

Meniscal tears left *in situ* during anatomic single bundle anterior cruciate ligament reconstruction

D. VERMESAN, R. PREJBEANU, S. LAITIN, V. GEORGIANU¹, H. HARAGUS, S. NITESCU¹, M. TATULLO², M. TATTOLI², M. CAPRIO², R. CAGIANO²

University of Medicine and Pharmacy 'Victor Babes', Timisoara, Romania

¹Clinical Emergency Hospital for Plastic Reconstructive and Burns Surgery, Bucharest, Romania

²Department of Biomedical Sciences and Human Oncology, Medical Faculty, University of Bari, Italy

Abstract. – OBJECTIVES: Anterior cruciate ligament (ACL) injuries are a common finding in sports medicine. Our scope is to investigate whether stable, incomplete medial meniscus tears could be left untreated during single bundle anatomic anterior cruciate ligament reconstruction.

PATIENTS AND METHODS: A prospective observational study on 597 knees from a single surgeon cohort, using the same reconstruction technique, found 23 medial and 48 lateral meniscus tears which could be left untreated.

RESULTS: None of the cases required reoperation during the first postoperative year. In fact, 21.7% of the medial meniscus group and 14.6% of the lateral group had potential residual symptoms that were not confirmed and gradually disappeared within one year. A comparison of Cincinnati Knee, IKDC scores and limb symmetry index values (calculated using the triple hop for distance into the two groups) found no differences for the last two variables (both $p = 0.065$) and was marginal for the first score ($p < 0.05$). The between groups comparisons, performed in the KT-1000, also yielded no difference ($p = 0.11$).

CONCLUSIONS: We then concluded that incomplete meniscal tears, left *in situ* at the time of anterior cruciate ligament reconstruction, could have favorable outcomes as long as decisions are carefully weighed with regard to the length of the lesion. Also, at least in this perspective, anatomic single bundle has proved a sufficient stabilizer for anterior translation of the tibia.

Key Words:

Incomplete tears, Meniscus *in situ*, Treatment outcome, Anatomic single bundle, Anterior cruciate ligament reconstruction.

performed in knees which have sustained high force trauma and have frequently associated meniscal lesions. These contribute to the overall stability as well as protection against future development of osteoarthritis. Large, unstable meniscal lesions are treated by repair or excision, depending from the acuteness of the injury and its potential healing for its anatomical location. One of the topics still debated is to define the management of incomplete meniscal tears found during anterior cruciate ligament reconstructions. One of the first study¹ approaching this subject found that stable vertical longitudinal tears, in the periphery of the menisci, have good healing whereas radial tears, in the avascular third of the meniscus, have not the same favorable healing potential. They recommend, for stable longitudinal tears, to be left *in situ*, but cannot find a solution for the vertical lesions. Further research² has also found that peripheral meniscal lesions, associated with surgery for chronic anterior instability, do not always require suture if they are limited to the posterior segment. The debate has then focused on laterality and length of the lesions. Shelbourne et al³ have shown favorable long term follow-up for lateral meniscal tears left *in situ* or stimulated by abrasion or trephination that are posterior horn, stable radial flap or peripheral/posterior third tears extending less than 10 mm in front of the popliteus tendon. In a previous study, the same authors also found that posterior horn avulsions, vertical tears posterior to the popliteus tendon and other stable tears, at the time of index anterior cruciate ligament reconstruction, can be left *in situ* without becoming clinically symptomatic⁴. With regard to the medial meniscus, Shelbourne et al observed most traumatic stable peripheral vertical medial meniscus tears treated with abrasion/trephination to be asymptomatic without stabilization⁵. Other studies also found

Introduction

Anterior cruciate ligament (ACL) injuries are a common finding in sports medicine. Restoration of antero-posterior and rotational stability is

limited stable medial lesions and most lateral tears to have good outcomes when left untreated during ACL reconstruction⁶⁻⁸. Furthermore, meniscal rasping is feasible for repairing longitudinal tears in the avascular region of the meniscus, but the healing potential is influenced by the distance to the capsule, length and stability of the tear⁹. ACL (anterior cruciate ligament) reconstruction is a constantly evolving procedure. The ever-changing trends follow the common goal to restore pre-injury anatomy and function as closely as possible¹⁰. With all the progress that has been made during the last years towards better understanding of the graft healing process and individually tailored surgery and rehabilitation, this target has not yet been fully achieved. Given these premises, we aimed to investigate whether stable, incomplete medial meniscus tears can be left untreated during single bundle anatomic anterior cruciate ligament reconstruction. Secondary objectives were to determine the factors which could influence the outcome and to compare medial to lateral tears.

