

# Anterior Cruciate Ligament Reconstruction After 10 to 15 Years: Association Between Meniscectomy and Osteoarthritis

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**Purpose:** To evaluate the stability and arthrosis of the knee 10 to 15 years after arthroscopic-assisted anterior cruciate ligament (ACL) reconstruction with patellar tendon graft. **Methods:** From July 1986 to March 1991, 82 patients underwent arthroscopic-assisted ACL reconstruction with patellar tendon graft. Of these, 62 returned for follow-up evaluation between November 2000 and April 2001. Four different physicians, blinded to each other's examination findings, evaluated the radiologic as well as surgical results according to the International Knee Documentation Committee criteria and the Lysholm knee scoring scale. **Results:** There were 47 male and 15 female patients. The mean period between injury and surgery was 16 months (range, 2 weeks to 8 years). Results of radiographs were compared with the finding of meniscal lesions during surgery and with International Knee Documentation Committee test results. A statistically significant association ( $P < .0001$ ) was found between medial or lateral arthrosis of the knee and meniscal injury. In all patients the presence of tears in both menisci was associated with osteoarthritis in both compartments (medial and lateral). **Conclusions:** In patients who underwent arthroscopic-assisted ACL reconstruction with patellar tendon graft who also had medial or lateral meniscectomy (or both), arthrosis of the respective compartments developed by 10 to 15 years after reconstruction. Meniscectomy was also associated with poorer results on objective tests of knee function, even with a stable knee joint. **Level of Evidence:** Level IV, therapeutic case series. **Key Words:** Anterior cruciate ligament—Knee osteoarthritis—Arthroscopy—Meniscal lesions—International Knee Documentation Committee.

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Since the first report of surgical anterior cruciate ligament (ACL) treatment,<sup>1</sup> techniques have been evolving very favorably and quickly, especially over the last few decades. Many authors have reported their results on ACL reconstruction,<sup>1-8</sup> but few have had more than 10 years of postoperative follow-up.<sup>2,6,7</sup>

Follow-up studies of ACL reconstruction with patellar tendon grafts<sup>2,3,9-14</sup> have reported short-term (<2 years),<sup>2,15-17</sup> medium-term (2 to 5 years), and long-term (>5 years) results. In most of these studies, improved objective, subjective, and functional results were obtained when reconstruction was performed within 3 months after the ACL injury.<sup>15</sup> Reconstruction may not prevent the development of late degenerative changes.<sup>8,15</sup> The challenge to the clinician is to understand and predict how ACL deficiency in a given patient will affect the patient's life and activities in the long term.<sup>8</sup>

Meniscal lesions are frequent in patients with ACL injuries and are more common in those with recurrent ACL instability.<sup>3,6,16</sup> The longer the period between ACL tear and surgical treatment, the more severe the meniscal lesions.<sup>8,17</sup> Over time, meniscal resection has come to be standard treatment for such lesions, even

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when the associated injured ACL is not reconstructed. Meniscal repair in conjunction with ACL reconstruction is associated with a higher rate of meniscal healing compared with repairs of lesions in knees in which the ACL is not reconstructed.<sup>18</sup>

The loss of part or all of the meniscus alters the mechanics of the knee and its function, leading to cartilage deterioration of the joint and osteoarthritis.<sup>19</sup> Even partial meniscectomy is associated with osteoarthritis but may not become symptomatic for many years.<sup>3,20</sup>

The hypothesis that guided this investigation is that degenerative phenomena will occur more frequently when meniscectomies are associated with ACL reconstruction, as well as that meniscectomies may lead to worse surgical results in long-term follow-up periods. The purpose of the study was to evaluate the long-term (10 to 15 years) subjective and objective results and development of arthrosis in knees in which the ACL was reconstructed arthroscopically with a patellar tendon autograft. We found that patients who underwent such reconstruction who had concurrent medial or lateral meniscectomies (or both) presented with arthrosis in the respective compartments at 10 to 15 years of follow-up. Meniscectomy was the determining factor for arthrosis. Meniscectomy was also associated with poorer results on objective tests of knee function, even when the knee joint was stable.

