

Treatment of Anterior Cruciate Ligament Injuries: A Systematic Review with Meta-Analysis

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Abstract

Objective: To evaluate the effectiveness of surgical treatment and conservative management in the treatment of anterior cruciate ligament injuries.

Methodology: Systematic review with meta-analysis carried out under the Prospective Register of Systematic Reviews (PROSPERO) database ID CRD42024572117. Records from 3 electronic databases (Pubmed, Biblioteca Virtual da Saúde BVS, Ebsco Sportdiscus) were analyzed with the terms anterior cruciate ligament injuries AND anterior cruciate ligament reconstruction.

Results: A total of 738 patients aged between 26 and 33 years were evaluated. Most of the studies presented primary results according to the Knee Injury and Osteoarthritis Outcome Score (KOOS), with better scores for those patients who underwent surgical reconstruction.

Conclusion: Early or late reconstruction of the collateral ligament after rupture was associated with better outcomes when compared to rehabilitation.

Keywords: Anterior cruciate ligament injuries; Anterior cruciate ligament reconstruction.

1. INTRODUCTION

Acute rupture of the anterior cruciate ligament (ACL) is a common and serious injury, especially in the young active population, with an incidence rate of 49-75 per 100,000 people per year. This injury is characterized by damage to the kinematics of the knee, mainly causing joint instability, leading to a painful and swollen knee, with meniscal and chondral damage, and an increased risk of secondary osteoarthritis. Instability causes a reduction in activity, poor knee function and low quality of life in the short term.¹

Patients with ACL injuries should be treated appropriately as soon as they are traumatized. However, patients with this type of injury usually present in a non-acute form. As a result, the ideal management of these patients remains open, but

it is known that it can be carried out surgically, through reconstruction, or non-surgically, through rehabilitation. Surgical reconstruction has been an option for obtaining a good result and is generally performed, especially in those patients who want to resume sporting activities.

This treatment involves reconstructing the ligament, almost always with tissue taken from the injured person's body. Rehabilitation, on the other hand, can be much cheaper than surgery and must be supervised by a physiotherapist, making it a central aspect in the treatment of these patients.^{2,3}

Although surgery is commonly considered the standard treatment, it is an expensive procedure and can cause some complications. In addition, evidence shows that if rehabilitation is not of high quality to stabilize the knee, it can be considered a waste, and can even harm patients

with ACL injuries, delaying standard treatment and leading to other problems.⁴

Although there are many studies on ACL injuries, there are still conflicts when choosing the best treatment strategy. For this reason, this study aims to evaluate the effectiveness of surgical treatment and conservative management in the treatment of anterior cruciate ligament injuries

2. METHODS

This proposed study is a systematic review with meta-analysis, based on the work of Khan et al, as it considers framing the questions for a literature review; identifying relevant research; assessing the quality of the studies; summarizing the evidence; and interpreting the results. The study protocol was designed and registered in the Prospective Register of Systematic Reviews (PROSPERO) database under the ID CRD42024572117.

In addition, the research questions were defined using the PICOS model by the PRISMA guidelines⁵, as follows:

Population: Patients with anterior cruciate ligament injuries. Intervention: Conservative versus surgical treatment. Comparator: Comparison of recovery intervals of different lengths Outcomes: Surgical treatment and conservative management in the treatment of anterior cruciate ligament injuries. Study design: Randomized controlled designs, counterbalanced crossovers or repeated measures designs that investigated the effects of the recovery interval.

In addition to a bibliographic survey from March to JULY 2024, records were analyzed from 3 electronic databases (Pubmed, Biblioteca Virtual da Saúde BVS, Ebsco Sportdiscus). The keywords were obtained using the PubMed “mesh terms” query. The search was conducted using the English terms for: anterior cruciate ligament injuries with a combination of “AND” and “OR”.

Inclusion and exclusion criteria

Table 1. Outcome of the selected studies

Estudo	Amostra	Resultado	Reconstrução ligamentar	Reabilitação
Beard e col	315 pacientes	KOOS pre tratamento	45.7+-19.6	43.3+-18.1
		KOOS post tratamento	73.0+-18.3	64.6+-21.6
Reijman e col	167 pacientes	KOOS pre tratamento	59,8+-52,8	60,5 (53,5
		KOOS post tratamento	90.5+-83.5	87.1+-80.2

The inclusion criteria for the articles were:

(01) studies evaluating conservative techniques for the treatment of anterior cruciate ligament injuries (2) studies more than 15 years old (2) studies on the surgical treatment of anterior cruciate ligament injuries (3) studies with a conservative approach to anterior cruciate ligament injuries.

