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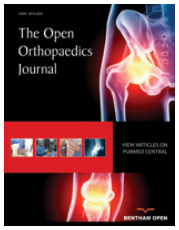

RESEARCH ARTICLE

# Clinical Evaluation of Patients with a Delayed Treatment of Anterior Cruciate Ligament Rupture

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**Abstract:**

***Background:***

Isolated ACL lesions can occur in up to 44.5% of sports patients and its association with a meniscal injury can be 30-80%.

***Objective:***

The aim of our study was to evaluate and compare clinical function of the knee in patients with reconstruction of the ACL, with or without meniscal injury.

***Methods:***

This was a retrospective study during a four-year period of patients with ACL repaired injury. Inclusion criteria were indistinct gender, >18 years of age with a primary ACL repaired injury (with or without associated meniscal injury). The exclusion criterion were an associated knee injury (except meniscal injury), an associated fracture in the lower limb, previous knee surgery, reconstruction surgery, graft failure after 7 months, rheumatological or psychiatric disease. The Tegner Lysholm Knee Scoring Scale, the International Knee Documentation Committee (IKDC) form and a Visual Analog Scale (VAS) were applied. The patients were divided into groups, ≤1 year and >1 year of follow-up after surgery , and in ACL injury alone or ACL plus meniscal injury.

***Results:***

A total of 126 ACL injuries were analyzed. No significant difference was observed between groups in demographic data. In the patients with meniscal injury, the medial meniscus was involved in 24 (50%) cases, and the lateral meniscus 22 (46%). No difference was observed between groups in the evaluation with the Lysholm-Tegner score, IKDC and VAS.

***Conclusion:***

Patients with isolated ACL lesions or ACL lesions plus meniscal injuries, treated with partial meniscectomy, presented a similar clinical and functional evolution even after four years of treatment.

**Keywords:** ACL injury, Meniscal injury, IKDC, Tegner Lysholm, delayed treatment, Meniscectomy.

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|---|---|---|---|

## 1. INTRODUCTION

Anterior cruciate ligament (ACL) injury represents over 50% of knee traumatic lesions and it has an estimated injury rate of 3,000 cases per year, being the most common ligament injury in the United States [1, 2]. This injury requires between 50 and 105 thousand surgical reconstructions and nearly 400,000 reconstructions worldwide annually [2].

Isolated ACL lesions can occur in up to 44.5% of sports patients and its association with a meniscal injury can be 30-80% [3 - 5]. The time between injury and surgical repair has been shown to be associated with increased knee lesions. In adolescents, it was found that 42.5% of ACL cases had a

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meniscal injury when operated more than 6 months after the initial lesion. While the lateral meniscus was more frequently injured in patients with more than 6 months between the ACL injury and surgical repair, a medial meniscus injury was observed in patients with less than 6 months. The delay in surgery greater than six months caused an increase in the frequency and severity of meniscal injuries, and decreased preoperative scores [6, 7]. It has been reported that the incidence of concomitant medial and lateral meniscal tears lies between 25-45% and 31-65%, respectively [8]. According to Salem et al., there is no difference in the incidence in meniscal injuries between noncontact and contact lesions in both menisci [9].

The medial meniscus (MM) surgery rate is reportedly six-times greater in patients who undergo ACL reconstruction ≥12 months after an ACL injury. The MM is an important secondary stabilizer for anterior tibial translation (10). ACL reconstruction surgically removes excessive stress on the posterior segment of the MM in flexion of the knee, and this reconstruction should not only improve knee instability, but also be a necessary treatment to protect the MM [10].

A surgical reconstruction within 2 years from the time of injury to reduce the likelihood of an increased meniscal lesion is recommended [11, 12]. Cain *et al*. report that the factors associated with an increased likelihood of meniscus tear are male gender, primary reconstruction of ACL, and less than 2 weeks between injury and surgery. A meniscus tear in primary reconstruction of ACL was observed in 51.9% of patients [13]. The aim of our study was to evaluate and compare the clinical function of the knee with the Lysholm-Tegner score, the International Knee Documentation Committee Form (IKDC) and pain using the Visual Analogue Scale (VAS) in patients with reconstruction of the ACL, with or without meniscal injury.