## METHODS

From July 1986 through March 1991, 126 consecutive patients underwent arthroscopic-assisted ACL reconstruction with patellar tendon autograft. Excluded from this retrospective study were patients with bilateral ACL reconstruction ( $n = 12$ ), previous knee surgery ( $n = 18$ ), degenerative changes and grade III or IV chondromalacia found radiographically or at the time of surgery ( $n = 11$ ), and other ligament injuries associated with the ACL injury (posterior cruciate ligament [ $n = 1$ ] and posterolateral deficiencies [ $n = 2$ ]). Of the 82 operative patients who were included, 62 returned for follow-up between November 2000 and April 2001. The mean follow-up was 11 years 2 months (range, 10 to 15 years) after ACL reconstruction.

All ACL reconstructions were performed via an arthroscopic technique by use of autografts of the mid third of the patellar tendon (bone-tendon-bone). When associated lesions of the meniscus were present, these were concomitantly treated with partial meniscectomy. Enlargement of the intercondylar notch was

**TABLE 1.** *Rehabilitative Treatment of 62 Patients Undergoing Surgery for Reconstruction of ACL Between 1986 and 1991*

Postsurgical Period	Procedures
Immediately	Immobilization of the knee in 20° to 30° of flexion with a brace Use of crutches for 3 weeks; walking permitted without touching the foot of the operative limb to the ground Removal of the brace 2 or 3 times a day for physical therapy exercises
1st wk	ICE therapy Open kinetic chain eccentric contraction exercises of the quadriceps from 30° to 90°
2nd wk	ICE therapy Flexion of the operative knee between 90° and 110° with little resistance Eccentric and concentric exercises for the ischiotibial muscle and isometric exercises for the quadriceps
3rd wk	Closed kinetic chain exercises on ergometry bicycle without a load and with the seat elevated
4th wk	Pool exercises and proprioception re-education Initiation of total range of motion of the operative knee, as well as walking without crutches and exercises with progressive resistance
8-12 wk	Progressive training with jogging and running and resumption of specific individual sporting activity
30 wk	Contact sports allowed

Abbreviation: ICE, ice, compression, and elevation.

performed. The grafts were fixed by use of a screw and washer on both sides. All of the patients participated in a similar rehabilitation program according to the protocol described in Table 1.

All patients were evaluated by 4 different physicians, each with a minimum of 10 years' experience. Each surgeon performed 1 of the following 4 parts of the examination: (1) Lysholm knee scoring scale<sup>21</sup> (translated into Portuguese and validated), along with a return-to-sports questionnaire; (2) physical examination according to the International Knee Documentation Committee (IKDC) criteria<sup>22</sup>; (3) KT-1000 (MEDmetric, San Diego, CA) evaluation at 30° of flexion with 30 lb of force; and (4) bilateral knee radiographic evaluation according to the criteria of Fairbank,<sup>23</sup> with a grade of 0 (normal), 1 (mild changes), 2 (moderate changes), or 3 (severe changes). The following radiographic views were obtained: anteroposterior weight-bearing, posteroanterior with 45° flexion, Merchant view, and lateral with 30° flexion.<sup>24</sup>

**TABLE 2.** Extension and Flexion Measurements in Operative and Normal Knees of 62 Patients After ACL Reconstruction on Active and Passive Mobility Tests

	Extension		Flexion	
	Passive*	Active	Passive	Active
Operative (mean $\pm$ SD) ( $^{\circ}$ )	-1.26 $\pm$ 2.82	-2.44 $\pm$ 3.52	142.6 $\pm$ 7.6	135.5 $\pm$ 9.1
Nonoperative (mean $\pm$ SD) ( $^{\circ}$ )	-0.23 $\pm$ 1.86	-0.68 $\pm$ 1.80	148.0 $\pm$ 5.9	141.0 $\pm$ 6.5
Significance	$P = .0001$ (Wilcoxon test)		$P < .0001$ (Wilcoxon test)	
	$P < .0001$ (Wilcoxon test)		$P < .0001$ ( $t$ test)	

\*Of the 62 patients, 5 lacked between 6 $^{\circ}$  and 10 $^{\circ}$  of passive extension and 2 lacked more than 10 $^{\circ}$  of passive extension.

The evaluating surgeons were blinded to each other's findings.

The data were summarized by use of routine descriptive statistics. Condition differences in dependent variables that were normally distributed were analyzed by a correlated  $t$  test. In the absence of normality, differences were analyzed by use of the Wilcoxon signed rank test. Correlations were determined via the method of either Pearson or Spearman, where appropriate. A  $\chi^2$  test was used to determine departures from expected values for 2  $\times$  2 tables.  $P \leq .05$  was considered to indicate statistical significance.

