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ORIGINAL ARTICLE

Does combined posterior cruciate ligament and posterolateral corner reconstruction for chronic posterior and posterolateral instability restore normal knee function?

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KEYWORDS
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Summary
Introduction: Posterior cruciate ligament (PCL) injuries are frequently associated with posterolateral corner (PLC) damages. These complex lesions are most often poorly tolerated clinically. Adherence to sound biomechanical principles treating these complex lesions entails obtaining a functional PCL and reconstructing sufficient posterolateral stability.
Hypothesis: Surgical treatment of postero-posterolateral laxity (PPLL) re-establishes sufficient anatomical integrity to provide stability and satisfactory knee function.
Material and methods: In this retrospective, continuous, single-operator study, 21 patients were operated for chronic PPLL with combined reconstruction of the PCL and PLC and were reviewed with a minimum 1 year follow-up. The clinical and subjective outcomes were evaluated using the IKDC score. Surgical correction of posterior laxity was quantified clinically and radiologically on dynamic posterior drawer images (posterior Telos™ stress test and hamstrings contraction lateral view).
Results: The mean subjective IKDC score was 62.8 at the last follow-up versus a preoperative score of 54.5 (NS). Preoperatively, all were classified in groups C and D. Postoperatively, 13 patients out of 21 were classified in groups A and B according to the overall clinical IKDC score. The radiological gain in laxity was 51% on the hamstring contraction films and 67% on the posterior Telos™ images ($p < 0.05$).

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Discussion: The objective of surgical treatment is to re-establish anatomical integrity to the greatest possible extent. The clinical and radiological laxity results are disappointing in terms of the objectives but are in agreement with the literature. The subjective evaluation demonstrated that this operation can provide sufficient function for standard daily activities but not sports activities.
Level of evidence: Level IV retrospective study.

Introduction

Posterior cruciate ligament (PCL) ruptures are rare lesions whose initial diagnosis is not always easy. Without treatment, the natural history of these lesions over the long term leads to osteoarthritis [1], for the most part medial femorotibial osteoarthritis [2] and later patellofemoral decompensation [3,4]. Isolated posterior laxity, evolving slowly and often well tolerated, must be contrasted with the faster progression of combined laxity, particularly in cases of PLC involvement. Postero-posterolateral laxity (PPLL) often results from a high-kinetic-energy mechanism [5] and is often associated with fractures [6] as a result of traffic accidents [7].

The main structures composing the PLC are the lateral collateral ligament, popliteal tendon, the popliteofibular ligament, and the lateral condylar capsule [8]. The PLC controls varus laxity, external tibial rotation, and the posterior drawer near extension. In PCL lesions, an associated PLC lesion is a factor for poor functional prognosis. This has been established by biomechanical and clinical studies. The PLC participates mainly in knee stability in extension if the PCL is preserved; if the PCL is absent, the PLP stabilizes the knee in all degrees of flexion [9]. For La Prade et al. [10], the in situ forces within the PCL significantly increase in PLC lesions when the knee is solicited in varus in different degrees of flexion or if there is internal tibial rotation associated with a posterior drawer. Therefore, the notion of an associated varus morphotype in PLC lesions adds to the severity of these lesions. The clinical studies corroborate the biomechanical studies: isolated PCL injuries are often well tolerated and do not require surgical treatment unless symptoms persist. However, combined PCL and PLC injuries are very poorly tolerated and frequently require surgical treatment. Therefore, the attempt to better understand the functional role of these structures has led to the development of so-called anatomical PLC reconstruction techniques [11,12].

The objective of this study was to assess combined PCL and PLC reconstructions in chronic complex laxity. Our main hypothesis was that surgical treatment of PPLL using a combined reconstruction technique (PCL + PLC) re-establishes sufficient anatomical integrity to stabilize and return good function to the knee. We therefore conducted a retrospective study on a series of patients who had at least 1 year of follow-up. Our main criteria of success was the knee's functional condition according to a subjective and clinical evaluation; our secondary criterion was the assessment of the clinical and radiological laxity correction.

Materials and methods

This was a retrospective, continuous study in which all the patients operated between September 1995 and November 2003 for combined PCL and PLC for chronic PPLL were reviewed. All patients were operated by one of the senior surgeons (PC). The minimum follow-up was 12 months. The exclusion criteria were rupture of both cruciate ligaments, isolated PCL reconstruction, a lesion in the posteromedial plane, presence of femorotibial osteoarthritis or a posterior drawer that could not be reduced at the clinical examination, and injury less than 3 months before.

