

# KNEE P.C.L. RECONSTRUCTION: A TIBIAL BED FIXATION (“INLAY”) TECHNIQUE OBJECTIVE AND SUBJECTIVE EVALUATION OF A 30-CASES SERIES

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## SUMMARY

Surgical reconstruction of the knee posterior cruciate ligament (P.C.L.) still remains as a major therapeutic challenge. In this paper, we assessed 30 patients submitted to surgical reconstruction of the P.C.L. with a technique of tendinous graft fixation on tibial bed by direct approach (“INLAY”). Twenty-eight male patients and 2 female patients, with mean age of 31.10 years, participated on the study. The average injury time was 34.24 months. In 67% of the cases, injury was secondary to motorcycle accidents. Chondral injuries and knee anterior cruciate ligament (ACL) injuries

were present in 67% and 33% of the cases, respectively. Patients were assessed objectively (posterior drawer test) and subjectively (Lysholm’s Scale). Mean post-operative follow-up time was 21.7 months. About 66% of the cases were rated as good and excellent at the subjective and objective evaluation. The statistical analysis showed a similar behavior for both evaluations. Post-operative clinical outcomes achieved in this study have encouraged us to keep using this surgical technique.

**Keywords:** Knee; Posterior cruciate ligament; Reconstruction.

## INTRODUCTION

Knee posterior cruciate ligament (P.C.L.) begins at medial femoral condyle and crosses the joint downwards and posterior, being inserted into tibial posterior face. In a healthy knee, it acts as a primary restrictor to posterior displacement of the tibia to the femur, especially when knee is 90° flexed<sup>(1)</sup>.

In literature, the incidence of P.C.L. injuries presents great variability. It is estimated that it occurs in about 3% of the population in general and in approximately 37% of the individuals suffering high-energy trauma associated to knee hemarthrosis, with a higher prevalence in motorcycle accidents<sup>(2)</sup>. The most frequent mechanism of injury is trauma at tibial anterior face with knee flexed at 90°, known as “panel trauma”<sup>(3)</sup>.

The clinical evolution of those injuries presents some pe-

culiarities. In an initial phase, the isolated P.C.L. injury may be underdiagnosed, because patients don’t present many symptoms at the time<sup>(4)</sup>. Over time, the P.C.L. failure imposes an additional overload to knee medial compartment and of the patellofemoral joint<sup>(3,5,6)</sup>. Complaints of pain, joint edema, and functional restraints become more frequent, especially if other ligament injuries coexist<sup>(2,3)</sup>.

Recent clinical studies addressing the natural history of P.C.L. injury have alerted to the impairment of joint function, which tends to occur according to how chronic the injury is<sup>(2,3,7,8)</sup>. In parallel, a better knowledge of P.C.L. biomechanical function, a more detailed clinical evaluation, and the development of new instruments, such as fixation guides and systems have widened surgical indications to this kind of injury<sup>(9-13)</sup>. There-

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fore, combined ligament injuries involving the P.C.L., grade III symptomatic ligament instability, and P.C.L fracture-avulsion constitute indications to surgical treatment.

In P.C.L. surgical reconstruction, an autologous graft of tendon is employed as ligament substitute. Patellar, quadriceps tendons and gracile and semitendinous muscles' tendons are the major options for replacement. Today, the most commonly used technique is the transtibial, which consists of fixing the tendinous graft in the tibia through a transtibial tunnel (7, 8, 14-16).

Although broadly recommended, this technique has been criticized. Several authors have suggested that the sharp angle formed by the graft when passing through transtibial tunnel and tibial posterior face is a determinant point on postoperative clinical evolution. That angle, called "murderer angle", determines a concentration of tension at the graft and its resulting degradation, and potential rupture with successive cyclical loads to which it is submitted everyday.

Since 1993 and 1995, with the studies by Jakob et al.<sup>(17)</sup> and Berg<sup>(18)</sup>, a new surgical approach is described for treating P.C.L. injury. In that technique, graft fixation is performed at the tibial bed through direct approach (INLAY). According to the authors, this procedure enables a more anatomical positioning of the graft at tibial bed, in addition to avoid an unfavorable angle on tibial posterior edge, as seen in transtibial technique.