## RESULTS

There were 47 male patients and 15 female patients. The mean age at surgery was 27 years (range, 15 to 46 years); most patients ( $n = 59$ ) were aged less than 40 years at the time of surgery. One patient was injured as the result of a fall; all others were injured during sporting activities. Patients were operated on at a mean of 16 months after the initial injury (range, 2 weeks to 8 years). During the initial surgery, meniscal lesions were found in 41 knees: 22 had isolated medial meniscus tears, 9 had isolated lateral meniscus tears, and 10 had tears in both menisci. Evaluation results are summarized in Tables 2, 3, and 4.

A statistically significant association ( $P < .0001$ ) was found between meniscal pathology and arthrosis of the knee (Table 5). Among 51 meniscectomies, more than 75% of the meniscus was surgically resected in 44 knees. The other 7 were resections of 25% to 75% of the meniscus (5 lateral and 2 medial). In all of the knees with more than 75% of the meniscus resected, the degenerative process was more intense.

After surgery, of the 62 patients, 41 could return to their usual sports and activities (17 with some restriction), 10 changed their sporting activity, and 11 stopped participating in sporting activities. Pa-

tients who had a positive pivot-shift test were less likely to return to sports that required cutting and twisting ( $P = .049$ ).

**TABLE 3.** Results of Follow-up Evaluation 10 to 15 Years After ACL Reconstruction ( $n = 62$ )

Test	No. of Patients
Lysholm	
Excellent	23
Good	26
Moderate	11
Poor	2
Effusion	
None	53
Mild	5
Moderate	4
Severe	0
Pivot-shift test	
Normal	21
Nearly normal (+)	35
Moderate (++)	6
Lachman	
Normal	17
1+	25
2+	13
3+	7
KT-1000*	
<3 mm	42
3-5 mm	15
>5 mm	5
Functional IKDC	
Normal (A)	22
Nearly normal (B)	25
Abnormal (C)	14
Severely abnormal (D)	1
Overall IKDC	
Normal (A)	0
Nearly normal (B)	31
Abnormal (C)	23
Severely abnormal (D)	8

\*The mean difference between operative and nonoperative knees was 1.9  $\pm$  2.63 mm.

**TABLE 4.** *Arthrosis and Crepitation*

	No. of Patients		
	Medial	Lateral	Patellofemoral
Arthrosis*			
None	21	26	16
Grade 1	27	25	32
Grade 2	10	11	14
Grade 3	4	0	0
Crepitation†			
None	19	25	7
With no pain	23	22	36
With light pain	18	14	16
With intense pain	2	1	3

\*Of the patients, 13 had no arthrosis, 18 had arthrosis in the medial and lateral compartments, 12 had arthrosis in the medial and patellofemoral compartments, 10 had arthrosis in the lateral and patellofemoral compartments, and 9 had arthrosis in all 3 compartments.

†Of the patients, 7 had no crepitation, 43 had crepitation in the medial compartment, 37 had crepitation in the lateral compartment, 6 had crepitation in the medial and lateral compartments, 55 had crepitation in the patellofemoral compartment, 8 had crepitation in the medial and patellofemoral compartments, 9 had crepitation in the lateral and patellofemoral compartments, and 4 had crepitation in all 3 compartments.

## DISCUSSION

In this study the knees of patients who underwent arthroscopic-assisted ACL reconstruction with a patellar tendon autograft with concurrent medial or lateral meniscectomy for meniscal lesions presented with arthrosis of the respective compartments at 10 to 15 years of follow-up. Meniscectomy was also associated with poorer results on objective tests of knee function, even when the knee joint was stable. The strength of this study lies in the length of the postoperative follow-up, the patient return rate (62/82 patients), and the performance of evaluations by 4 different blinded evaluators.

The mean time between injury and surgery in this study was 16 months; the longest interval was 8 years. At the time of initial injury in this group of patients, ACL reconstruction was less often recommended by physicians and less frequently accepted by patients than it is today. The current literature shows that early ACL reconstruction reduces the incidence of recurrent symptomatic instability and the risk of late meniscus tear. Surgeons agree that, to maximize overall results, the optimal time between initial ACL injury and surgical reconstruction is a minimum of 3 weeks or when patients have near-normal range of motion of the knee.<sup>1,3,25,26</sup>

The Lysholm scores of excellent and good for 49 of 62 patients indicate that patients were satisfied even in cases with arthrosis, crepitation, and poor objective and functional test results.