Studies with the following criteria were excluded: (1) experimental studies using animal models (2) non-original studies - literature reviews (3) opinion studies (4) studies which dealt with management after infection had been established, i.e. which did not discuss the treatment of anterior cruciate ligament injuries (5) studies published more than five years ago (6) studies which did not meet the other inclusion criteria mentioned above.

The search and selection of studies was carried out by two reviewers who analyzed the studies. Initially, studies published in the last five years (2019-2024) were selected using the aforementioned DECS and Boolean operators, followed by an analysis of titles and abstracts. At this stage, studies using animal models, opinion articles and literature reviews were excluded. Duplicate citations and studies not corresponding to the proposed review parameters were also excluded. Possible disagreements were resolved through discussion with a third reviewer, and inclusion was decided after consensus with the two main reviewers.

To prioritize methodological quality, studies classified as “Good” after the NIH quality assessment were included, with studies with more than nine items ticked being considered suitable for inclusion. Epidemiological and demographic data was extracted using a Microsoft Excel spreadsheet.

3. RESULTS

The articles selected for the study were based on the parameters established by the PRISMA protocol (Figure 1).

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Soni e col	136 pacientes	KOOS pre tratament	37.6+-1.8	37.4+-1.6
		KOOS post tratament	76.8+-2.6	75.8+-3.6
Frobell e col	120 pacientes	KOOS pre tratament	38.8+-2.7	38.0+-2.7
		KOOS post tratament	80.0+-75	82.0+-76

Those that analyzed late or early surgical reconstruction of the anterior collateral ligament versus conservative treatment through

rehabilitation were selected. A total of 738 patients aged between 26 and 33 years were evaluated. Table 01 shows the selected studies and their main outcomes (Table)

