F. Steenbrugge · W. Van Nieuwenhuyse · R. Verdonk ·
K. Verstraete

Arthroscopic meniscus repair in the ACL-deficient knee

Received: 17 October 2004 / Accepted: 26 October 2004 / Published online: 5 February 2005
© Springer-Verlag 2005

Abstract Between 1985 and 1995, 45 patients underwent closed meniscus repair. There were 30 men and 15 women with a mean age of 32.5 years. In 23 patients, the anterior cruciate ligament was intact (group 1) whereas it was deficient in 22 patients (group 2). All patients were managed with the same postoperative program of partial weight bearing, immediate motion and rehabilitation of the knee. Five patients had a failed meniscal repair and underwent a repeat arthroscopy and a partial meniscectomy. These patients were considered as failures and excluded from the final scoring. After a mean follow-up of more than 9 years, all patients were subjected to a clinical examination using the Hospital for Special Surgery (HSS) knee rating system. Seven patients in group 2 had episodes of frequent giving way and had their anterior cruciate ligament (ACL) reconstructed 6 and 7 years after the initial meniscus repair. None of the other patients had any clinical symptoms or signs of a meniscal tear. In group 1, 20 patients and in group 2, 14 patients, all had a satisfactory knee score. Even though the failure rate of meniscus repair may be greater in an unstable knee, it is concluded that meniscal repair is not contraindicated in a knee with a deficient ACL.

Résumé Entre 1985 et 1995 45 malades ont eu une réparation méniscale à foyer fermé. Il y avait 30 hommes et 15 femmes à l'âge moyen de 32,5 ans. Chez 23 malades le ligament croisé antérieur (LCA) était intact (Groupe 1), alors qu'il était défectueux chez 22 malades (Groupe 2). Tous les malades ont eu le même programme postopératoire avec appui partiel, mobilisation immédiate et rééducation du genou. Cinq malades ont présentés un échec et ont subi une arthroscopie secondaire avec méniscectomie partielle. Ces malades ont été considérés comme échecs et ont exclu du dernier marquage de points. Après une moyenne de suivi de plus de neuf ans tous les malades ont été soumis à un examen clinique qui utilise le score HSS pour l'estimation du genou. Sept malades du groupe 2 ont eu de fréquent épisodes de dérobement et ont eu leur LCA reconstruit 6 et 7 ans après la réparation du ménisque. Aucun des autres malades n'avait de symptôme clinique ou de signe d'une déchirure méniscale. Vingt malades du groupe 1 et 14 malades du groupe 2 avaient tous un score du genou satisfaisant. Bien que le taux d'échec de réparation du ménisque puisse être plus grand dans un genou instable, notre conclusion est que la réparation du ménisque n'est pas contre-indiquée sur un genou avec un LCA défectueux.

F. Steenbrugge (✉) · W. Van Nieuwenhuyse
Department of Orthopaedic Surgery and Traumatology,
ASZ Campus Aalst,
Merestraat 80,
9300 Aalst, Belgium
e-mail: Fsteenbr@belgacom.net
Tel.: +32-5-3764914
Fax: +32-5-3764918

R. Verdonk
Department of Orthopaedic Surgery and Traumatology,
University Hospital,
Ghent, Belgium

K. Verstraete
Department of Radiology,
University Hospital,
Ghent, Belgium

Introduction

Meniscal tears are the most common knee injuries, comprising 75% or more of all internal derangements of the knee [2, 15]. Meniscus repair, however, did not receive widespread attention and acceptance until the last two decades [6, 14]. During the last decade, better understanding of the histological, biological and functional significance of the meniscus has led to a more conservative therapeutic approach to lesions of the meniscus [3]. Long-term follow-up of meniscal repair procedures is important to ascertain that repaired menisci will survive, function effectively and prevent late degenerative changes seen after meniscectomy [6, 16].

When meniscal tears occur in conjunction with anterior cruciate ligament (ACL) injuries, most authors, including

us, advocate concurrent meniscal repair and repair or reconstruction of the torn ACL. However, some patients elect to have a meniscal repair without ACL reconstruction. This study was undertaken to evaluate the results of meniscal repair in knees lacking a functional ACL and compare these results with those of meniscal repair in ACL-intact knees.

Materials and methods

Between 1985 and 1995, 45 patients (45 knees) underwent meniscal repair by a closed arthroscopic technique. There were 30 men and 15 women with a mean age of 32.5 (17–55) years. In 23 patients (group 1), the knee had an intact ACL and in 22 patients (group 2), the knee was ACL-deficient. At 5-years' follow-up, 20 patients also underwent an MRI investigation. In all patients, history, physical examination and preoperative CT scan were always used to identify ligamentous or meniscal injury [19]. A modification of the Hospital for Special Surgery (HSS) knee rating system [17] was used for evaluation. Based on their score, patients were assigned to excellent, good, fair, or poor results. The mean follow-up was 9 years 2 months (7 years 11 months to 13 years 4 months) for group 1 and 9 years 5 months (8 years to 13 years 10 months) for group 2. The location and the extent of the tear were described by zones based on the distance from the synovial meniscal junction (SMJ) and whether the tear length was smaller than 3 mm; from 4 to 6 mm or longer than 6 mm (more details see Tables

1 and 2). Approximately 45% of tears fell within 0–3 mm of the SMJ in both groups.