## MATERIALS AND METHODS

Between May 2002 and January 2005, 30 patients with knee posterior cruciate ligament injury were submitted to surgical reconstruction by the technique fixa-

ting tendinous graft at tibial bed by means of direct approach ("INLAY"). Injury diagnosis was provided upon anamnesis and clinical tests (posterior drawer test in neutral position). Twenty eight patients were men (93%) and 2 women (7%). Mean age was 31.10 years old (ranging from 17 to 47 years old). Only one case (nr. 23) was a surgical review of P.C.L. reconstruction by transtibial technique, while 29 cases were primary surgeries. Injury mechanisms were motorcycle and car accidents in 73% of the cases, sprains in 17% and miscellaneous in 10%. Injury time ranged from three months to 10 years, with an average of 33.30 months. Regarding the presence of related injuries, 10 cases of anterior cruciate ligament injury were observed (33%); 16 cases of meniscus injury (53%); 20 cases of chondral injury (67%), and 2 cases of ligament injury of the posterolateral edge (7%), (Chart 1).

## SURGICAL TECHNIQUE

With patient under anesthesia, positioned in dorsal horizontal

decubitus, the knee was accessed through median anterior incision of approximately 15 cm, followed by medial arthrotomy, joint inspection and identification of intra-joint injuries.

Once the central third of the homolateral patellar tendon graft was removed, femoral tunnel positioning and milling was performed at the origin of femoral posterior cruciate ligament. After graft fixation with interference metal screw (**Figure 1-A and B**), garrote was released, the homeostasis was performed and sutures by planes were provided.

At a second moment, patients were positioned in dorsal horizontal decubitus for knee

Cases	Gender	Age (years)	Injury time (months)	Post-op time (months)	Injury mechanism	Related injuries
1	male	21	3	43	motorcycle	A.C.L.
2	male	36	24	42	motorcycle	chondral
3	male	32	24	36	motorcycle	medial meniscus + ACL + chondral menisci
4	male	17	3	34	motorcycle	chondral
5	male	23	9	29	trampling	chondral
6	male	22	12	29	motorcycle	posterolateral + chondral
7	female	38	60	29	motorcycle	chondral + medial meniscus
8	male	26	66	29	motorcycle	L femoral fracture + chondral
9	male	42	48	28	motorcycle	meniscus + ACL + chondral
10	male	32	12	27	sprain	meniscus + chondral
11	male	35	8	24	sprain	menisci + ACL + chondral
12	male	21	12	24	motorcycle	menisci
13	male	26	24	24	motorcycle	chondral
14	male	21	12	22	motorcycle	chondral
15	male	26	24	21	motorcycle	chondral
16	male	27	12	20	sprain	medial meniscus + ACL
17	male	36	42	20	high fall	ACL + medial meniscus + chondral
18	male	37	120	20	motorcycle	medial meniscus + chondral
19	male	47	120	18	motorcycle	chondral + menisci
20	male	41	27	13	sprain	ACL + chondral
21	female	31	120	13	car	L femoral fracture + ACL + chondral
22	male	35	7	13	motorcycle	ACL + medial meniscus
23	male	35	12	13	car	posterolateral + chondral
24	male	22	24	8	motorcycle	chondral
25	male	44	12	7	motorcycle	lateral meniscus
26	male	29	96	7	motorcycle	L tibial open fracture + popliteaartery + medialmeniscus
27	male	28	4	6	sprain	ACL + medial meniscus
28	male	42	26	6	motorcycle	chondral + menisci
29	male	29	33	6	trampling	L femoral fracture + L hip disloc + intestinal perforation
30	male	32	3	3	motorcycle	menisci + chondral

**Chart 1** – Data regarding gender, age (years), injury and postoperative time (months), injury mechanism, and presence of related injuries in 30 patients submitted to knee posterior cruciate ligament reconstruction.