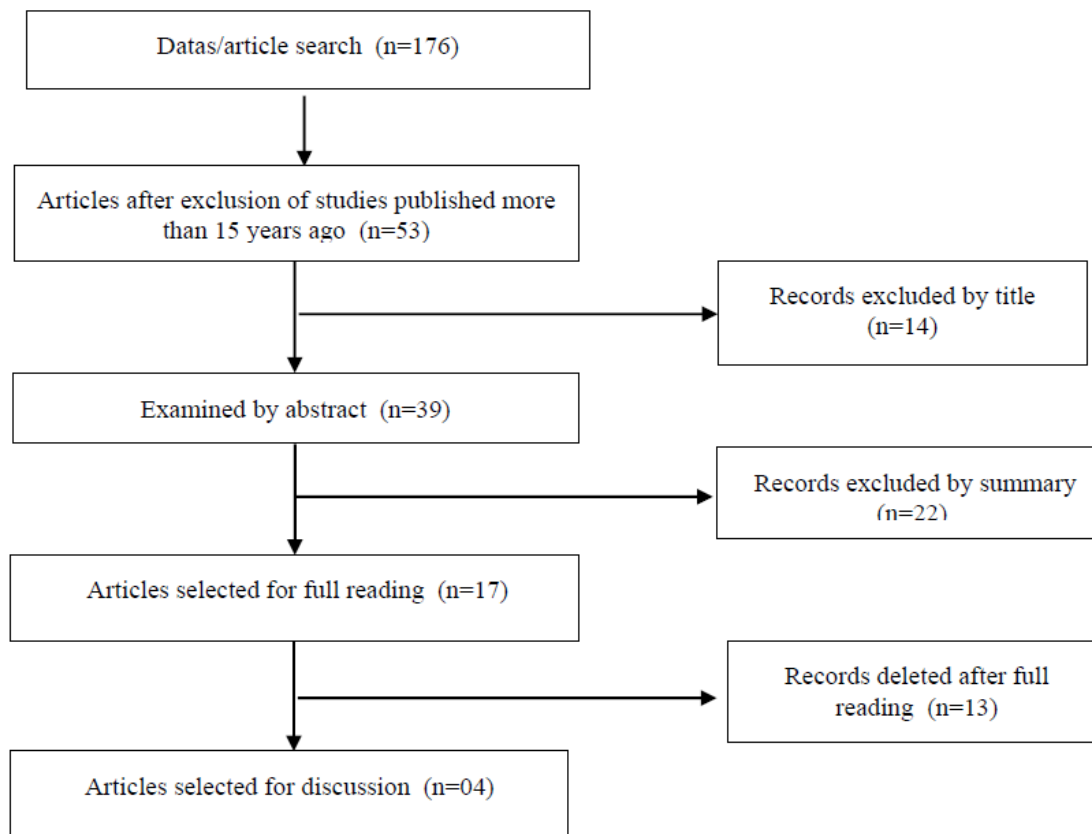


Figure 1. Selection of articles according to the PRISMA protocol

Table 2. Knee Injury and Osteoarthritis Outcome Score (KOOS) presented by the studies.

Estudo	Amostra	Resultado	Reconstrução ligamentar	Reabilitação
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		KOOS post tratament	76.8+-2.6	75.8+-3.6
Frobell e col	120 pacientes	KOOS pre tratament	38.8+-2.7	38.0+-2.7
		KOOS post tratament	80.0+-75	82.0+-76

Table 02 contains the Knee Injury and Osteoarthritis Outcome Score (KOOS) presented by the studies (Table 02). 6,7,8,9

Figure 02 shows the forest graph with the analysis of the final Knee Injury and Osteoarthritis Outcome Score (KOOS) (Figure 2). 6,7,8,9

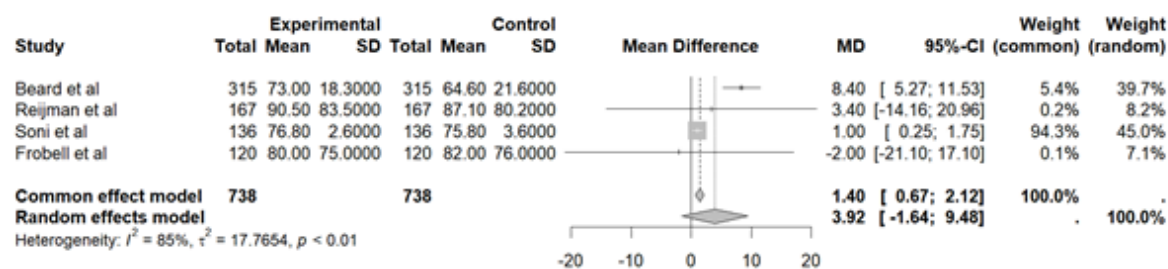


Figure 2. Forest graph of the final Knee Injury and Osteoarthritis Outcome Score

The randomized clinical trial by Beard et al, presented 315 patients diagnosed with non-acute anterior ligament injury, of whom 156 underwent surgical reconstruction and 159 rehabilitation. 34% of patients had onset of symptoms less than four months after starting treatment, 53% between four months and one year and 13% over 24 months. The Knee Injury and Osteoarthritis Outcome Score (KOOS), used to assess immediate and long-term damage after a knee injury, at baseline for the surgical group was 45.7+-19.6 versus 43.3+-18.1 for the rehabilitation group. The quality of life score used by the initial study was 26.1+-17.4 for surgery and 23.2+-14.6 for rehabilitation, and the initial VAS score was 64.2+-20.8 versus 68.4+-20.6 between the groups. The primary results were based on the KOOS, after establishing the proposed treatments, the values for surgical patients were 73.0+-18.3 and for rehabilitation 64.6+-21.6, with a difference between the groups of 7.9 (2.5-13.2) (p=0.0053). The secondary results showed an improvement in pain for the operative group and the group undergoing rehabilitation to 85.3+-15.5 versus 79.3+-19.2 (p=0.02); symptoms 79.4+-15.7 versus 71.9+-20.8 (p=0.002); activities of daily living 91.2+-14.5 versus 85.0+-20.3 (p=0.002); sports and recreational activities 68.9+-24.9 versus 59.2+-29.8 (p=0.043); quality of life related to knee function 58.1+-25 versus 48.1+-26 (p=0.006). Patient satisfaction was assessed by asking them if they would undergo the same treatment again; 102 (83%) surgical participants said they would choose this type of treatment again compared to 79 (68%) in the rehabilitation group, a difference of 15% (95% CI 4-25) in favor of surgical management.6

