axes of the knee. The value in normal adults ranges from 23.7° to 27.4° with a mean of about 25° [21, 24, 33]. In lateral tibial torsion, the lower end of the tibia is rotated laterally in relation to the upper end; this affects the stability of the knee by producing an increased Q-angle (the angle between a line from the anterior superior iliac spine to the mid-patella and a line from the mid-patella to the tibial tubercle). The average angle in males is 15° and in females 17°. Knee joint rotation is the angle formed between the posterior bicondylar line of

the femur and the posterior tuberosity of the tibia; normal values are between 3° and 4° [10, 26].

A medial tibial rotation osteotomy attempts to correct the structural abnormality which is causing patello-femoral instability and restore the normal function of the extensor apparatus by returning the Q-angle to normal. Various techniques for this operation have been described [2, 3, 17, 29, 30].

The purpose of this study was to evaluate tibial rotation in patients with patello-femoral syndromes and instability secondary to torsional deformities. The aim was to change lateral tibial torsion to the normal angle of between 23° and 25°, to realign the Q-angle and to re-centre the patella.

Table 1. Preoperative clinical features

Feature	Incidence
Symptoms	
Giving way	31/35
Pain (anterior)	35/35
Stair-climbing difficulty	33/35
Crepitus (moderate)	20/35
Subluxation	13/35
Signs	
Varus alignment	31/35
Marked outward foot rotation	29/35
Excessive Q angle	33/35
Apprehension	7/35
Hyperextension	5/35

Patients and methods

Thirty five medial rotational tibial osteotomies were carried out in 25 patients with the patello-femoral syndrome and instability secondary to torsional deformities (Table 1). The patients had lateral tibial torsion of more than 30° and normal to moderate femoral antetorsion (<25°). All had pain in the knee and functional instability, and most had symptoms for more than 3 years. There were 22 women and 3 men with a mean age of 20 years (range 15 to 45 years). Two patients, aged 12 and 13 years, had recurrent dislocation of the patella and previous soft tissue procedures had failed.

Clinical evaluation. The gait was observed with reference to the angle between the axis of the foot and the line of progress in order to detect rotational abnormalities [11]. Deviation of >10° was considered abnormal [12] and may indicate lateral tibial torsion. The patient then stood directly in front of the examiner with the feet slightly apart and pointing straight ahead. The overall alignment of the lower extremities was assessed and any genu valgum or varum observed, or flexion or recurvatum from the side view. The patello-femoral joint was examined with the legs hanging at 90° over the edge of a couch. The initial position of the patella was assessed and then patellar tracking evaluated. Crepitus was looked for during active flexion and extension of the knee.

When supine. lateral mobility of the patella, the Q-angle, tenderness of the patellar facets and the apprehension test were assessed. A podoscope was used to evaluate the plantar arches of the feet.

Finally, patellar function was assessed by Insall's method [22]; excellent – if there are no complaints and function is normal (including a return to sports); good – when there is mild pain, no instability and normal function; fair – if there is moderate pain, a feeling of insecurity, slight limitation of function, but some improvement, and poor – if there is moderate to severe pain and instability (including dislocation) which limits function significantly.

The diagnosis was the patellar syndrome in 26 knees, minor patellar instability in 4 and major instability in 5. The lower limb alignment was normal in 24%, genu varum was present in 66% and genu valgum in 10%; in the side view 88% were normal and 12% showed recurvatum.

The preoperative features of the knees are given in Table 1. All the patients had inwardly pointing knees when they were sitting. Knee movement was not limited and there was no evidence of meniscal or ligamentous abnormality. Their hips were freely mobile.

Radiographic assessment. The following radiographs were taken before and after operation: (1) anteroposterior with the knee extended and under load; (2) lateral in 30° of flexion; (3) axial in 30° flexion, and (4) teleradiography. The femorotibial angle, the shape and height of the patella and the trochlear angle were measured. The average tibiofemoral angle was 0.69° of varus (range 4° varus to 10° valgus).