posterior access through an “inverted-L” incision, as described by Burks and Schaffer<sup>(19)</sup>. With medial arthro-  
tomy, the insertion bed of the P.C.L. was identified on tibial posterior face. At that moment, a small canal was performed proportionally to the size of graft (**Figure 2-A and B**), which was fixed by pressure with the aid of a cortical

screw 3.5 and washer (**Figure 3-A and B**)

keeping knee extended. Graft fixation was then addressed through knee flexion and extension movements, followed by garrote release, homeostasis, aspiration drain placement and sutures by planes. All cases were operated by the same surgeon.

Postoperatively, knees were maintained with orthosis in extension during six weeks, being allowed partial load with the aid of clutches after the fourth week and a physiotherapeutic rehabilitation program was kept for three months.

Subsequently, all patients were submitted to an objective (posterior drawer test) and subjective evaluation (Lysholm Scale).

## RESULTS AND DISCUSSION

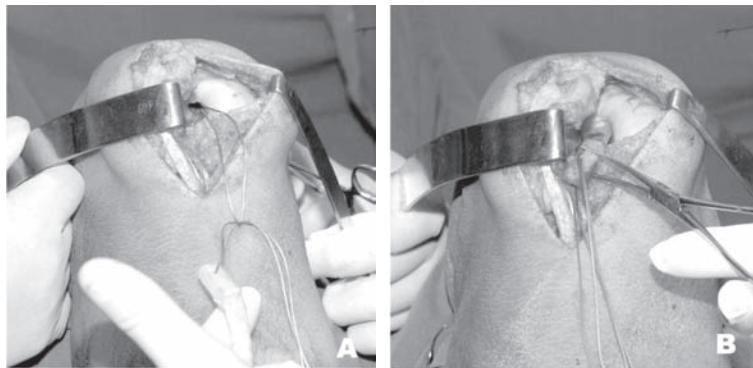
Surgical reconstruction of the knee posterior cruciate ligament still remains as a major therapeutic challenge

(14-18, 20, 21). This ligament is a complex structure; it has anatomical peculiarities, such as its tibial insertion, which makes surgical approach difficult. For being less frequent than injuries of the anterior cruciate ligament (A.C.L.), many surgeons are not experienced with this procedure. On the other hand, basic sciences studies concerned to biomechanical aspects of

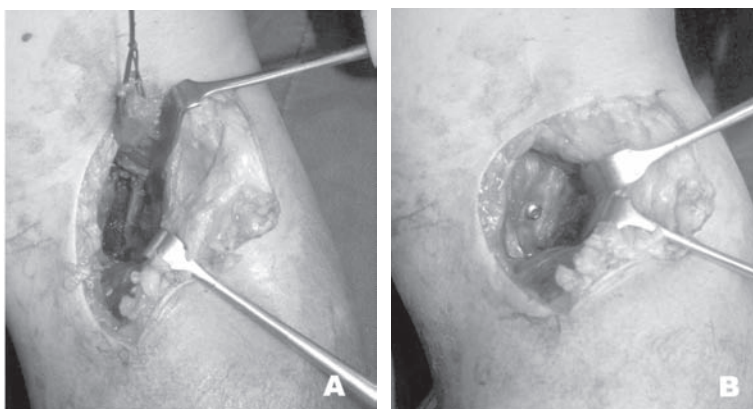
this ligament are also limited when compared to A.C.L.; thus, this makes experience with P.C.L. to be at least ten years behind A.C.L. In this study, we present outcomes achieved in 30 cases of P.C.L. reconstruction by using the tibial bed fixation (“INLAY”) technique, being postoperatively clinically followed up for an average of 20.47 months. In 67% of the cases, injuries were secondary to motorcycle accidents.

During clinical evolution, four complications were reported. Three cases (nr. 8, nr. 24 and nr. 28) presented with a restricted range of motion picture secondary to arthrofibrosis, which evolved well after manipulation under anesthesia, and one case (nr. 29) presented with dehiscence of surgical scar, knee posterior face, which resolved simply with conservative measures.