The clinical diagnosis of PCL rupture for all patients included the search for posterior drawer at 90° flexion in any rotation, in external and then internal rotation [13], and the search for spontaneous incomplete dislocation of the tibia that could quantify the severity of the laxity according to the Clancy classification [14] (Table 1). The PLP lesions were diagnosed by the existence of lateral subluxation during monopodal weightbearing and by a greater than 15° increase in external tibial rotation (ETR) in the decubitus ventral position at 30° and 90° flexion of the pathological knee compared to the healthy side [15]. Lateral laxity on a knee at 30° flexion when reducing the posterior drawer was used to assess the lateral collateral ligament. The reverse pivot shift test [16] was considered positive if there was a sensation of reduction of the clunk. Each clinical exam was recorded on an International Knee Documentation Committee (IKDC) form [17]. A subjective IKDC evaluation quantified knee function with a score from 0 to 100. Two dynamic lateral X rays at 90° were taken: one posterior stress X-ray using the Telos™ device and the other with the hamstring muscles contracted. We measured the posterior tibial translation side to side difference at the posterior intercondylar area. For the patients treated after January 2000, the axial view 70° flexion, as described by Puddu et al. [18], was also taken. The frontal axis was evaluated using a lower-limb X-ray with full-weight bearing.

All patients had arthroscopic double-bundle PCL ligament reconstruction [19—24]. The graft was a patellar tendon—bone transplant in four cases and a quadriceps tendon graft in the 17 other cases. The damaged PLC structures were reconstructed by tenodesis derived from the technique described by Larson et al. [25] to reconstruct the popliteofibular ligament and the lateral collateral ligament, and a popliteal bypass according to Müller [26] to replace the popliteal muscle tendon (Fig. 1). In six cases, a high valgus tibial osteotomy (VTO) was performed through a medial opening at least 3 months before the ligament reconstruc-

Table 1 Clancy classification (90° knee flexion).

Grade 0	Normal knee: medial tibial plateau shift is 1 cm anterior to medial femoral condyle
Garde 1	The medial tibial plateau remains 5 mm anterior to the medial femoral condyle, but had dropped back compared to the contralateral normal knee.
Grade 2	The medial tibial plateau was flush with the femoral condyles. The posterior tibial displacement is between 5 and 10 mm
Grade 3	The tibial crest lay behind the femoral condyles. The posterior tibial displacement is greater than 10 mm

tions for the patients with radiological varus malalignment greater than 5° on the loaded films.

Postoperative care included initial unloading for 6 weeks. After an immobilization phase in extension, a custom-designed adjustable articulated knee brace was used beginning on the 8th day when the edema had lessened. The rehabilitation protocol [27—29] lasted until the end of the 4th postoperative month, with closed-kinetic chain exercises, then, beginning at the 5th month, open-kinetic chain exercises of the hamstrings.

The series comprised 21 patients, 13 males and eight females. The patients' mean age at surgery was 26.8 years (range, 18—40 years). All patients were reviewed with a mean follow-up of 22.6 months (range, 12—53 months). The cause of the injury was most often related to a traffic accident (Table 2). The time from accident to surgery was a mean 18.9 months (range, 8—47 months).

All patients were reviewed with at least 1 year of follow-up, with a subjective IKDC questionnaire and a clinical examination recorded on the IKDC form. Dynamic images at 90° knee flexion (posterior Telos™ and hamstrings contracted) and an axial view 70° were also taken. We defined gain in laxity by the differential between the measurements

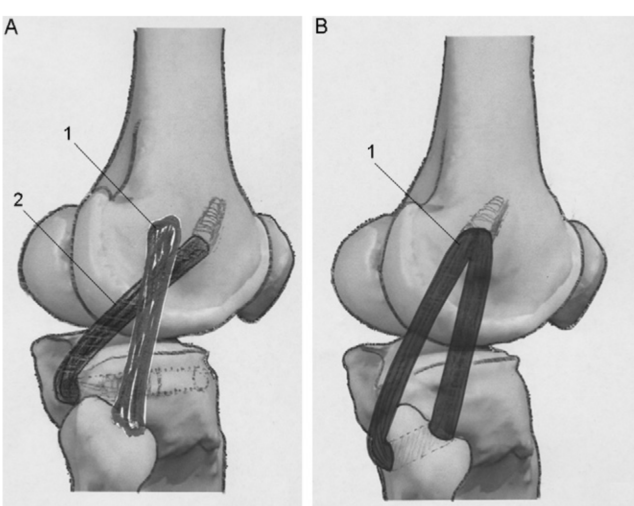

Figure 1 A. Müller popliteal bypass. 1: lateral collateral ligament; 2: iliotibial tractus reconstruction. B. Larson lateral reconstruction. 1: gracilis graft, with interference screw in the femoral tunnel.

Table 2 PCL and PLC injury mechanism.

