KLINICAL OUTCOMES AFTER TWO-STAGE BICRUCIATE KNEE LIGAMENT RECONSTRUCTION

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

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ABSTRACT

Objective: To correlate clinical and intraoperative findings with the postoperative evaluation of two-stage bicruciate knee ligament reconstruction. Methods: The study was conducted with 25 patients (20 men and 05 women) with mean age of 32.3 years, mean body mass index (BMI) of 26.2, and mean lesion duration of 18.3 months. The treatment consisted of an Inlay reconstruction of the posterior cruciate ligament (PCL) followed by the anterior cruciate ligament (ACL) reconstruction, at least 3 months after the first surgical procedure. Four patients required additional procedures: patellar tendon (02), medial collateral ligament (MCL) (02). Results: With an average follow-up of 24.8 months, 60% of the patients scored zero or + at the posterior drawer test, while 40% scored ++; 60% of patients were evaluated as good/excellent according to the Lysholm scale. Only one patient reached the pre-injury Tegner activity level. Injury duration had a negative influence on functional limitation, vitality, and mental health (SF-36). Conclusion: Although two-stage bicruciate knee ligament reconstruction improved knee stability and self-assessment, 96% of patients did not recover their pre-injury state. In the 36-item short form survey (SF-36), injury duration was inversely correlated with self-assessment of functional capacity, physical limitation, vitality, and mental health. Level of Evidence II, retrospective study.

Keywords: Posterior Cruciate Ligament. Knee Injuries. Ligaments. Patient Reported Outcomes Measures.

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INTRODUCTION

Bicruciate knee ligament injury, that it, lesions affecting both the posterior cruciate ligament (PCL) and the anterior cruciate ligament (ACL) simultaneously, is one of the most severe knee joint injuries, occupying a chapter of its own in the universe of knee ligament lesions.1,2 Considering that, surgeons’ knowledge about the complex anatomy and biomechanics of both ligaments, trauma history and mechanism, and patients’ physical demand level plays a vital role in the decision-making process of this condition. This complex knee ligament injury is a rare injury, mostly associated with high-energy traumas incurring or not in lesions of...
other joints, structures, or organs. Meniscal and osteochondral injuries also commonly occur with other peripheral ligament lesions, worsening symptoms, instability, and joint degeneration. Boisgard et al. described four types of bicruciate knee ligament injury mechanisms: the first one concerns a simple plane femorotibial gaping around a perpendicular axis; the second occurs due to femorotibial translation; the third is a combination of simple gaping and knee translation; and the last is a combination of femorotibial gaping and translation, isolated or associated with rotational movements. However, the clinical practice may fail in identifying the mechanism of injury, especially in chronic cases, due to patients underreporting.

From a biomechanical perspective, knee bicruciate injuries affect stability and normal joint kinematics, causing significant clinical repercussions that interfere in individuals’ quality of life. Given the complexity of this lesion, specialists indicate a surgical procedure.

Studies approaching the outcomes of bicruciate knee ligament reconstruction on quality of life, symptoms improvement, return to work and sports practice, as well as subjective and objective assessments of outcomes are still scarce on the literature, thus presenting a topic of substantial interest.

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

**MATERIALS AND METHODS**

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

**Exclusion criteria**

Patients presenting bilateral lesion (n = 1), intra-articular fracture of the lateral tibial plateau (n = 1), and tibial osteotomy (n = 2) were excluded from the study. Two patients were also lost to follow-up, totaling six excluded patients. Therefore, the study comprised 25 patients (Table 1).

| patients | age | gender | BMI | affected knee | mechanism of injury | associated knee injuries | associated injuries |
|----------|-----|--------|-----|--------------|--------------------|-------------------------|---------------------|
| 1        | 17  | F      | 19.9| R            | bicycle            | condral                 | MCL                 |
| 2        | 21  | F      | 28  | R            | motorcycle         | present                 | MCL / PT            |
| 3        | 24  | M      | 25.8| R            | motorcycle         | present                 | femoral fracture (diaphysis) |
| 4w       | 24  | M      | 25.9| R            | motorcycle         | present                 | PLC                 |
| 5        | 24  | M      | 27.9| L            | motorcycle         | present                 | PLC                 |
| 6        | 24  | M      | 28  | R            | bicycle            | present                 |                     |
| 7        | 25  | M      | 22.4| L            | motorcycle         | present                 | tibial fracture (diaphysis) |
| 8        | 27  | M      | 26.2| L            | sports             | present                 |                     |
| 9        | 28  | M      | 26.4| R            | motorcycle         | present                 |                     |
| 10       | 28  | M      | 25.2| R            | motorcycle         | present                 |                     |
| 11       | 28  | M      | 25  | R            | motorcycle         | present                 | PCL                 |
| 12       | 29  | M      | 22.9| L            | motorcycle         | present                 |                     |
| 13       | 29  | M      | 26.2| L            | sports             | present                 | MCL                 |
| 14       | 30  | M      | 27.7| R            | car                | present                 | PLC                 |
| 15       | 32  | M      | 26.2| L            | motorcycle         | present                 | clavicle + C2 fracture |
| 16       | 33  | M      | 26.9| R            | sprains            | present                 | tibial fracture (proximal) |
| 17       | 34  | M      | 24.1| L            | motorcycle         | present                 |                     |
| 18       | 35  | M      | 24  | L            | motorcycle         | present                 | forearm fracture    |
| 19       | 35  | M      | 30  | L            | motorcycle         | present                 | PLC                 |
| 20       | 37  | F      | 18.9| L            | car                | present                 | femoral fracture + face + retine injury |
| 21       | 41  | M      | 26.9| R            | sports             | present                 |                     |
| 22       | 46  | F      | 30.5| R            | sprains            | present                 |                     |
| 23       | 52  | M      | 28.4| R            | motorcycle         | present                 | PLC                 |
| 24       | 52  | F      | 34.9| R            | sprains            | present                 | MCL                 |
| 25       | 53  | M      | 27.4| L            | bicycle            | present                 |                     |