## 2. MATERIALS AND METHODS

The Research Ethics Committee of our institution approved this retrospective study. Patients with an ACL repaired injury were analyzed during a four-year follow-up period. The patients were divided in two principal groups, group 1, patients with only ACL, and group 2, patients with ACL injury plus meniscal injury. The follow-up time after surgery was also studied and it was divided into 2 groups: one year or less after surgery, and more than one year after surgery. Inclusion criteria were indistinct gender, age >18 years, and primary ACL repaired injury (with or without associated meniscal injury). The exclusion criteria included an associated knee injury (except meniscal injury), an associated fracture in the lower limb, previous knee surgery, reconstruction surgery, graft failure after 7 months, and rheumatological or psychiatric disease. Elimination criterion was incomplete data in medical records. The collected data included age, gender, body mass index (BMI), knee side affected, time in months between injury and surgery, and years of follow-up after surgery, which was divided into ≤1 and >1 year, type of graft used (autograft or allograft), and associated meniscal injuries. The Tegner Lysholm Knee Scoring Scale [14], The International Knee Documentation Committee (IKDC) Form [15] and a visual analog scale (VAS) [16] were applied before and after ACL repair in order to identify knee functionality and pain results between ACL alone, and ACL and meniscal injury groups.

### 2.1. Statistical Analysis

The Kolmogorov-Smirnov test was performed for independent samples in order to analyze data distribution ($p < 0.05$). Then, a comparison between groups (ACL versus ACL and meniscal Injury) was made; if the distribution was parametric a t-test for independent samples was performed or the Mann-Whitney U test was used if the distribution was non parametric ($p < 0.05$). The Chi-square test was used for nominal variables. IBM® SPSS® Statistics version 20 for Mac was used for all statistical analyses.

## 3. RESULTS

In the four years of evaluation, 140 patients were treated for ACL injury, 14 were excluded due to exclusion criteria, and a total of 126 ACL injuries were analyzed.

### 3.1. Demographic Data

No significant difference was found between groups. The median age of all patients was 28 years (range: 21-38). The majority of patients were male and they also had a normal BMI; 40 patients (32%) were overweight or obese. The graft more frequently used in both groups of patients was the autograft (gracillis/semitendinous). Follow-up after surgery in patients ≤1 year was 0-1, median 1 year; range in patients >1 year was 2-4, median 3 years. There was no difference in follow-up after surgery in either group of patients (ACL injury, and ACL injury plus meniscal injury) (Table **1**).

In patients with meniscal injury, it was observed that the medial meniscus was involved in 24 (50%) cases, and the lateral meniscus in 22 (46%); 2 cases presented lesion of both meniscuses. All meniscal injuries were treated with partial meniscectomy.

In the comparison of patients with ACL injury alone and ACL injury plus meniscal, the following results were found: in the evaluation of the Lysholm-Tegner score, no significant difference was observed between both groups of patients. In a similar way, the IKDC and VAS evaluations showed no difference. Both groups of patients showed better results when compared to the initial evaluation and the final evaluation (Table **2**).

When the patients were divided with regard to follow-up time, a significant improvement was observed in those with one year or less of follow-up after surgery and those with more than one year of follow-up after surgery in patients with only ACL injury, when compared to the initial evaluation and final evaluation in these patients, in all evaluated scales (Table **3**).

In a similar division of follow-up time after surgery in patients with ACL plus meniscal injuries, a favorable evolution was observed on the results obtained from these patients (Table **4**).