The structure of the patellae was classified according to Wiberg [32]; there were 2 type I, 9 type II, and 5 type III. There were 2 cases of low patella, and 3 of high patella. The Caton AT/AP index was measured; AT is the distance between the lower edge of the articular surface of the patella and the anterosuperior edge of the tibia, and AP the length of the articular surface of the patella [7]. The mean was 0.94 cm (median 1.0 cm, range 0.5 cm to 1.4 cm).

Two cases with flat (>125° to 145°) and 10 with deep trochlear grooves were observed; the mean was 137° (median 138°, range 115° to 150°).

In patients with the patellar syndrome and minor instability we found the femoro-tibial angle to be in slight varus, a deep trochlear groove and a Wiberg type II patella whereas in major patellar instability the trochlea was flat, the patella high and the Wiberg type was III.

CT scan. General Electric 9000CT equipment was used. Scanning was carried out before and after operation with the patient supine and the knees flexed to 15°. Before operation, exaggerated acetabular anteversion was found in 3 cases. The mean femoral antetorsion was 15° with diminished antetorsion in 7 cases, a moderate increase (24°) in 9, and an increase of 32° in one case. The knee joint rotation was >5° in 18. The mean lateral tibial torsion was 38°, with a range of 30° to 45° in 19 and >45° in 10. Patellar tilt was found in 26 cases and lateral subluxation in 13. The unstable type of patella showed a tendency towards increased lateral tibial torsion and knee joint rotation.

Operative technique. The patient was supine, a tourniquet was used and general or peridural anaesthesia. A vertical antero-lateral incision was made and a lateral retinacular release carried out. The proximal tibial metaphysis was exposed and 2 parallel Kirschner wires inserted through the tibia above and below the site of the osteotomy. The degree of rotation was measured with a goniometer (Fig. 1a, b). The proximal tibio-fibular joint was released and the osteotomy carried out proximal to the tibial tubercle. With the leg extended, the distal fragment was rotated medially (always less than 30°) and the osteotomy fixed with one or 2 staples placed laterally.

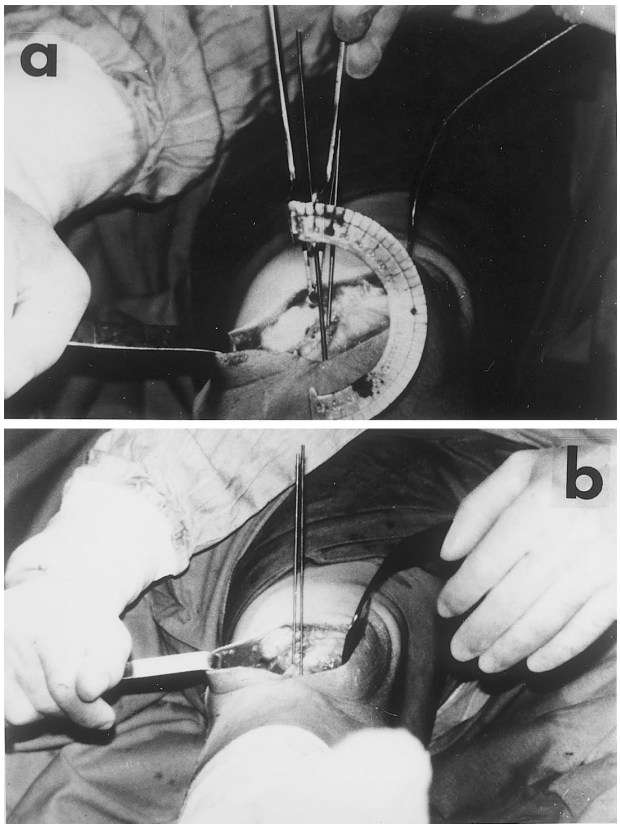

Fig. 1 a, b. Operative photographs. **a** The goniometer used during osteotomy to indicate the degree of correction. **b** Correct rotation has been obtained when the Kirschner wires are parallel