**Table 1. Patients’ characteristics, affected knee, mechanism of injury, and associated injuries.**
Cases
Twenty-five patients were reassessed (twenty men and five women). Among these, mean age was 32.3 ± 9.81 years (17-53), mean body mass index (BMI) was 26.2 ± 3.27 (18.9 – 34.9), and 14 presented the right knee affected whereas 11 presented the left knee. Regarding the mechanism of injury, car, motorcycle, and bicycle accidents were responsible for 72% of injuries, sports practices for 16%, and falls or sprains for 12%. Average lesion duration was 18.28 ± 29.63 months (1 – 120), so that all patients had chronic injuries.

Surgical technique
Patients’ mean age at surgery was 29.4 years (16 – 50). Inlay posterior cruciate ligament (PCL) reconstruction with a central third patellar tendon graft was one of the surgical techniques used. The graft was fixed in the femoral tunnel with an interference screw and in the tibial tunnel with cortical screw and washer (Figure 1). In the postoperative care, the knee remained extended in inguinal–malleolus splint for six weeks.

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

After at least 3 months from the first surgical procedure and observing an improvement in the range of motion, patients underwent anatomical outside-in arthroscopic anterior cruciate ligament (ACL) reconstruction using quadruple hamstring grafts and interference screws fixation in both the femur and tibia (Figure 2).

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

Four patients with associated lesions in ligaments required additional surgery: two underwent patellar tendon reconstruction using contralateral semitendinosus-gracilis grafts, and two underwent medial collateral reconstruction using contralateral semitendinosus-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. For being considered minor injuries, the reports only contained information on the presence or absence of cartilage damage, without areas measurement.

Postoperative evaluation
Mean postoperative follow-up was 24.8 ± 20.63 months (9 – 92). Data regarding clinical and radiological assessment was collected, as well as on functional assessment according to the Lysholm scale, Tegner activity score, and the 36-item short form survey (SF-36). Thighs circumference was measured 14 cm above the upper end of the patella. All participants agreed to participate by providing informed consent, and the study was approved by the institution Ethics Committee (CEP no. 963/2010).

Statistical analysis
Statistical analyses were conducted on the Statistical Package for the Social Sciences (SPSS) 13.0. Numerical and categorical variables were tested using the Mann-Whitney, Spearman, and Wilcoxon tests, with significance level set at p < 0.05. Univariate and multivariate linear regression analyses were performed to identify variables influencing participants’ quality of life and clinical assessment. In the absence of normality, dependent variables were transformed using stepwise selection. Statistical tests were conducted considering a 5% significance level.

RESULTS
After treatment completion, all 25 patients fully recovered the range of motion. In 10 patients (40%), the difference in thighs circumference was greater than 2cm when compared to postoperative evaluation.

According to the posterior drawer test, tibialis posterior drawer decreased by at least one level (+ or 0.5 cm). Seven patients (28%) presented a negative posterior drawer, eight patients (32%) showed a 0.5-cm-residual posterior drawer (+/++), and ten patients (40%) presented a 1-cm-residual posterior drawer (++/+++). But none presented residual posterior drawer ≥ 1.5 cm (+++/+++) in the operated knee.

Sixteen patients presented chondral lesion (64%), 11 presented meniscal lesion (44%), and 12 associated ligament lesion (48%). Clinical records contain intraoperative findings on chondral injury, but no measurements.

Regarding associated lesions in ligaments, two patients presented patellar tendon injuries (08%), five presented medial collateral ligament injuries (20%) and six patients posterolateral corner injuries (24%) (Figure 3). Patellar tendon reconstruction was performed on two patients and medial collateral reconstruction on other two, but none of the six patients diagnosed with mild posterolateral corner injury was submitted to surgical reconstructions.