None of the knees in this study had radiographic preoperative degenerative changes, which was confirmed during surgery. Our results concur with previous findings of patellofemoral crepitation after ACL reconstruction.<sup>5,9,27,28</sup> Crepitation was present with no pain in most of the knees in this study, a finding that departs from previous reports that indicate that pain is usually associated with crepitation during active extension of the knee.<sup>5,9,27,28</sup> Some authors show that crepitation and patellar pain do not really impair the range of motion.<sup>28</sup> Others have indicated that crepitation and patellar pain are not associated with surgical technique.<sup>9,29</sup> One report describes an association between crepitation and osteoarthritis of the knee.<sup>25</sup>

Our KT-1000 results were similar to those reported in the literature.<sup>10-14,21-27</sup> In this study the differences between the results of KT-1000 evaluation and the Lachman and pivot-shift tests were not significant, which differs from other reported results.<sup>19,27,28,30-32</sup> This inconsistency may be the result of our small sample size or of differences in technique among KT-1000 operators, as has been indicated in several reports.<sup>11-14,21,22-28,30-34</sup> Each of our evaluators had more than 10 years of experience. The IKDC recommends against reliance on KT-1000 data alone.

The literature corroborates our finding that positive pivot-shift test results are associated with a reduction of patients returning to sports that require rotation of the knee.<sup>9-15,20,21-28,30-34</sup> Some authors suggest that a positive Lachman test can also be associated with poorer results on functional and objective IKDC tests.<sup>14,21-26</sup> In this study patients with a positive pivot-shift test presented with more functional instability, a factor to be considered when analyzing the results because laxity will affect IKDC results.<sup>35</sup>

**TABLE 5.** *Distribution of Osteoarthritis and Meniscal Lesions in Patients With Reconstruction of ACL*

Medial Osteoarthritis* (With Medial Lesion)		Lateral Osteoarthritis† (With Lateral Lesion)		Osteoarthritis‡ (With Medial and Lateral Lesions)	
Absent	Present	Absent	Present	Absent	Present
21 (6)	41 (26)	26 (0)	36 (19)	13 (0)	49 (10)

\* $P < .0198$  ( $\chi^2$  test).

† $P < .0001$  ( $\chi^2$  test).

‡ $P = .1029$  ( $\chi^2$  test).

In counseling patients about treatment after an ACL injury, the clinician can use knee ligament goniometry measurements and the patients' preinjury sports activity level to help estimate the risk of injury and overall results over the next 5 to 10 years.<sup>8</sup> However, the objective and subjective results over a longer period of time (>10 years) are influenced by the condition of the menisci and of the cartilage during reconstruction.<sup>5</sup>

Our findings of meniscal lesions during surgery (41/62 knees) were similar to those reported in the literature.<sup>3,25,28,30-32</sup> When arthrosis was found on follow-up, it was associated with prior meniscal lesions. Patellofemoral arthrosis was more frequently seen than medial or lateral arthrosis. Other authors have shown that patients who undergo meniscectomy have an increased probability of arthrosis developing.<sup>3,19,20</sup> The rationale is that lateral or medial meniscal lesions cause articular degeneration to happen faster, even in stable operative knees. Some authors, however, have not found an association between radiographic evidence of arthrosis and previous meniscectomy.<sup>16</sup> The relation between bone contusion on initial magnetic resonance images and the finding of degenerative changes on follow-up radiographs has not been established.<sup>15</sup> The literature indicates that arthrosis of the knee will develop in 46% to 85% of patients with ACL tears, especially when nonsurgical treatments are used.<sup>13,17,31</sup> Even with surgical ACL reconstruction, arthrosis can still occur, depending on surgical technique, previous arthritis, patient age, and type of graft used.<sup>4</sup>

## CONCLUSIONS

Patients who underwent arthroscopic-assisted ACL reconstruction with patellar tendon graft who had concurrent medial or lateral meniscectomies (or both) presented with arthrosis in the respective compartments at 10 to 15 years of follow-up. Meniscectomy was the determining factor for arthrosis. Meniscectomy was also associated with poorer results on objective tests of knee function, even when the knee joint was stable.

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