The randomized clinical trial by Reijman et al evaluated 167 patients with anterior ligament rupture (ACL), 85 underwent surgical treatment

after injury (group one) and 82 rehabilitation treatment with subsequent ligament reconstruction (group two) in 41 patients during the two-year follow-up period of the study. The primary results were through the estimated International Knee Documentation Committee (IKDC) score, early ACL reconstruction and rehabilitation with delayed reconstruction showed a score of 84.7+-78 versus 79.4+-73.6, respectively, after 24 months of study, with a difference between the groups of 5.3(0.6-9.9) (p<0.001). The secondary results corresponded to the KOOS (Knee Injury and Osteoarthritis Outcome Score), group one compared to group two showed an assessment of pain improvement, two years after the start of the study, of 90.5+-83.5 versus 87.1+-80.2; symptomatology 86.8+-80.4 versus 82.5+-76.2; activities of daily living 93.6+-85.8 versus 92.0+-84.2; sports and recreational activities 80.8+-75.5 versus 72.8+-67.4; quality of life 76.6+-71.8 versus 65.8+-60.8. The number of patients in the group undergoing early surgical treatment of the lesion who reported satisfaction with the treatment was 92.6%, while for the other type of treatment it was 91.3%. The Lysholm score, which assesses the degree of knee instability at the impairment and limitation levels, was 90.6+-85.4 versus 87.1+-81.9 between the respective groups.7

In the prospective comparative study by Soni et al, patients were divided into group A (71 patients) treated with ACL reconstruction and rehabilitation and group B (65 patients) treated conservatively with rehabilitation. The IKDC (International Knee Documentation Committee) after the end of the study period for group A and group B was 74.46+-2.81 versus 73.68+-2.82 (p=0.1088), the KOOS (Knee Injury and Osteoarthritis Outcome Score) recorded was 76.81+-2.65 versus 75.84+-3.62, respectively. The TAL score (Tegner Activity Level score)

was also assessed, showing a final score for those patients who underwent surgical intervention of 4.11+0.48 versus 3.95 0.53 for conservative treatment ($p = 0.0669$). Only 6.58% of patients in group A had some kind of complication, such as knee pain; in group B, this percentage was 5.80%, such as cases of hemarthrosis.⁸

The randomized clinical trial by Frobell et al. analyzed the clinical response of the first group of 61 patients who underwent early ACL reconstruction and the second group of 59 patients who could or could not undergo delayed ACL reconstruction. The primary results were obtained using the KOOS (Knee Injury and Osteoarthritis Outcome Score). The first group had a score after five years of study of 80+-75, with subscales for pain 91+-88, symptomatology 83+-78, activities of daily living 95+-93, sport and recreation 76+-70. The physical component of the SF-36 score was 85+-79 and the mental component 87+-83, in addition to 76% of the patients having a normal Lachman test. As for the second group, of the 59 patients, 30 underwent delayed ligament reconstruction and 29 remained on rehabilitation as their treatment of choice. The 30 patients who underwent delayed ligament reconstruction had a final KOOS of 81+-75, pain subscale 91+-86, symptoms 85+-79, activity of daily living 97+-95, sport and recreation 78+-63. The physical and mental components of the SF-36 were 83+-78 and 86+-81, and 60% of the Lachman test was normal. As for the 29 patients who remained with rehabilitation as a form of treatment, the KOOS was 82+-76, pain subscale 92+-87, symptomatology 89+-83, activity of daily living 96+-93, sport and recreation 81+-73. The physical and mental components of the SF-36 were 85+-79 and 83+-76, and the Lachman test was normal in only 4% of cases.⁹

4. DISCUSSION

Most of the studies presented showed that patients with ACL rupture who underwent early or late surgical reconstruction had better results in terms of symptom perception, sports participation and general knee function when compared to those groups who underwent rehabilitation. However, even so, some studies such as the Swedish KANON trial suggest that in the first instance, for acute cases, rehabilitation should always be attempted, and that if it is done during a period before the surgical procedure it can reduce the need for surgery by up to 50%.

