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CLINICAL OUTCOMES AFTER BICRUCIATE KNEE LIGAMENT TWO-STAGE RECONSTRUCTION

RESULTADO CLÍNICO APÓS RECONSTRUÇÃO LIGAMENTAR BICRUZADO DO JOELHO, EM DOIS TEMPOS

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"Os autores declaram inexistência de conflito de interesses na realização deste trabalho."

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Abstract

Introduction: Bicuruciate knee ligament injury has not a well-establish surgical protocol in the literature. Objective: To correlate clinical data and intraoperative findings compared to the postoperative evaluation data from Lysholm scale, Tegner activity score and SF-36 questionnaire after bicruciate knee ligament two-stage reconstruction.

Materials and Methods: 25 patients (20 males and 05 females) were evaluated, mean age 32.3 years (17 - 53 years), mean BMI 26.2(18.9 -34.9), mean duration of lesion 18.3 months (chronic lesion). The INLAY technique was applied in PCL reconstruction using the central 1/3 of the patellar tendon. After the 3-months minimum interval, ACL reconstruction was arthroscopically performed using hamstrings. An additional surgical procedure was required for 04 patients (patellar tendon -02 cases, MCL-02 cases).

Results: With a 24.8-month mean follow-up, in 60% of cases, the posterior drawer test rated zero or + (0.5 cm), while 40% as + + (1cm) and 60% of patients rated good condition/ excellent (Lysholm). Only one patient achieved the pre-lesion Tegner activity level. The duration of lesion influenced postoperative clinical results negatively, especially regarding parameters such as physical functioning limitation of physical aspects, vitality and mental health (SF-36). **Conclusion:** the bicruciate knee ligament two-stage reconstruction improved the knee stability and subjective evaluation, but, 96% of patients did not recover the pre-injury status of physical activity. Moreover, the time of injury had an inverse statistical correlation with the subjective evaluation of physical functioning, limitation of physical aspects, vitality and mental health in the S-36 score.

Keywords: posterior cruciate ligament; Knee injury; Ligaments; Patient Reported Outcomes Measures.

Level of evidence: IV

Introduction

The bicruciate knee ligament injury [posterior cruciate ligament (PCL) and the anterior cruciate ligament (ACL)] is defined as one of the most severe injuries of the knee joint, taking on a chapter of its own in the universe of knee ligament lesions [1, 2]. In this context, the surgeon's knowledge of this complex anatomy and biomechanics of both ligaments, the history and mechanism of trauma, patient's level of physical demand plays a vital role in decision-making.

This complex knee ligament injury is described as a rare injury, in most cases, associated with high-energy traumas, with or without lesions of other joints, structures or organs. Moreover, very often, meniscal and osteochondral injuries are also present together with other peripheral ligament lesions, contributing to worsening of symptoms, instability and joint degeneration [3].

Boisgard et al. [4] described four types of bicruciate knee ligament injury mechanisms. The first one is a simple femorotibial gaping on a plane around a perpendicular axis; the second occurs due to femorotibial translation and the third is a combination of simple gaping and knee translation, and the last type is a combination of femorotibial gaping and translation in isolation or association with rotational movements [5]. However, in clinical practice, the mechanism of trauma cannot be identified, especially in chronic cases, due to lack of information reported by the patient.

From a biomechanical viewpoint, the knee bicruciate injury affects stability and normal joint kinematics with significant clinical repercussions that interfere in the individual's quality of life. Given the complexity of this lesion, a surgical procedure is indicated.

The outcomes of bicruciate knee ligament reconstruction on quality of life, improvement of symptoms, return to work and sports practice, as well as subjective and objective assessments of outcomes, is still a topic of substantial interest since few scientific studies address this subject.

This study aims to correlate clinical data and intraoperative findings compared to the postoperative evaluation data from Lysholm scale, Tegner activity score and SF-36 questionnaire after bicruciate knee ligament two-stage reconstruction.