Ten patients in each group underwent an arthroscopic meniscal repair using an inside-out technique as described by Cannon [1] whereas in the remaining, an all-inside technique was used. For the red-red (R-R) tear, a rasping of the parameniscal synovium in both meniscomfemoral and meniscotibial regions was performed and sutures placed at 3- to 4-mm intervals. The Biofix suture device was used in 13 patients in group 1 and in 12 patients in group 2. After the rupture had been freshened and reduced, the chosen cannula with the blunt obturator inside was inserted through the portals. Every 5–10 mm, a new tack was inserted until the rupture was stable.

In both groups, aftercare included a 3-week period of maximum protection where only touch weight bearing was permitted. This was followed by a period of continuing protection from heavy stresses until 3 months after surgery. Hereafter, a gradual return to full-speed running, agility and unrestricted activities was encouraged as desired and tolerated.

Results

In each group, there was one superficial infection and in group 1 a patient with neurapraxia of the saphenous nerve. In group 2, one patient showed persistent hemarthrosis during the first postoperative month, which regressed spontaneously. Irritation from the Biofix implant was observed

Table 1 Patient characteristics and results in group 1 with intact anterior cruciate ligament (ACL). *R-R* red-red zone, *R-W* red-white zone, *W-W* white-white zone, *Acute* injury-to-repair interval <2 weeks, *chronic* injury-to-repair interval >2 weeks, *I-O* inside-out, *A-I* all-inside

Patient	Age (years/ months)	Gender	Side	Extent of tear	Zone of Location	Acute/ chronic	Suture	Score ^a
1	44y 6m	M	L	>6 mm	R-W	Acute	I-O	Excellent
2	45y 5m	M	L	0–3 mm	R-R	Chronic	A-I	Good
3	34y 1m	M	R	>6 mm	R-W	Chronic	A-I	Excellent
4	40y 9m	M	L	4–6 mm	R-R	Chronic	A-I	Good
5	44y 6m	M	L	0–3 mm	R-R	Acute	A-I	Good
6	38y	M	R	4–6 mm	R-W	Chronic	I-O	Good
7	63y	M	R	4–6 mm	R-W	Chronic	A-I	Fair
8	31y 10m	M	L	>6 mm	R-R	Acute	A-I	Excellent
9	37y 10m	M	L	4–6 mm	R-W	Chronic	A-I	Good
10	41y 6m	M	R	4–6 mm	W-W	Acute	I-O	Failure
11	19y	M	L	4–6 mm	R-R	Acute	A-I	Good
12	31y 10m	M	R	4–6 mm	R-W	Chronic	I-O	Good
13	44y 10m	M	R	0–3 mm	R-R	Acute	A-I	Good
14	33y	M	R	>6 mm	R-W	Chronic	A-I	Excellent
15	37y 10m	M	L	0–3 mm	R-R	Acute	I-O	Good
16	37y 10m	M	L	>6 mm	R-W	Chronic	A-I	Fair
17	33y 6m	M	R	>6 mm	R-W	Chronic	A-I	Excellent
18	22y 10m	F	R	4–6 mm	R-W	Chronic	A-I	Good
19	35y 6m	F	L	>6 mm	R-R	Acute	I-O	Excellent
20	31y 1m	F	R	0–3 mm	R-W	Chronic	I-O	Good
21	32y 9m	F	R	4–6 mm	R-R	Acute	I-O	Good
22	34y 6m	F	L	>6 mm	R-R	Chronic	I-O	Good
23	44y 10m	F	R	0–3 mm	R-W	Acute	I-O	Good

^aScore based on Modification of Hospital for Special Surgery (HSS) knee rating scale

Table 2 Patient characteristics and results in group 2 with deficient anterior cruciate ligament (ACL). *R-R* red-red zone, *R-W* red-white zone, *W-W* white-white zone, *Acute* injury-to-repair interval <2 weeks, *chronic* injury-to-repair interval >2 weeks, *I-O* inside-out, *A-I* all-inside