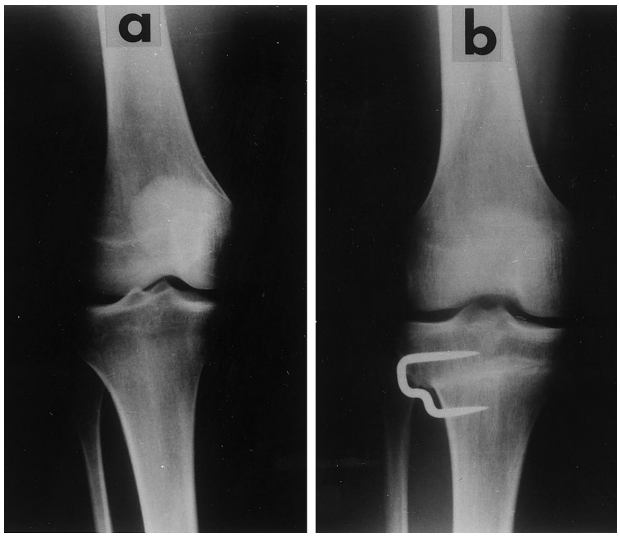

Fig. 2 a, b. Radiographs showing correction of lateral tibial torsion. **a** Before operation. **b** After operation

After operation, a plaster case was applied for 6 weeks. Nonweightbearing with crutches was allowed after one week, and partial weightbearing after one month. This was followed over 2 months by isometric exercises for mobilisation and strengthening.

The osteotomy was transverse in 17 knees in which the axis was normal or in moderate varus, and oblique in 18 knees with genu varum. Two staples were used in 23 cases and one in 12. Immobilisation ranged from 5 to 8 weeks (mean 6.3 weeks). Weightbearing was allowed 4 to 6 weeks after operation (mean 4.9 weeks).

Statistical analysis. With the SPSS statistical package, the general descriptive statistics and comparison of means using chi-square and Wilcoxon tests were applied to the clinical and anatomical characteristics before and after operation.

Results

Twenty-five knees were painless and stable; 6 had occasional pain on strenuous activity, but no instability and the patients had returned to normal sports activities. Two had moderate pain or fatigue and occasional instability. Two knees had a poor result; one patient had pain on flexion and extension and disability due to a lateral pressure syndrome, while the other had difficulty on stairs and pseudo-locking.

Pain was relieved in 83%, although some had occasional discomfort which was compatible with strenuous activity or sports. Only 5% had residual instability. Subjectively, 23 patients were satisfied and 2 were not.

Functional recovery took between 3 and 5 months. In 8 knees moderate wasting of vastus medialis persisted for up to 6 months, but resolved after prolonged physiotherapy. Two sportsmen began their sports within 14 weeks. Knee movement recovered fully in every case. The mean time to consolidation of the osteotomy was 6.3 weeks (range 5.2 to 8 weeks). Two patients with painful cavo-valgus feet were relieved of their symptoms. One with a symptomless cavo-valgus foot had improvement in the arch, but the valgus of the heel persisted.

Radiographic measurements (Table 2)

The mean femoro-tibial angle was corrected from 0.7° varus before operation to 4.5° valgus after operation. Median figures and ranges are shown in Table 2. Realignment of the tibial spines with the intercondylar groove was achieved in all except 2 knees (Fig. 2 a, b). The height of the patella was not changed.