Patients and Methods

For this purpose we performed a prospective observational study on subjects enrolled over four years in the University Hospital. Out of 597 knees (590 patients) 23 were considered to have medial meniscus tears that could be left untreated and 48 with tears of the lateral meniscus. None of the included patients were bilateral cases. All surgeries were performed by a single surgeon using the same procedure and following the same postoperative physical therapy programme. Patient demographics are summarized in Table I.

All 597 screened knees had primary anterior cruciate ligament reconstructions using an anatomical single bundle technique. Our tibial stump preservation technique was comparable to that described by Lee et al¹¹ and Locherbach et al¹² in the sense that ACL remnants are used as a biological sleeve for the graft. We used ipsilateral quadruple hamstrings autografts and the tibial

tunnel was performed inside and through the tibial ACL stump. The femoral tunnels were positioned through the anteromedial portal, low on the internal side of the lateral condyle, under the “*residual’s ridge*”, in the center of the native ACL insertion. Remnant ACL scar was completely removed from the femur in all cases. The femoral fixation used either inside out biodegradable interference screws or two types of cortical buttons. For graft preparation, the tendons were removed from the tibial insertion for preparation as a free graft and the subsequent tibial fixation used a biodegradable interference screw. Postoperatively, the patients were asked to ambulate with protective weight-bearing and crutches for 3 weeks, followed by a variable period of physical therapy under the supervision of two trainers. Complete return to sports was allowed after a minimum of 6 months. In the internal meniscus group 8.3% of tears were radial, 25.5% were horizontal and the rest were longitudinal. The average length of the longitudinal lesions was 7 mm (interval 5-10). Of these, half were in the external third (red-red/zone 3) and half in the middle portion, in relationship to the capsule. 11.5% associated grade I and II (Outerbridge) condral lesions of the medial compartment. In the external meniscus group, 23.5% of tears were radial and the rest were longitudinal. Except for two cases, all involved the posterior third of the meniscus. The average length of the longitudinal lesions was 11.5 mm (interval 5-17.5). 17.6% associated a tear of the posterior horn of the medial meniscus and 29.4% a ‘bucket handle’ respectively; all these were excised. 11.7% had grade I, 35.2% grade II and 5.8% grade III (Outerbridge) condral lesions of the medial compartment. The patients were made aware of the incomplete lesions that were treated conservatively but were blinded for laterality and the same applied to the follow-up examiner. None of the bilateral cases had incomplete lesions in both knees. Clinical evaluation was made using the Cincinnati Knee¹³ and IKDC (International Knee Documentation Committee) rating scores¹⁴. Residual laxity was determined using the KT-1000 (MEDmetric® Knee Ligament ARTHROM-

Table I. Descriptive statistics of the patients data at the point of index surgery; weeks to surgery; estimated time from injury until index ACL reconstruction.

Meniscus	Female	Age (SD)	BMI op (SD)	Weeks to surgery
N = 23 Medial	7	26.64 (5.63)	25.64 (4.23)	14.36 (9.04)
N = 48 Lateral	6	29.88 (5.94)	24.38 (4.50)	10.25 (3.99)