Material and methods

This retrospective and descriptive study analyzed thirty-one (31) patients, who underwent bicruciate knee ligament two-stage reconstruction between 2002 and 2010.

Exclusion Criteria

Six patients were excluded for the following reasons: bilateral lesion- one patient, intra-articular fracture (fracture of the lateral tibial plateau) - one patient, tibial osteotomy – two patients, loss to follow-up- two patients. Therefore, the study consisted of twenty-five patients (Table 1).

Table 1 - Characteristics of the patients, involved knee, mechanism of trauma and associated injuries**Cases**

Twenty-five patients were reassessed (twenty men and five women), average age 32.3 ± 9.81 years (17-53), mean BMI 26.2 ± 3.27 (18.9 - 34.9), fourteen right knees and eleven left knees.

Regarding the mechanism of injury: car, motorcycle and bicycle accidents were responsible for 72%, while sports practices 16% and falls or sprains 12%.

The average duration of the lesion was 18.28 ± 29.63 months (1 - 120) and so, all patients had chronic injuries.

Surgical Technique

The mean age at surgery was 29.4 years (16 – 50). One of the surgical techniques used was the INLAY PCL reconstruction with a graft of the central third of patellar tendon. The graft was fixed by one interference screw in the femoral tunnel and cortical screw with washer in the tibial tunnel (Figure 1). In the postoperative care, the knee extended was maintained at inguinal–malleolus splint for six weeks.

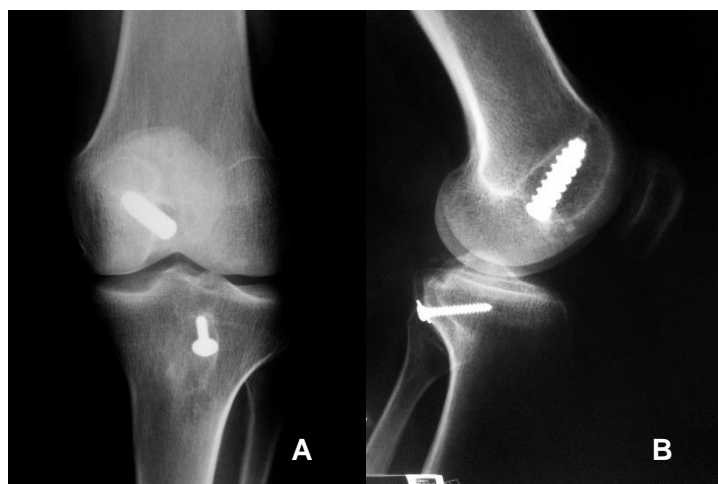


Figure 1 – Postoperative radiographs of open PCL Inlay reconstruction: anteroposterior (A) and lateral (B) view of the knee.

After the 3-months minimum interval and an improvement in the range of motion, the patient underwent anatomical, outside-in position guide, arthroscopic ACL reconstruction using quadruple hamstring grafts with femoral-tibial fixation using interference screws (Figure 2).

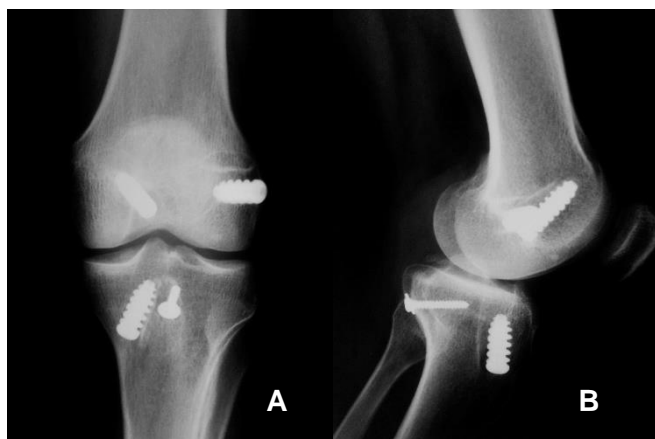


Figure 2 – The arthroscopic ACL reconstruction: anterior-posterior (A) and lateral (B) radiographs of the knee.