**Table 1. Demographic data of Anterior Cruciate Ligament (ACL) injury and ACL and meniscal injury groups.**

| - | ACL injury, n=78 | ACL and meniscal injury, n=48 | Total, n=126 | P value |
|---|---|---|---|---|
| **Age (IQR)** | 29 (21-38) | 26 (22-33) | 28 (21-38) | 0.277* |
| **Gender (%)** | | | | |
| **Male** | 68 (87%) | 39 (81%) | 107 (85%) | 0.444 # |
| **Female** | 10 (13%) | 9 (19%) | 19 (15%) | |
| **BMI (%)** | | | | |
| **Underweight <18.5** | 2 (3%) | 7 (15%) | 4 (7%) | 0.090 # |
| **Normal 18.5-25** | 50 (64%) | 27 (56%) | 77 (61%) | |
| **Overweight >25-30** | 20 (26%) | 11 (23%) | 31 (25%) | |
| **Obese >30** | 6 (8%) | 3 (6%) | 9 (7%) | |
| **Months between injury and surgery (IQR)** | | | | |
| **Knee side** | 8 (2-8) | 12 (1-12) | 12 (2-12) | 0.512 † |
| **Right** | 40 (52%) | 27 (58%) | 67 (53%) | 0.587 # |
| **center** | 38 (47%) | 21 (42%) | 59 (47%) | |
| **Graft** | - | - | - | - |
| **Autograft** | 69 (88%) | 42 (88%) | 111 (88%) | 0.871 # |
| **Allograft** | 9 (12%) | 6 (12%) | 15 (12%) | |
| **Follow-up years after surgery (%) [min-max, median]** | | | | |
| **≤1 [0-1, 1]** | 39 (50%) | 29 (60%) | 68 (54%) | 0.275 * |
| >1 **[[2-4,** 3**]]** | 39 (50%) | 19 (40%) | 58 (46%) | |

Data are presented as median and inter quartile range (IQR) and frequency and percentages. *Mann-Whitney U test. # $Chi^2$ test. † Student´s t-test. ACL, anterior cruciate ligament; IQR, interquartile range; BMI, body mass index.

**Table 2. Comparison between Anterior Cruciate Ligament injury (ACL) and ACL and meniscal injury groups.**

| - | ACL injury, n=78 | ACL and meniscal injury, n=48 | Total, n=126 | P value |
|---|---|---|---|---|
| **LTS initial** | 46 (32-57) | 45.5 (32-68) | 46 (32-63) | 0.598 |
| **LTS final** | 91 (85-97) | 93 (83-98) | 92 (85-98) | 0.676 |
| **IKDC initial** | 48 (38-59) | 48 (55-64) | 48 (37-60) | 0.763 |
| **IKDC final** | 90 (85-94) | 91 (85-95) | 90 (85-94) | 0.250 |
| **VAS initial** | 6 (4-8) | 6 (4-9) | 6 (4-8) | 0.656 |
| **VAS final** | 1 (0-2) | 1 (0-1) | 1 (0-1) | 0.722 |

Data are presented as median and interquartile range (IQR), and frequency and percentages. The Mann-Whitney U test was applied to these variables in order to compare initial versus final scores in both groups.
LTS, Lysholm-Tegner Scale; IKDC, International Knee Documentation Committee; VAS, visual analog scale.

**Table 3. Comparison between initial and actual Lysholm-Tegner Scale (LTS), International Knee Documentation Committee (IKDC), and Visual Analog Scale (VAS) per groups subdivided according ≤1 or >1 year after surgery.**

| - | Initial | Final | P value |
|---|---|---|---|
| **ACL injury ≤1 year** | - | - | - |
| **LTS** | 49 (38.5-59.5) | 91 (86-97.5) | <0.001 |
| **IKDC** | 52.5 (40-63) | 89 (82-93) | <0.001 |
| **VAS** | 5 (3-7.8) | 0 (0-1) | <0.001 |
| **ACL injury >1 year** | - | - | - |
| **LTS** | 44.5 (27.5-54.5) | 91 (84-97.3) | <0.001 |
| **IKDC** | 42 (28-58) | 90 (85.8-94.3) | <0.001 |
| **VAS** | 7 (5.6-9) | 1 (0-2) | <0.001 |

Data is presented as median and interquartile range (IQR). The Wilcoxon signed-rank test was applied.
ACL, anterior cruciate ligament.