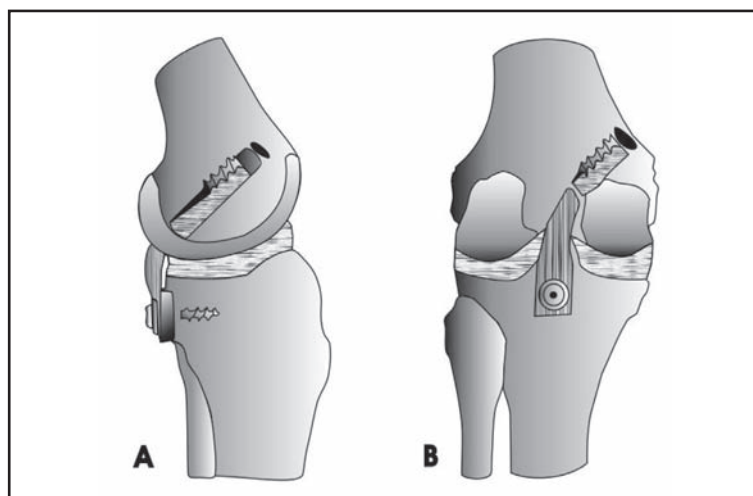
The results achieved by objective (posterior drawer test) and subjective (Lysholm



**Figure 1-A and B** – Detail of graft passing through the central third of patellar tendon at the femoral tunnel (A) and its fixation with interference screw (B).



**Figure 2-A and B** – Detail of the canal created on tibial posterior face, P.C.L. insertion (A) and graft fixation with screw and washer (B).



**Figure 3-A and B** – Schematic illustration of the fixation of a graft from the central third of patellar tendon on the femur with interference screw and on the tibia with screw and washer, at lateral (A) and posterior (B) planes.

Scale) evaluations are presented on Chart 2. From results presented on Chart 2, a statistical analysis for those data was performed aiming to establish a correlation among them and their distribution characteristics, with **Figure 4** being prepared.

In **Figure 4**, we can see that the correlation coefficient between objective and subjective variables was  $r = -0.624$ , significant to the 1% probability level. It is seen that the high values of the subjective evaluation are strongly correlated to the low values of objective evaluation, characterizing a decreasing linear correlation. Thus, the joint stability gain was consistent to better subjective evaluations provided by patients.

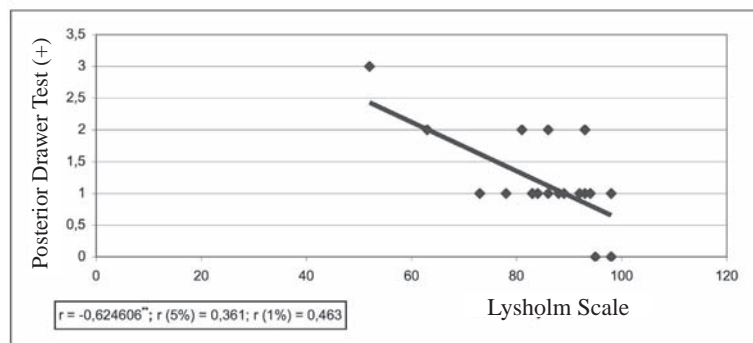
By correlating the number of cases with the subjective (Lysholm Scale) and objective (posterior drawer test) evaluations and their correspondent classifications performed postoperatively, **Chart 3** was built.