	Pivot sport contact	Pivot sport without contact	Traffic accident injury	Other
PPLL	1 (5%)	5 (25%)	13[a] (65%)	1 (5%)

[a] Eight patients out of 13 had fracture around the knee during traffic accident injury.

of the preoperative and postoperative side to side difference compared to the preoperative side to side measurements.

Statistical analysis was carried out using Stat View™ 5.0.0 (SAS Institute NC® 1992—1998, Cary, NC, USA). Paired data were analyzed within each group using the nonparametric Wilcoxon test. The significance threshold chosen was 5%.

Results

Complications

Arthrolysis associated with ablation of a screw on the medial condyle was necessary in one case 2 months after surgery. No other complications were observed.

Subjective evaluation

The mean subjective IKDC score increased from 54.5 preoperatively to 62.8 at the last follow-up ($p = 0.3$). At the last follow-up six patients presented a subjective score under 50. In this group, in addition to the ligament lesions, three patients had an associated fracture (tibial plateau or femoral condyle) and another presented ICRS stage IV femoral chondropathy.

In the six patients who underwent a VTO in addition to the ligament treatment, the mean IKDC score was 58.3 at the last follow-up versus 42.1 preoperatively.

Clinical evaluation

The mean preoperative mobility values were 4° extension and 132° flexion. At the last follow-up, they were 2° extension and 129° flexion.

The overall clinical IKDC results are presented in Fig. 2. Before surgery, all the patients were classified C or D. At the last follow-up, 13 patients out of 21 were distributed in groups A and B (respectively, three and 10), seven were classified C and one D.

Posterior laxity evaluation

According to the Clancy classification (Table 3), preoperatively 11 knees presented a grade 2 posterior drawer and eight grade 3. At the last follow-up, four knees no longer had spontaneous posterior drawer, 11 were grade 1 and six grade 2.

For the preoperative IKDC clinical laxity (Fig. 3), eight knees had laxity classified D and 12 classified C. At the last follow-up, four knees had a laxity that was classified A, 11 B, and six C.

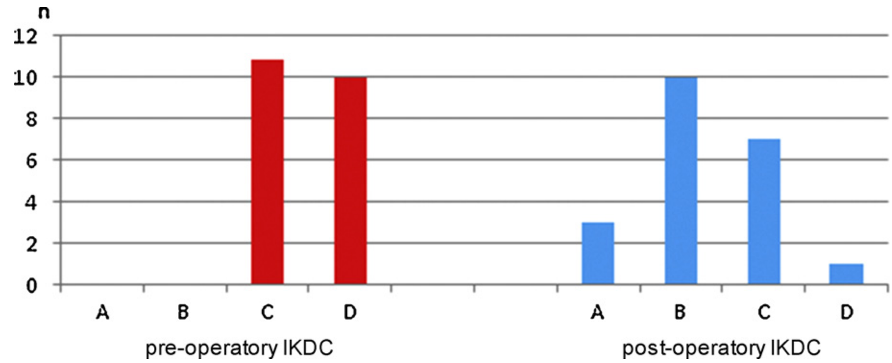

Figure 2 Overall IKDC score. Preoperative IKDC, postoperative IKDC.

Table 3 Patient distribution, Clancy classification.

	Preoperative	Postoperative
Grade 0		4
Grade 1	1	11
Grade 2	11	5
Grade 3	8	

The gain in laxity with the hamstrings contracted was 51% ($p = 0.01$) and on the posterior Telos™ stress test at 90° flexion was 67% ($p = 0.0003$) (Table 4). Twelve knees had a patellofemoral axial view 70° preoperatively. In these cases, the 51% gain obtained at the last follow-up was not significant.

Evaluation of rotation laxity

Preoperatively, 15 knees (71.4%) presented a reverse pivot shift; at the last follow-up this dynamic pivot shift had disappeared in all the patients.

Before surgery, seven knees (33%) presented an ETR at least 20° greater than the healthy side, which was between 15° and 20° for 12 patients. At the last follow-up, none of the knees had an ETR greater than 20°. Rotational laxity persisted with ETR less than 10° for 11 patients.

Discussion

The study's main limitations include its retrospective design and the small number of patients, limiting the power of the statistical results. The follow-up period of this series remains shorter than other series reported in the literature, which present results with a minimum of 2 years follow-