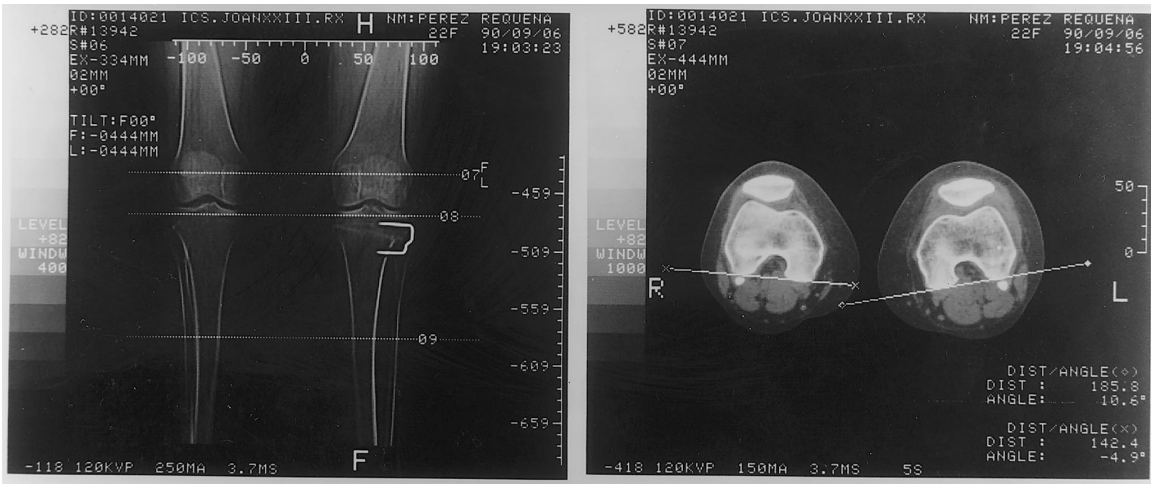

Fig. 3. Radiograph and CT scans showing correction of the lateral patellar tilt after operation on the left side and the persistent tilt on the right side

CT scan (Table 2)

Femoral anteversion was changed from 14.5° to 17.4° and the difference was not statistically significant. Knee joint rotation changed from a mean of 5.8° to 5.5° ($p < 0.0001$). Median figures and ranges are shown in Table 2. Lateral tibial torsion was corrected from a mean of 38.1° to 21.5° ($p < 0.0001$). Patellar tilt was corrected in 18 cases, improvement greater than 50% occurred in 4 and in 3 the tilt persisted. The tilts changed from a mean of 16.8° to 11.8° (Fig. 3). Ten of the 13 cases of subluxation have been corrected and 3 have persisted; the mean values changed from 2.2 mm to 1.5 mm (Fig. 4).

Complications

One patient sustained an oblique fracture just below the osteotomy without displacement during operation which healed after nonweightbearing for 2 months. One case of phlebitis occurred and improved with standard treatment. One patient had pain and paraesthesiae for several hours in the first web space and over the dorsum of the foot, but there was no paralysis.

Table 2. Radiographic and CT scan measurements pre- and post-operation. All values are in degrees (except subluxation, in mm) and are presented as the medians with the ranges in brackets. Probability values (2-tailed) are derived from the Wilcoxon Matched-Pairs Signed-Ranks Test

	Pre-operative	Post-operative	p
Femoro-tibial angle	0.0 (–4.0 to 10.0)	4.0 (–3.0 to 8.0)	<0.0001
Femoral antetorsion	14.5 (1.0 to 31.0)	17.4 (1.2 to 32.0)	NS
Knee-joint rotation	6.0 (2.9 to 11.2)	6.8 (2.8 to 32.0)	<0.0001
Lateral tibial torsion	37.0 (18.0 to 60.0)	26.0 (7.6 to 41.5)	<0.0001
Patella tilt	16.0 (8.0 to 30.0)	12.0 (8.0 to 25.0)	<0.0001
Patella subluxation	2.0 (0.0 to 3.0)	1.5 (0.0 to 5.0)	<0.0001

Discussion

Operations designed to realign the extensor mechanism by moving the patellar tendon may provoke stress on the patella, as well as on the medial compartment of the knee [6, 8]. Conversely, an oblique osteotomy above the tubercle realigns the extensor apparatus and improves the gait and appearance of the leg [27].