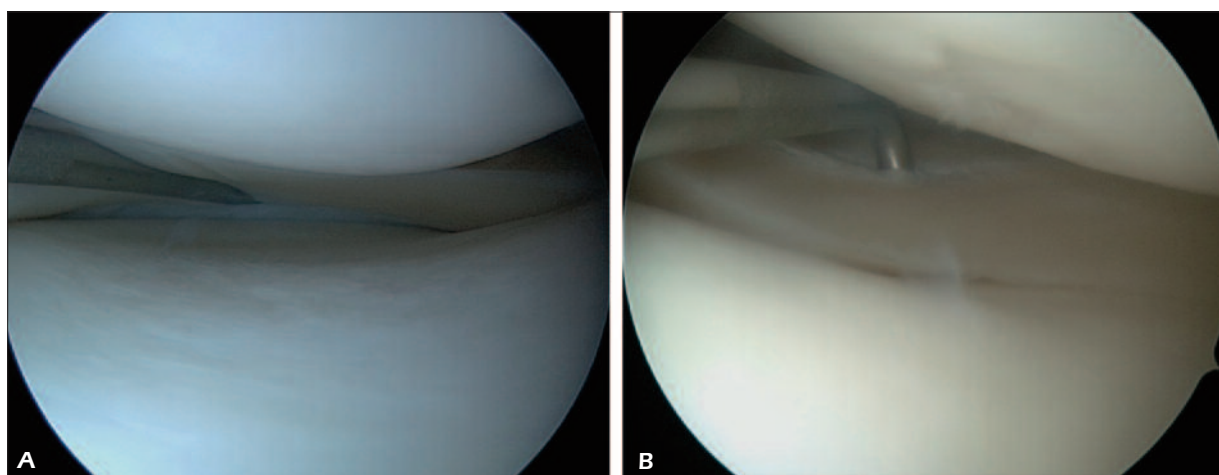


Figure 1. **A,** An example of a stable longitudinal posterior horn medial meniscus tear. **B,** An example of a stable longitudinal posterior horn external meniscus tear.

ETER®). Return to pre-injury function was determined by the limb symmetry index (LSI) calculated using the triple hop for distance (3 maximal effort hops in a straight line)¹⁵.

An unofficial local translation the scores was administered at one year postoperatively to determine outcome. All authors agreed on a local translation of the original form as described by orthopaedicscore.com patient questionnaires forms for a theoretical floor of 6 and ceiling of 100 points for Cincinnati and 1.1 to 100 for IKDC respectively. The patients were instructed to answer all questions and completed the forms with assistance from one of the authors (when needed). Data processing was done using SPSS version 2.0. The study was approved by our hospital Ethics Committee and all measures were taken to ensure patients safety and privacy including intervention if one of the techniques proved unequivocal inferiority.

Results

All patients returned for the one year follow-up (11-13 months). None of the cases required rein-

tervention during the first postoperative year. 21.7% of the medial meniscus group and 14.6% in the lateral group had residual pain with physical activity that gradually disappeared until the one year endpoint. The comparative scores and functional evaluations were discontinued after this final follow-up. The collected data are systematized in Table II. Patients from both groups had results that can be considered favorable when compared to expected follow-up after such a procedure. After one year, follow-up was maintained in the same manner as for the rest of the patients. One patient from the medial meniscus group returned after approximately 4 years with a traumatic tear that was excised. During second look arthroscopy, there was unclear whether this was or not an aggravation of the previous tear. The most prevalent causes for injury in both groups (similar to all of our ACL reconstruction patients) are soccer (43%) and ski (15%) for males and ski (23%) and handball (21%) for females.

We compared Cincinnati Knee, IKDC and LSI values of the two groups using the Mann Whitney U-test and Wilcoxon test; we found no significant differences for the last two variables (both $p = 0.065$) and marginal for the first score

Table II. Statistical analysis of the data collected at one year follow-up.

	Cincinnati (SD)	IKDC (SD)	KT-1000 (SD)	LSI (SD)
N = 23	96.09 (2.91)	95.72 (2.63)	0.82 (0.75)	100.45 (9.42)
N = 48	92.50 (4.60)	92.67 (3.59)	1.50 (0.53)	99.00 (10.45)
<i>p</i>	0.049	0.065	0.110	0.065

($p < 0.05$) (Figure 3). For the KT-1000 the comparison was made using Pearson Chi-Square test with no difference ($p = 0.11$) between groups. The cases were identified only preoperatively. We did not perform standard preoperative scoring on all ACL reconstructions.

Discussion

An interesting incidental finding resulted from correlations between arthroscopic findings of incomplete meniscal tears and preoperative MRIs. All patients had preoperative MRIs performed in 5 different services. The initial radiologist interpretation failed to identify most medial and all lateral incomplete lesions of either menisci when the acquisition was performed on a 0.2T open machine. Even with the 1.5T MRI the findings were missed in 47% of the cases for the lateral meniscus. There were considerable more missed lesions when compared to the literature¹⁶ with all machines but we can still conclude that 0.2T open MRIs cannot be used to identify incomplete meniscal tears in the setting of anterior cruciate ligament rupture. Pujol et al¹⁷ performed a literature review concerning the healing results of meniscal tears left *in situ* during anterior cruciate ligament reconstruction and recommend fixation for medial meniscus tears. These findings are supported by other authors that found meniscal repairs at the time of anterior cruciate ligament reconstruction had a lower failure rate than isolated repairs and better long-term outcomes than partial meniscectomy¹⁸. One explanation might be that longitudinal tears of the medial meniscus in an ACL-deficient knee alter kinematics, particularly the anterior-posterior tibial translation comparable to a partial meniscectomy and that