It is important to note that four of the patients with associated ligament lesions required additional surgery – two patients for patellar tendon reconstruction using contra-lateral semitendinosus and gracilis grafts and two patients for medial collateral reconstruction using contra-lateral semitendinosus and gracilis grafts.

Intraoperative findings

Data on meniscal and chondral lesions (grade ≥ 2) were obtained from medical records. These lesions were prevalent on the medial side of the knee (femoral condyle, medial tibial plateau), patellar surface. As they were considered as small injury, no measurement of cartilage damage area was done, and the reports informed just the presence or not of cartilage damage.

Postoperative evaluation

With a mean postoperative follow-up of was 24.8 ± 20.63 months (9 - 92), data regarding clinical and radiological assessment and functional assessment of the questionnaires (Lysholm scale, Tegner activity score and SF-36 questionnaire were also collected. The circumference of the thighs measured at 14 cm above the superior end of the patella was recorded. Informed consent was obtained from all the patients and the study also received the approval of this service's Ethics Committee (CEP n° 963/2010).

Statistical Analysis

The data were statistically analyzed using the SPSS 13.0 program with numerical variables and categories applying the Mann-Whitney, Spearman and Wilcoxon tests with significance level $p < 0.05$.

In order to identify variables that have an influence on quality of life and clinical assessment, the univariate and multivariate linear regression analyses were applied. In

the absence of normality, positions on the variable dependents were transformed. The stepwise selection criterion was used. The significance level applied for statistical tests was 5%.

Results

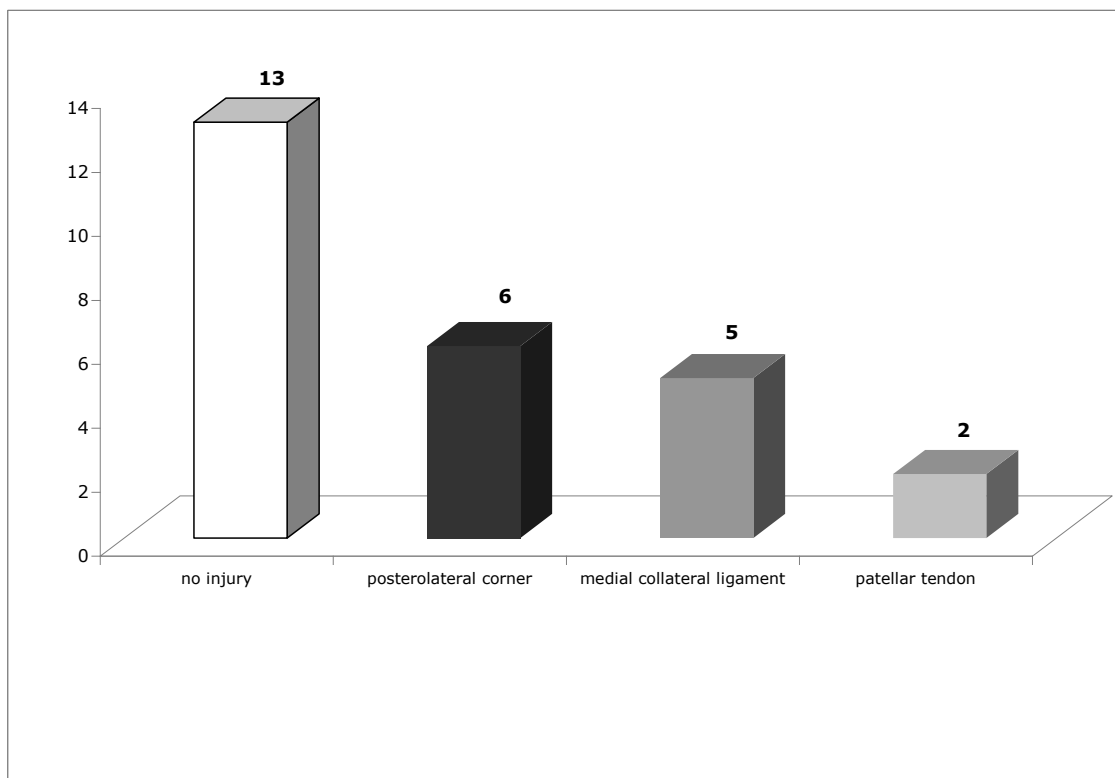
All 25 patients in this study fully recovered a range of motion. Ten patients (40%) revealed that the circumference difference between the thighs measured at 14 cm above the superior end of the patella was greater than 2cm.