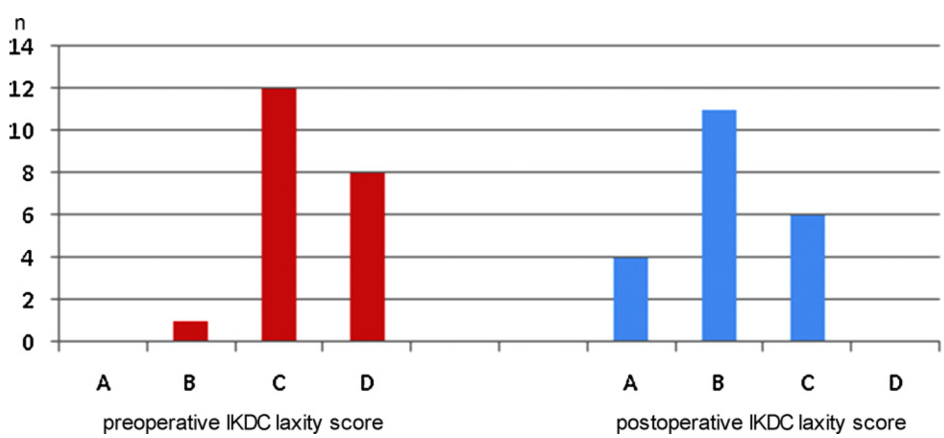

Figure 3 IKDC laxity score.

Table 4 Preoperative and postoperative assessment of X-ray laxity and gain in knee laxity.

	Preoperative	Postoperative	Gain (%)	p[a]
HC at 90°	9.6 (1–18)	4.7 (2–9)	51.0	0.01
Posterior Telos™ at 90°	5.1 (−5–12)	1.7 (−9–12)	67.0	0.003
AV at 70°	9.4 (−4–29)	4.6 (−8–12)	51.0	0.29

HC: hamstring contraction; AV: axial view; NS: not significant.
[a] p-value calculated with Wilcoxon nonparametric test.

up. The strong points of this study are the single-observer clinical evaluation and a complete and documented clinical evaluation as well as static and dynamic radiological evaluation.

The biomechanical studies showed that isolated PCL reconstruction did not suffice to restore normal kinematics of the knee with PPLL [30]. It results in excess stress in the reconstruction, which could result in its failure [31]. Posterolateral reconstruction must be associated. These experimental conclusions are confirmed by the clinical study conducted by Freeman et al. [32], for which the results of the PPLL treated with combined reconstruction showed significantly better subjective scores than those treated with isolated PCL reconstruction.

These combined reconstructions do not result in stiffness. However, rotational laxity is not entirely corrected, with residual rotational laxity in 40% of our patients. These results are also reported by Khanduja et al. [33], with persistence of rotational laxity in 26% of the cases. We believe that these results are at least partially explained by the fact that PLC reconstructions are static reconstructions that can relax when subjected to substantial stresses. Moreover, they only incompletely reproduce the function of the popliteal muscle, which is a dynamic structure.

Our results also remain less in terms of overall IKDC score improvement, with 50% of the patients in categories A and B, whereas in the series studied by Khanduja et al. [33] and Chen et al. [34] this value was 89% and 57%, respectively. Moreover, we could not demonstrate a significant improvement in the subjective IKDC score in our patients.

The mean subjective IKDC score of the six cases that had a VTO was less than the mean score of the series; given the low number of patients, we could not demonstrate the place of this procedure in PPLL treatment. However, Arthur et al. [35] concluded that VTO can be proposed in isolated cases in isolated PLC lesions, but it should be associated with ligament reconstruction in patients suffering from PPLL with genu varum.

The quality of anatomic restoration was evaluated by the gain obtained in posterior laxity. For the clinical evaluation, the results according to the Clancy classification remain subjective, but they have the advantage of quantifying laxity clinically. In the present series, 75% of the patients were classified in grade 0 and 1 postoperatively, whereas none was in these categories preoperatively. These results are in accordance with those reported by Khanduja et al. [33] (37% grade 0, 58% grade 1), Fanelli and Edson [36] (70% grade 0, 27% grade 1), Freeman et al. [32], and Wang et al. [37].

As for the radiological evaluation, the posterior Telos™ measurements and those of the films with the hamstrings contracted concluded in a significant postoperative reduction of laxity (respectively, $p = 0.01$ and $p = 0.003$); the Puddu and Chambat X rays showed no preoperative and postoperative differences. These results are in agreement with the conclusions of the study by Margheritini et al. [38] in which the Telos™ and hamstring contracted images proved to be good tools for measuring posterior laxity, whereas the patellofemoral axial views 70° served more for screening posterior laxity. It would also have been advantageous to assess laxity correction with posterior Telos™ tests with the knee flexed 30°; they would have assessed PLC reconstruction, which controls posterior laxity at this degree of flexion.

Conclusion

Complete treatment of ligament lesions in PPLL is safe, with no morbidity related to the procedure. For this type of laxity, lesion repair should associate PCL and PLC repair, the only guarantee that the reconstruction will last over time. The clinical and radiological results show a significant correction of laxity compared to the preoperative condition. However, our results can be perfected, notably in terms of rotational laxity control and in the subjective results, which were not significantly improved. All in all, the results obtained recuperated sufficient function for everyday activities but not for sports activities.

Conflict of interest

None.

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