Furthermore, it was decided to make a comparison of patients with an evolution time of less or equal to one year. No difference was observed between the groups of patients with ACL injury and ACL plus meniscal injury (Table **5**). In the same way, no difference was shown in the same groups of patients but with more than a year of evolution (Table **6**).

**Table 4. Comparison between initial and final Lysholm-Tegner Scale (LTS), International Knee Documentation Committee (IKDC), and Visual Analog Scale (VAS) per groups subdivided according ≤1 or >1 year after surgery.**

| - | Initial | Final | P value |
|---|---|---|---|
| **ACL and meniscal injury ≤1 year** | | | |
| **LTS** | 46 (33.5-73) | 94 (82-98) | <0.001 |
| **IKDC** | 54 (32-68) | 93 (88.5-95) | <0.001 |
| **VAS** | 6 (4.5-9) | 1 (0-1) | <0.001 |
| **ACL and meniscal injury >1 year** | | | |
| **LTS** | 45 (28-68) | 92 (84-98) | <0.001 |
| **IKDC** | 48 (36-59) | 90 (78-94) | <0.001 |
| **VAS** | 7 (4-8) | 1 (0-1) | <0.001 |

Data are presented as median and interquartile range (IQR). The Wilcoxon signed-rank test was applied.
ACL, anterior cruciate ligament.

**Table 5. Comparison between initial and final Lysholm-Tegner Scale (LTS), International Knee Documentation Committee (IKDC), and Visual Analog Scale (VAS) per group subdivided according injury of ACL alone or ACL and meniscal injury in one year of follow-up after surgery.**

| - | ACL injury ≤1 year, n=39 | ACL and meniscal injury ≤ 1 year, n=29 | Total, n=68 |
|---|---|---|---|
| **LTS initial** | 50 (40-97) | 52 (35-68) | 0.611 |
| **LTS final** | 93 (87-97) | 92 (82-94) | 0.329 |
| **IKDC initial** | 52 (40-60) | 54 (40-64) | 0.891 |
| **IKDC final** | 89 (82-93) | 91 (87-95) | 0.200 |
| **VAS initial** | 5 (3-8) | 6 (4-8) | 0.320 |
| **VAS final** | 0 (0-1) | 1 (0-2) | 0.193 |

Data are presented as median and interquartile range (IQR). The Wilcoxon signed-rank test was applied.
ACL, anterior cruciate ligament.

**Table 6. Comparison between initial and final Lysholm-Tegner Scale (LTS), International Knee Documentation Committee (IKDC), and Visual Analog Scale (VAS) per groups subdivided according lesions in patients with more than one year of follow-up after surgery.**

| - | ACL injury >1 year, n=39 | ACL and meniscal injury > 1 year, n=19 | Total, n=58 |
|---|---|---|---|
| **LTS initial** | 44 (28-53) | 43 (32-72) | 0.875 |
| **LTS final** | 91 (84-97) | 96 (89-100) | 0.085 |
| **IKDC initial** | 43 (29-58) | 48 (55-64) | 0.934 |
| **IKDC final** | 90 (86-95) | 91 (86-95) | 0.703 |
| **VAS initial** | 7 (6-9) | 7 (6-9) | 0.815 |
| **VAS final** | 1 (0-2) | 0 (0-1) | 0.042 |

Data are presented as median and interquartile range (IQR). The Wilcoxon signed-rank test was applied.
ACL, anterior cruciate ligament.

## 4. DISCUSSION

ACL injuries usually occur in young and active population, but they can also occur in isolation or be associated with meniscal or chondral injuries. This association has been related with the time of evolution of the primary lesion. It has been reported that more than 65% of the patients with ACL injury with or without meniscal injury were recreational soccer players with a mean age of 27 years [5]. A diminished performance in their sport activities after this type of injury has been identified [17]. The ACL injury occurs more commonly in women with a relative risk of 3.96. This is due to a variety of anatomical factors, such as a relatively weaker quadriceps and an ACL shorter and weaker in women [1]. Some other factors such as an active daily life (high-intensity sports) and injury recurrence (an explicit injury to the same knee introduced by joint instability after the initial injury and the time from the initial injury) have been associated in patients with ACL injury with associated meniscal injuries [4, 18].