The postoperative evaluation showed a reduction tibial posterior drop on posterior drawer test of at least one level (+ or 0.5cm). therefore, So, seven patients (28%) presented a negative posterior drawer test, while eight patients (32%) showed 0.5 cm residual posterior drawer (+/+++) test, ten patients (40%) presented 01 cm residual posterior drawer (+/+++) and none of the patients presented residual posterior drawer ≥ 1.5 cm (+++ /+++) in the operated knee.

The chondral lesion was found in 16 patients (64%), meniscal lesion in 11 patients (44%) and associated ligament lesions in 12 patients (48%). The charts recorded the intra-operative findings of chondral injury, but no measurement was performed.

The associated ligament lesions were patellar tendon lesions in 02 patients (08%), medial collateral ligament -05 patients (20%) and posterolateral corner -06 patients (24%) (Table 2). It should be noted that patellar tendon reconstruction (two patients) and medial collateral reconstruction (two patients) was performed, while, none of six patients diagnosed with mild posterolateral injury was submitted to the surgical reconstructions.

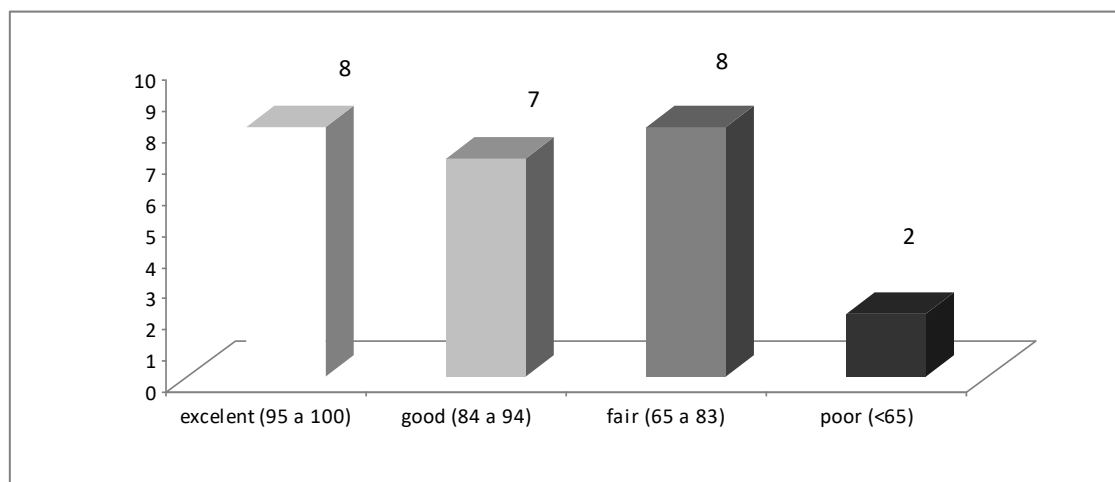
Table 2 – Distribution of associate ligament lesions in 25 evaluated cases



No statistical difference was observed in the groups when analyzed for age, BMI, presence of chondral, meniscal and ligament associated lesions as well as residual posterior drawer.

According to the Lysholm score (83.44 ± 16.83), 08 patients (32%) were classified as excellent, 07 (28%) good, 08 patients (32%) regular and 02 patients (8%) poor (Table 3).

Table 3 – Distribution of Lysholm scores of 25 evaluated cases.