The high prevalence and public health burdens related to ACL rupture lead to continuous debates in favor of one or another therapeutic strategy,

but they do not elaborate an ideal treatment strategy^{1,10}. Although there have been numerous studies on ACL rupture¹¹, there is still no consensus on whether to treat conservatively or surgically reconstruct the ligament¹. The choice of treatment is based on the type of ligament injury, the patient's clinical condition and complaints, the examination, the presence of a growth physis and the activity goals^{12,13}.

Surgical interventions have become more common for athletes and initial conservative treatments, based on physiotherapy, are more indicated in the non-athlete population¹⁴. However, treatments aim to restore function, reduce pain and knee instability. Reconstructive surgery aims to restore instability by replacing the torn ACL. Conservative therapies, such as rehabilitation, aim to improve muscle function around the knee and thus replace the function of the injured ACL¹⁰.

Conservative treatment includes physiotherapy, progressive rehabilitation, patient education on how to avoid instability¹⁵, the use of cryotherapy, continuous passive movement, electrotherapy, restrictive restraint, balance and strengthening exercises¹⁰. It should be noted that the use of plaster casts for the initial immobilization of the knee¹⁴ is now rare.

There are higher success rates for conservative treatment in patients with partial rupture and no symptoms of instability; with complete rupture and no complaints of knee instability during low-need or low-activity sports and in children, since the growth plates are still open¹⁶.

Patients treated conservatively are often unable to return to their previous level of sporting activity¹⁷. There are some more optimistic late results with good functional outcomes, but neuromuscular rehabilitation and early modification of activity are important¹⁸.

Surgical treatment of ACL rupture has progressed from simple repair with suture or suture with some kind of augmentation to ligament reconstruction, which involves repairing the ligament by manipulating a substitute graft from the tendon or ligament, fixed in position in pre-prepared holes. Three types of graft are usually used: autograft, allograft or a synthetic ligament substitute. Patellar, hamstring and quadriceps tendons are used in autografts, while calcaneal, semitendinosus, gracilis or posterior tibial tendons are used in allografts¹².

Tsoukas et al.(2016)¹⁹ argues that operated knees are less likely to have a positive pivot-shift test. In addition, the satisfaction of patients treated conservatively with regard to their ability to participate in physical activities decreases more over the years than in the surgical group²⁰. Surgery produces a more stable knee during the first few years, but non-operated knees show a faster increase in muscle strength, recovery of function and range of movement. Therefore, a patient with high physical demands would be a likely candidate for surgery²¹.

Ligament reconstruction shows very good results in the short and medium term, regardless of the graft used^{22, 23, 24}. Most long-term studies show good results ten or more years after surgery^{16, 25, 26}. It has been reported that degenerative changes in the cartilage become evident seven years after surgery²⁷. These increase with time over the years²⁸.

It has been reported that the alterations in gait kinematics caused by a defective ACL lead to subsequent osteoarthritis, without any relation to ligament reconstruction^{29, 30}. Meniscal lesions are usually coexistent with ACL ruptures and also contribute to the development of osteoarthritis^{31, 32}. Patients with ACL ruptures who are treated conservatively more often need surgical treatment for meniscal lesions^{33, 34, 35}.

Since chronic knee instability leads to cartilage degeneration, the literature points to a strong relationship between ACL injury and osteoarthritis²⁰. There is an increased risk of high-level athletes with a permanently unstable knee developing cartilage damage over 20 years³⁶. Although there is research supporting the importance of an intact ACL in reducing the risk of cartilage degeneration, the literature does not confirm that reconstruction reduces the risk⁷. However, it is indisputable that some patients will benefit more from ACL reconstruction than others.

5. CONCLUSION

Reconstruction, whether early or late, of the collateral ligament after rupture, was associated with better outcomes involving pain response, general perception of symptoms, quality of life and performance of sports and recreational activities when compared to conservative limb rehabilitation treatment. We observed that ACL reconstruction does not prevent osteoarthritis, but can only reduce the prevalence of its onset. However, it is still a controversial issue as to how and when to select patients for surgery.

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