From data presented on Chart 3, **Figure 5** was prepared, where evaluation systems (subjective and objective) distribution and their correspon-

Cases	Numeric Value – Lysholm Scale	Lysholm Scale Grade	Posterior Drawer Test
1	98	E	zero
2	93	G	+1
3	98	E	+1
4	98	E	zero
5	78	F	+1
6	83	F	+1
7	88	G	+1
8	92	G	+1
9	78	F	+1
10	84	F	+1
11	78	F	+1
12	83	G	+1
13	84	F	+1
14	94	G	+1
15	94	G	+1
16	98	E	+1
17	89	G	+1
18	93	G	+2
19	93	G	+2
20	86	F	+1
21	93	G	+1
22	98	E	zero
23	52	P	+3
24	88	G	+1
25	86	G	+2
26	81	F	+2
27	95	E	zero
28	63	P	+2
29	98	E	+1
30	73	F	+1

**LYSHOLM GRADES – Excellent (E):** scores from 95 to 100; **Good (G):** scores from 84 to 94; **Fair (F):** scores from 65 to 83; **Poor (P):** scores < 64

**Chart 2 – Postoperative clinical outcomes achieved at subjective (Lysholm scale) and objective (posterior drawer test) evaluations of 30 cases of P.C.L. reconstruction with tibial bed fixation technique.**



**Figure 4 – Linear comparison achieved for subjective (Lysholm Scale) and objective (Posterior Drawer Test) evaluations.**

dent classifications at 4 levels (excellent, good, fair and poor) are shown.

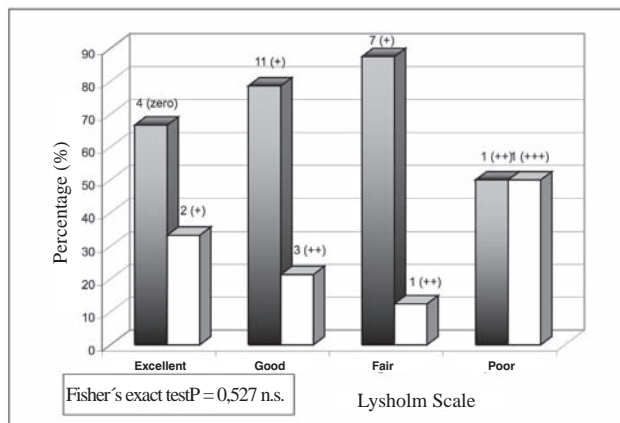
Similarly, the use of Fisher's exact test showed a p value of 0.527, which is much higher than the 0.05 commonly adopted, which leads us to accept the null hypothesis. Evaluations do not differ regarding the distribution of cases as excellent, good, fair and poor. Thus, subjective and objective evaluations present similar behaviors.

Literature emphasizes that in P.C.L. injuries, the presence of related injuries, injury time and the patient's level of activities may influence postoperative clinical evolution. Furthermore, it is worthy to highlight that in the subjective evaluation, we have patients' individual interpretation bias regarding their restraints and pain, which may be responsible for different results of the subjective evaluation with the same grades of the objective evaluation. Not less important, the presence of related injuries also contributes as a bias factor at subjective evaluation. This occurrence may be observed in cases

where a correlation with a posterolateral edge injury exists, where clinical evaluation was more unfavorable (cases nrs. 6 and 23), as shown on **Chart 1**. It is important to highlight that case nr. 23, where the worst objective evaluation was provided by a posterior drawer test graded +3, corresponds to a surgical reconstruction failure by transtibial technique. In this case series, we had negative posterior drawer tests in 4 cases. These are young pa-

Evaluation	Excellent	Good	Fair	Poor	Number of Cases
Subjective	6	14	8	2	30
Objective	4	20	5	1	30
	10	34	13	3	60

**Chart 3** – Distribution of cases submitted to subjective and objective evaluations and their correspondent classifications within levels: excellent, good, fair, and poor.



**Figure 5** – Numeric and percent distribution of subjective (Lysholm Scale) and objective (Posterior Drawer Test) evaluations of 30 cases of PCL reconstruction by tibial bed fixation ("INLAY") technique.

tients, with ages below 35 years old, with injury time shorter than 7 months, and with no major peripheral ligament injury, which may have contributed to a good postoperative clinical evolution.

## CONCLUSIONS

Although surgical reconstruction of the P.C.L. still remains as a great therapeutic challenge, the clinical results achieved in this case series have encouraged us to continue using this technique.

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