stability can be improved by repair¹⁹. A more recent review performed by Noyes et al²⁰ found that meniscectomy is performed two to three times more frequently than meniscus repair during anterior cruciate ligament reconstruction. This raises concern since meniscectomy significantly alters long term outcomes and favors arthritic changes, especially in the lateral compartment²¹. To a certain degree, this can be attenuated by the fact that lateral meniscus tears are better tolerated and can be excised more parsimoniously hoping they will continue to provide support²².

In our study group the lateral meniscus lesions group had overall more damage when compared to the medial group, judged by the lateral compartment associated to more severe injuries. This might have led to comparable postoperative symptoms for both groups. The favorable results with preservation of the medial meniscus incomplete tears might have been biased by the reduced length of the tears when compared to the lateral. The higher percentage of males and reduced interval from injury to surgery in the lateral meniscus group might be related to the presence of more severe associated injuries in this group, as determined by associated lesions. To our knowledge this is the only material focusing on the possibility of leaving the medial meniscus *in situ* in the presence of incomplete tears in association with anatomic single bundle ACL reconstructions. Our data come from a single surgeon cohort using the same technique for positioning the femoral tunnel through the antero-medial portal. As such, the favorable outcomes can even support the stability of the ACL reconstruction using this technique. There are some weaknesses to our study design. The consecutive cases were not randomized compared to suture repair or even partial meniscectomy of the incomplete lesions. A further propensity score method can be attempted to reduce confounding and compare to a matched control group of untorn menisci reconstructions²³. Furthermore, attempts to stimulate local healing potential such as needling or rasping have been unsystematically and sporadically performed. Another issue is the contribution of the ACL injury and repair to the final outcome. We cannot provide advice on treating incomplete medial meniscal tears in knees that are not ACL deficient or when the ACL has not been reconstructed. The antero-posterior stability of the knee might suggest a degenerative lesion and persistence of the ACL deficiency can expose the menisci to further injury due to instability.

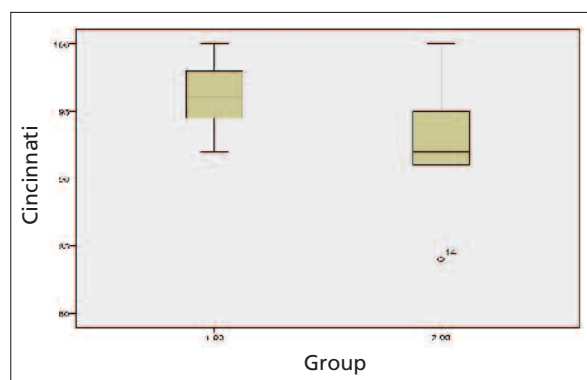


Figure 2. Chart distribution of Cincinnati scores comparison.

Conclusions

Incomplete medial meniscal tears left *in situ* at the time of anterior cruciate ligament can yield favorable outcomes as long as decisions are carefully weighed with regard to length of the lesion. Also, at least in this perspective, anatomic single bundle has proved a sufficient stabilizer for anterior translation of the tibia.

Acknowledgements

Special thanks to Cristina Nuta, MD, for contributing to the postoperative physical therapy.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