The reported incidence of associated meniscal tears in patients operated in less than 8 weeks is 72.7%, meanwhile an incidence of 84.8% has been reported in patients operated more than 8 weeks after the injury [4, 5]. Acute injury of ACL was associated with more lateral meniscal tears, while medial meniscal tears were observed in chronic ACL injury [4]. It has been reported that 87% of patients with ACL rupture associated with a meniscal or chondral injury participated in sports activities [5]. All of our patients with an ACL lesion or ACL lesion plus meniscal injury, practice sports activities,

amateur or semi-professional; an incidence of 61.5% of patients with associated meniscal injury was found. The treatment of all patients with meniscal injury was partial meniscectomy. In addition, no difference between lateral or medial meniscus injury was observed; the lateral meniscus was injured in 20 patients and the rest was the medial meniscus. Only two patients had lesions of both meniscuses. However, it was observed that even with a prolonged treatment time in both groups (8 months & 12 months), there was no significant difference observed in the outcomes of these patients. The main cause of the treatment being lengthy was the lack of medical insurance, and the patient had to pay for the implant and surgery, as the members of these groups were mostly low-income individuals.

In a retrospective analysis, when comparing post-operative outcomes in patients with ACL reconstruction with and without meniscal injury with a mean follow-up of 3.5 years, no significant differences between patients with or without meniscal injury, related with age, BMI and preoperative outcome scores were found [19]. Similar results were observed in our patients during a mean follow-up of 4 years. In a short-term evaluation of patients with ACL reconstruction with autograft to correlate age of the patient, time since injury and meniscal injury with functional outcomes, Biswal *et al* [20] found that these parameters do not influence short-term functional outcome scores. When we performed a comparison between clinical results appreciated in our study groups, using the Lysholm-Tegner score, the IKDC and VAS, we did not appreciate a significant difference, neither in time of evolution, with a mean of four years, nor in relation with isolated ACL injuries or ACL injuries plus meniscal injury but when a comparison between initial evaluation and final evaluation was performed, patients had better functional scores. This was also observed in patients with more follow-up time. The majority of our patients presented a normal Body Mass Index (BMI), while patients with overweight or some degree of obesity represented a third of the total studied patients, but the patients with overweight or obesity did not present more associated lesions than patients with healthy weight. On the other hand, it has been reported that the allograft has been used to repair the ACL injury in almost 40% of the cases in patients without meniscal injury, with a meniscal surgery-free survival probability at 4 years of 99% [19]; furthermore, the use of an allograft or a hamstring autograft has been associated with a higher risk of meniscal surgery after ACL reconstruction when compared with bone-patellar tendon-bone autografts [21]. It was found that the hamstring and double-bundle reconstruction had a significantly increased risk of traumatic re-injury in a follow-up of two years. Other factor associated with this risk was younger age (27 years). Most of the patients were treated with the hamstring autograft to repair the ACL injury with only 12% of our cases being treated with an allograft using the tibialis posterior for the reconstruction; no re-rupture was observed in these patients. This might be the result of diminished physical activities of our patients [22].

Some of the limitations of our study was the retrospective study of patients treated by three different orthopedic surgeons, no randomization was documented; moreover, we did not investigate the time to return to sports activities of the patients, and their level of return. However, our follow-up time, with a mean of four years, is an appropriate time to evaluate any decrease in the clinical scores in our patients, and this situation was not observed. We believe that the number of patients that we followed for this study is adequate to make an accurate evaluation of patients with ACL injury plus meniscal injuries.

## CONCLUSION

We found that patients with isolated ACL lesions or ACL lesions plus meniscal injuries, treated with partial meniscectomy, presented a similar clinical and functional evolution even at four years of treatment.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Ethics in research of committee of the Universidad Autónoma de Nuevo León Maxico approved this study.

## HUMAN AND ANIMAL RIGHTS

No Animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

Not applicable.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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