The Tegner activity score revealed that postoperative level of physical activity was lower compared to the no injury status (Table 4); however, this change showed no difference in the statistical analysis. In this series of cases, only one patient achieved the pre-injury activity level ($p < 0.001$).

Table 4 – Distribution of patients according to the three levels of the Tegner score (light, moderate and high) and Postoperative Tegner deficit (mean values and standard deviation).

Condition	TEGNER (physical activity level)			postoperative Tegner deficit
	light (0 to 3)	moderate (4 to 6)	high (7 to 10)	
pre-injury	7	13	5	35.56 ± 18.81
postoperative	16	7	2	

The Lysholm scale presented a statistical correlation with the Tegner deficit – improved Lysholm scale meant a smaller drop in the physical activity level after bicruciate knee ligament reconstruction.

The preoperative duration of the lesion presented an inverse statistical correlation with physical functioning, limitation of physical aspects, vitality and mental health (SF-36 questionnaire), suggesting a negative impact on the final clinical result. Table 5 presents the results of the SF-36 questionnaire.

Table 5– Mean, standard deviation and range SF-36 questionnaire values of 25 patients.

SF-36 scores	mean values	SD	range
physical functioning	71	± 21.2	(30 - 100)
role physical	60	± 38.9	(0 - 100)
bodily pain	74	± 25.0	(22 - 100)
general health	80	± 17.2	(42 - 100)
vitality	72	± 19.2	(25 - 100)
social functioning	86	± 17.8	(37 - 100)

role emotional	85	± 27.4	(0 - 100)
mental health	76	± 14.8	(48 - 100)

Duration of the postoperative period did not demonstrate a statistical correlation with the variables studied, indicating that a postoperative period of nine months was sufficient time to provide the final clinical outcome.

Discussion

The most important finding of this study was that even though the bicruciate knee ligament two-stage reconstruction had improved the knee stability and subjective evaluation, the pre-injury status of physical activity was not re-establish in 96% of patients. Moreover, the time of injury had an inverse statistical correlation with the subjective evaluation of physical functioning, limitation of physical aspects, vitality and mental health in the S-36 score.

Concomitant lesions are commonly seen in the bicruciate ligaments injury due to its high-energy trauma nature of these injuries. [3]. In this study, 72% of the cases were related to car and motorcycle accidents (Table 1).

In world literature, the unsatisfactory and the inconsistent clinical outcomes after conservative treatment have stimulated a surgical approach, but the ideal moment for the surgery has not been standardized. Shapiro et al. and Harner et al. [6, 7] recommend surgery between the second and third week after injury, while Chuang et al. [8] propose the surgical procedure only after regaining range of motion.

Hayashi et al. [9] evaluated joint mobility after surgical bicruciate reconstruction and observed motion deficit in 15% of the patients (n=19), while Lo et al., 2009 [10] reported motion deficit in 27% of the cases (n=11) and Hirschmann et al. [11] observed motion deficit in 38% of the patients (n=24). However, in this study, all the patients recovered knee range of motion after undergoing the two-stage surgery. Therefore, it appears that the magnitude of surgical trauma interferes in postoperative joint mobility.

Analyzing the postoperative stability of the knee, Hirschmann et al. [11] reported that in 96% of the patients in a series of acute and chronic cases and Ohkoshi et al. [12] observed residual posteriorization of less than 0.5cm in 100% of the cases. Spiridinov et al. [13] reported significant improvement in subjective and objective outcome and with objective knee stability after endoscopic treatment of isolated and combined grade-III PCL double-bundle reconstruction

Although in this series of cases, the preoperative knee stability was improved after bicruciate knee ligament reconstruction, it was observed a residual posteriorization less

than or equal to 0.5cm in 60% of the patients. It should keep in mind that it was a heterogenic series of chronic cases, where, 28% of patients had associated injuries such as a bone fracture or patellar tendon rupture.