In our study, lateral tibial torsion was corrected in 22 cases, undercorrected in 8 and overcorrected in 5. These variations may be caused by incorrect insertion of the Kirschner wires used to control rotation. The orientation of the osteotomy had no influence because the same differences were found in both transverse and oblique osteotomies.

In 4 patients, there was genu recurvatum greater than 10°; in 3 the anteroposterior obliquity of the osteotomy was 15° or more, and in one a low patella appeared to be responsible for moderate pain. Two continued to have moderate pain and occa-

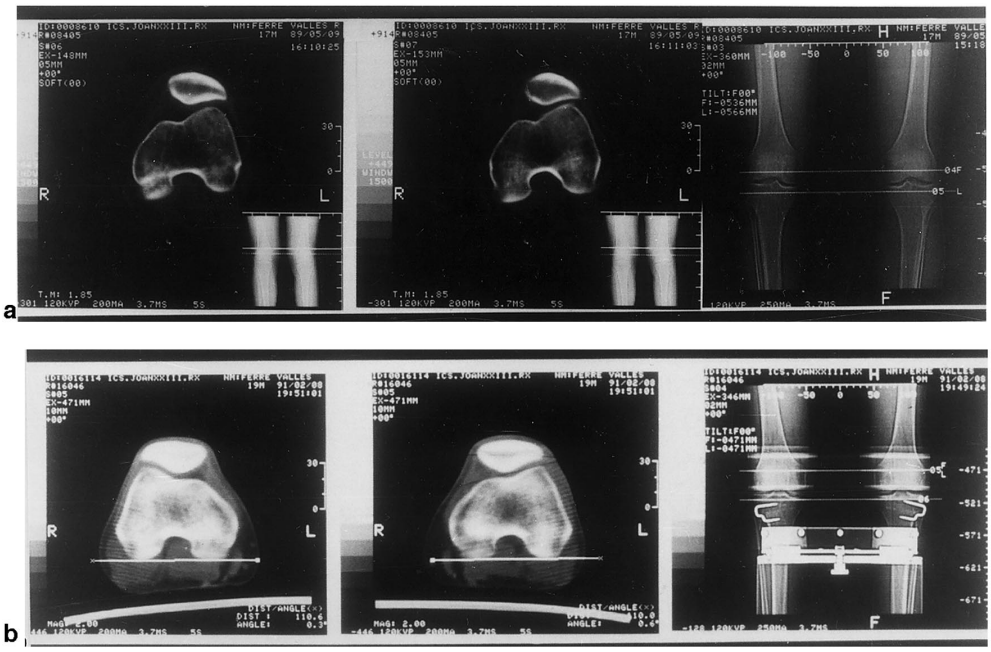

Fig. 4 a, b. Radiographs and CT scans showing correction of bilateral patellar subluxation after medial rotational osteotomy. **a** Before operation. **b** After operation

sional instability due to persistent wasting of the quadriceps.

In 2 the operation was unsuccessful; in one the indication was incorrect as moderate crepitus was diagnosed, but grade III chondromalacia was found at arthroscopy. The operation should only be used in grade II chondromalacia, or less. Also the tibial torsion was normal in this patient. In the other case, patellar subluxation was realigned, but the knee joint rotation remained increased.

The age of the patient had no influence on the outcome, and we agree with other reports which indicate that a poor prognosis is related to the severity of the cartilage lesions and not to age [14, 25, 28].

The results of medial rotational osteotomy with patellar realignment have been promising when there was underlying lateral tibial torsion. The operation is recommended when there is a severe deformity and disability which does not respond to conservative treatment. The overall results have been satisfactory in sportsmen. The indication for operation must be based on precise clinical, radiographic and CT criteria, and carried out after growth has ceased.

An oblique osteotomy facilitates, in one step, medial rotation and valgus correction. The bone must be divided above the tibial tubercle and the frontal obliquity depends on the amount of varus to be corrected, but it must never be greater than 10° in the sagittal plane, so as to prevent recurvatum. The prognosis depends on the correction of the lateral torsion and on the severity of damage to the articular cartilage.

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