Figure 3. Distribution of associated ligament lesions in the 25 evaluated cases.
We found no statistical difference among groups regarding age, BMI, presence of associated chondral, meniscal, and ligament lesions, and residual posterior drawer. According to the Lysholm score (83.44 ± 16.83), eight patients (32%) presented excellent results, seven (28%) presented good results, eight (32%) regular, and two (8%) poor results (Figure 4).

DISCUSSION

Although two-stage bicruciate knee ligament reconstruction improved patients’ knee stability and self-evaluation, 96% of patients did not achieve the pre-injury physical activity level. Injury period was inversely correlated with self-evaluated physical functioning, physical limitation, vitality, and mental health in the 36-item short form survey (SF-36). Bicruciate ligament injuries are caused by high-energy traumas, so that associated lesions are commonly observed in these injuries. In our study, 72% of the cases owed to car and motorcycle accidents (Table 1).

The unsatisfactory and inconsistent clinical outcomes resulting from conservative treatments fostered the need for a surgical approach to treat bicruciate ligament injuries. Yet, no consensus has been reached in the literature regarding the ideal moment for surgery. Whereas Shapiro and Freedman and Harner and Poehling recommend surgery between the second and third week post-injury, Chuang et al. believe that surgery should only be performed once the patient has restored the range of motion. When evaluating joint mobility after surgical bicruciate reconstruction, Hayashi et al. observed 15% of the patients (n = 19) to present motion deficit; for Lo et al., such condition occurred in 27% of the cases (n = 11) and for Hirschmann et al. in 38% (n = 24). However, all of our study patients recovered knee range of motion after the two-stage surgery, suggesting that surgical trauma magnitude interferes in postoperative joint mobility. Hirschmann et al. found 96% of patients in a series of acute and chronic cases to present knee postoperative stability. According to Ohkoshi et al., 100% of the cases presented residual posterior drawer of less than 0.5 cm. Spiridinov, Slinkard, and LaPrade reported significant improvement in subjective and objective evaluations and knee stability after endoscopic treatment of isolated and combined double-bundle posterior cruciate ligament (PCL) grade-III reconstruction.

Our results show an improvement in knee stability after bicruciate knee ligament reconstruction. Yet, 60% of the patients presented a residual posterior drawer of less than or equal to 0.5 cm. We should also consider that our sample was heterogeneous, with 28% of patients presenting associated injuries such as a bone fracture or patellar tendon rupture. Lo et al. evaluated 11 patients with bicruciate lesions and found 73% of them to present associated ligament injuries and 27% to present meniscal injuries. Subbiah et al. reported associated ligament lesions in 73% of their study sample, Lustig et al. in 83.4% to 97%, and Fanelli and Edson in 97% of 35 knee dislocation cases. Within our study sample, 48% had associated ligament lesions (Table 1), 16% of which required additional surgical procedure. In turn, 44% of the cases had meniscal injuries.

Correcting the results reported by Lo et al., our study recorded no postoperative complications. In a study conducted with 9 patients with chronic bicruciate lesions, Schofer et al. reported a mean Lysholm score of 74. Hirschmann et al. analyzed 17 cases of acute lesions and 7 cases of chronic injuries and registered a mean Lysholm score of 85 (n = 24). Lo et al. obtained a mean score of 88 for 11 chronic patients. In our study, an overall Lysholm score of 83 was classified as regular (Figure 4). A total of 64% of our sample presented chondral lesions, thus achieving poorer subjective Lysholm scores than patients without these injuries (82.6 ± 19.5 and 85.0 ± 11.5, respectively). However, we verified no statistical difference between these groups (p = 0.609).

Lustig, Leray, and Boisrenoult reported 42% of their study sample to present chondral lesions. Imprecise diagnoses, added to these patients’ delayed referral to specialized services, contributed to chronic cases within our sample.
Regarding pre-injury activity level, we found this complex lesion to significantly impair patients' quality of life. In a study conducted by Hirschmann et al.\(^11\), 33% of the patients (n = 8) attained the pre-injury activity level, whereas for Lo et al.\(^15\) this number was 82% (9 out of 11). However, only one of the participants in our study attained the pre-injury activity level (4%) (Table 2).

Considering isolated anterior cruciate ligament (ACL) reconstruction, Möller, Weidenhielm and Werner,\(^17\) and Nuñez et al.\(^18\) recorded a mean SF-36 score ranging from 43 to 58 points, whereas in our study mean scores were between 60 to 80 points (Table 3).

When analyzing bicruciate reconstruction, Schofer et al.\(^16\) and Hirschmann et al.\(^20\) observed a mean physical functioning SF-36 score ranging from 43 to 58 points, whereas in our study mean values were between 60 to 80 points (Table 3).

We also found preoperative injury period to be inversely correlated with the following items of the SF-36 questionnaire: physical functioning, physical limitation, vitality, and mental health. These findings indicate a negative effect of lesion duration on the postoperative outcomes.

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