Lo et al. [10] evaluated 11 patients with bicruciate lesions and detected related ligament and meniscal injuries in 73% and 27% of the patients, respectively, while Subbiah et al. [14] reported related ligament lesions in 73%, LUSTIG et al. [3] observed in 83,4% to 97% of the patients and Fanelli et al. [15] in a series of 35 cases of knee dislocation, reported the presence of related ligament lesions in 97% of the cases.

In the present series, 48% had related ligament lesions (Table 2), and in 16% of these cases, an additional surgical procedure was performed, while 44% of the cases had meniscal injuries.

Lo et al. [10] analyzed postoperative results and did not record any postoperative complications. This study also did not reveal any type of postoperative complication.

In a series of 9 patients with chronic bicruciate lesions, Schofer et al. [16] reported a mean Lysholm score of 74. Hirschmann et al. [11] registered a mean Lysholm score of 85 (n=24), in 17 cases of acute lesions and 7 cases of chronic injuries. Lo et al. [10] obtained a mean score of 88 for 11 patients, who were all chronic patients. In the present study, an overall Lysholm score of 83 was classified as regular (Table 3).

It is important to note that in the present study, the presence of chondral lesions was reported in 64% of cases and these patients had poorer subjective Lysholm scores than patients without chondral injuries (82.6 ± 19.5 and 85.0 ± 11.5 , respectively). However, no statistical difference was noted ($p=0.609$). Lustig et al. [3] related to the presence of chondral lesions in 42% of the cases.

It should also be emphasized that imprecise diagnoses, coupled with the delayed referral of these patients to specialized services, contributed to this sample's distribution of prominently chronic cases.

About the pre-injury activity level, it was observed that this complex lesion significantly impaired the patient's quality of life. Hirschmann et al. [11] reported that 33% of the patients (08 patients) attained the pre-injury activity level, while Lo et al. [10] observed that 82% of the patients (09/11) achieved the pre-injury activity level. However, in this study, only one patient attained the pre-injury activity level (4%) (Tegner score activity = 4) (Table 4).

Considering the isolated ACL reconstruction, Möller et al. and Nunez et al. [17, 18] reported a mean SF-36 score superior to 70. In contrast, in isolated PCL reconstruction, Sekiya et al. [19] presented a mean score close to 50. The authors have emphasized that acute and subacute PCL injuries had a better score compared to chronic injuries ($p=0,036$).

Analyzing bicruciate reconstruction, Schofer et al. and Hirschmann et al. [16, 20] observed a mean SF-36 score of physical functioning varied from 43 to 58 points, while, in the present study the mean values were 60 to 80 points (Table 5).

Moreover, the time of preoperative injury showed an inverse correlation with four items of SF-36 questionnaire, such as physical functioning, limitation of physical aspects, vitality and mental health, suggesting a negative effect of lesion duration on the postoperative clinical result.

However, variables such as age, BMI, related ligament lesions, posterior residual drawer and duration of postoperative follow-up did not demonstrate a correlation with postoperative results.

Considering the limitations, this is a non-randomized, retrospective study of heterogenic series of patients with chronic lesions were submitted a bicruciate knee ligament two-stage reconstruction using autograft. However, its importance lies in the fact that it evaluates a set of 25 patients with bicruciate injuries who underwent the same two-stage surgical procedure, performed by the same surgeon. Bearing in mind a learning curve involved on this surgical procedure, where, two or more autografts needs to be harvested, the surgical trauma and time-lapsed, a bicruciate knee ligament two-stage reconstruction could be considered as a realistic strategy.

Conclusion

The bicruciate knee ligament two-stage reconstruction improved the knee stability and subjective evaluation, but, 96% of patients did not recover the pre-injury status of physical activity. Moreover, the time of injury had an inverse statistical correlation with the subjective evaluation of physical functioning, limitation of physical aspects, vitality and mental health in the S-36 score.

Declaração da contribuição de autores

Cada autor contribuiu individual e significativamente para o desenvolvimento deste artigo. Piedade SR e Inada MM: realização de cirurgias; Piedade SR e Inada MM: análise dos dados e redação; Piedade SR: revisão do artigo e conceito intelectual do artigo.”

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