- WEISS CB, LUNDBERG M, HAMBERG P, DEHAVEN KE, GILLOQUIST J. Non-operative treatment of meniscal tears. *J Bone Joint Surg Am* 1989; 71: 811-822.
- BEAUFILS P, BASTOS R, WAKIM E, CHO SH, PETIT-JOUVET C. Meniscal injury in the plastic reconstruction of the anterior cruciate ligament. Meniscal suture or abstention. *Rev Chir Orthop Reparatrice Appar Mot* 1992; 78: 285-291.
- SHELBOURNE KD, HEINRICH J. The long-term evaluation of lateral meniscus tears left in situ at the time of anterior cruciate ligament reconstruction. *Arthroscopy* 2004; 20: 346-351.
- FITZGIBBONS RE, SHELBOURNE KD. "Aggressive" non-treatment of lateral meniscal tears seen during anterior cruciate ligament reconstruction. *Am J Sports Med* 1995; 23: 156-159.
- SHELBOURNE KD, RASK BP. The sequelae of salvaged nondegenerative peripheral vertical medial meniscus tears with anterior cruciate ligament reconstruction. *Arthroscopy* 2001; 17: 270-274.
- PIERRE A, HULET C, LOCKER B, SCHILTZ D, DELBARRE JC, VIELPEAU C. Outcome of 95 stable meniscal tears left in place after reconstruction of the anterior cruciate ligament. *Rev Chir Orthop Reparatrice Appar Mot* 2001; 87: 661-668.
- ZEMANOVIC JR, McALLISTER DR, HAME SL. Nonoperative treatment of partial-thickness meniscal tears identified during anterior cruciate ligament reconstruction. *Orthopedics* 2004; 27: 755-758.
- YAGISHITA K, MUNETA T, OGIUCHI T, SEKIYA I, SHINOMIYA K. Healing potential of meniscal tears without repair in knees with anterior cruciate ligament reconstruction. *Am J Sports Med* 2004; 32: 1953-1961.
- UCHIO Y, OCHI M, ADACHI N, KAWASAKI K, IWASA J. Results of rasping of meniscal tears with and without anterior cruciate ligament injury as evaluated by second-look arthroscopy. *Arthroscopy* 2003; 19: 463-469.
- MUSAHL V, BECKER R, FU FH, KARLSSON J. New trends in ACL research. *Knee Surg Sports Traumatol Arthrosc* 2001; 19(Suppl 1): S1-S3.
- LEE BI, MIN KD, CHOI HS, KIM JB, KIM ST. Arthroscopic anterior cruciate ligament reconstruction with the tibial-remnant preserving technique using a hamstring graft. *Arthroscopy* 2006; 22: 340.e1-7.
- LÖCHERBACH C, ZAYNI R, CHAMBAT P, SONNERY-COTTET B. Biologically enhanced ACL reconstruction. *Orthop Traumatol Surg Res* 2010; 96: 810-815.
- NOYES FR, BARBER SD, MOOAR LA. A rationale for assessing sports activity levels and limitations in knee disorders. *Clin Orthop* 1989; 246: 238-249.
- HEFTI F, MULLER W, JAKOB RP, STAUBLI HU. Evaluation of knee ligament injuries with the IKDC form. *Knee Surg Sports Traumatol Arthrosc* 1993; 1: 226-234.
- REID A, BIRMINGHAM TB, STRATFORD PW, ALCOCK GK, GRIFFIN JR. Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction. *Physical Ther* 2008; 87: 337-349.
- DE SMET AA, MUKHERJEE R. Clinical, MRI, and arthroscopic findings associated with failure to diagnose a lateral meniscal tear on knee MRI. *AJR Am J Roentgenol* 2008; 190: 22-26.
- PWJOL N, BEAUFILS P. Healing results of meniscal tears left in situ during anterior cruciate ligament reconstruction: a review of clinical studies *Knee Surg Sports Traumatol Arthrosc* 2009; 17: 396-401.
- PAXTON ES, STOCK MV, BROPHY RH. Meniscal repair versus partial meniscectomy: a systematic review comparing reoperation rates and clinical outcomes. *Arthroscopy* 2011; 27: 1275-1288.
- AHN JH, BAE TS, KANG KS, KANG SY, LEE SH. Longitudinal tear of the medial meniscus posterior horn in the anterior cruciate ligament-deficient knee significantly influences anterior stability. *Am J Sports Med* 2011; 39: 2187-2193.
- NOYES FR, BARBER-WESTIN SD. Treatment of meniscus tears during anterior cruciate ligament reconstruction. *Arthroscopy* 2012; 28: 123-130.
- SALATA MJ, GIBBS AE, SEKIYA JK. A systematic review of clinical outcomes in patients undergoing meniscectomy. *Am J Sports Med* 2010; 38: 1907-1916.
- SHELBOURNE KD, ROBERSON TA, GRAY T. Long-term evaluation of posterior lateral meniscus root tears left in situ at the time of anterior cruciate ligament reconstruction. *Am J Sports Med* 2011; 39: 1439-1443.
- AUSTIN PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behav Res* 2011; 46: 399-424.