Patient	Age	Gender	Side	Extent	Zone of location	Acute/chronic	Suture	Score ^a	ACL
1	27y 4m	M	L	4–6 mm	R-R	Acute	I-O	Excellent	
2	50y 2m	M	L	>6 mm	W-W	Chronic	I-O	Failure	
3	48y 1m	M	R	0–3 mm	R-W	Acute	A-I	Excellent	
4	31y 10m	M	L	4–6 mm	R-W	Chronic	A-I	Good	
5	35y 1m	M	R	0–3 mm	R-W	Acute	A-I	Good	Reconstructed
6	29y 6m	M	L	0–3 mm	R-R	Acute	I-O	Excellent	
7	37y 10m	M	L	4–6 mm	R-W	Chronic	I-O	Poor	
8	31y 4m	M	R	>6 mm	R-W	Chronic	I-O	Good	
9	29y 6m	M	L	>6 mm	R-W	Chronic	A-I	Fair	
10	69y 5m	M	R	4–6 mm	R-R	Acute	I-O	Failure	Reconstructed
11	34y 6m	M	L	4–6 mm	R-R	Acute	A-I	Good	Reconstructed
12	31y 10m	M	R	>6 mm	R-W	Chronic	I-O	Fair	
13	27y 6m	M	L	4–6 mm	R-W	Chronic	A-I	Good	Reconstructed
14	50y 2m	F	L	>6 mm	R-W	Chronic	A-I	Fair	
15	35y 1m	F	L	0–3 mm	R-R	Acute	A-I	Excellent	
16	38y	F	R	4–6 mm	R-R	Acute	I-O	Good	Reconstructed
17	32y 9m	F	R	>6 mm	R-W	Chronic	A-I	Good	
18	34y 6m	F	L	>6 mm	R-R	Acute	A-I	Failure	Reconstructed
19	46y 4m	F	L	0–3 mm	R-R	Chronic	I-O	Good	
20	25y 8m	F	R	>6 mm	R-W	Acute	A-I	Excellent	
21	31y 1m	F	L	4–6 mm	R-R	Chronic	I-O	Failure	Reconstructed
22	22y 10m	F	R	>6 mm	R-R	Acute	A-I	Good	

^aScore based on Modification of Hospital for Special Surgery (HSS) knee rating scale

in two cases of which one (group 1) had a repeat arthroscopy. Five patients had a secondary meniscectomy, one in group 1 and four in group 2, and were excluded from the rating of the final result. Seven patients in group 2 had episodes of frequent giving way and had their ACL reconstructed 6 and 7 years after the initial meniscal repair. In group 1, six patients were rated as excellent, 14 as good and two as fair. There were no poor results. In group 2, six patients had an excellent result, eight a good result, two a fair result and two patients were rated as poor. If ratings of excellent and good were considered as satisfactory, there were 20 satisfactory in group 1 and 14 satisfactory in group 2. Age did not affect the outcome, nor did gender. All acute tears (interval from injury to repair less than 2 weeks) had good-to-excellent results. All repairs of tears in the R-R zone and 80% of all in the red-white (R-W) zone had good-to-excellent results. Only one white-white (W-W) zone tear (>6 mm from the SMJ) was repaired in group 1. This patient underwent a secondary meniscectomy and was excluded from the final evaluation. In group 2, the patient with the W-W zone tear also had a repeat arthroscopy at 1 year follow-up, and a partial meniscectomy was performed due to non-union. In both groups patients with a tear between 0 and 3 mm in length had good-to-excellent results.

Ten patients in each group had an MR examination at 5 years' follow-up. Sagittal proton-density and T2-weighted images followed by 2-mm coronal 3D gradient echo images and 4-mm axial T1-weighted images and 3-mm

sagittal T2-weighted images were obtained. In all patients, the site of the previous suture could still be detected, mainly by the small micrometal artefacts in the meniscus evident on the gradient echo images. In one patient, a new tear was found. In five patients (three in group 1, two in group 2), hyperintense areas were found in the meniscus. Four patients (group 2) clearly showed an early onset of arthritis and cartilage degeneration (grade 3), and two (group 1) showed minor signs of cartilage degeneration (grade 1) [9, 11]. The patients with grade 3 lesions had good-to-excellent functional results.

Discussion

Ideally, in a knee in which there is both an ACL tear and a repairable meniscal tear, the former should be reconstructed and the latter repaired [4, 7, 8]. However, for various reasons, some patients elect not to undergo a ligament reconstruction. In our study, chronicity of the tear was found to affect the percentage of satisfactory results. All menisci repaired within two weeks of injury had a good-to-excellent result.

Rubman and Noyes [13] recommend arthroscopic repair for meniscal tears extending into the avascular zone in select cases. The 20% reoperation rate in their study should not be interpreted as the rate of meniscal healing but as the incidence of tibiofemoral joint symptoms. In our

study, both cases of meniscal tears in the W-W zone were due to suture failure.

Knee stability seems to affect the result of meniscal repair. In the current study there was a failure rate of 18% (4/22) in group 2 versus 5% (1/23) in group 1. Hanks et al. [8] reported a 13% failure rate of meniscal repair in the ACL-deficient knee. They concluded that even though the failure rate may be higher in an unstable knee, meniscal repair was not contraindicated in an ACL-deficient knee. Roos et al. [12] concluded that osteoarthritis (OA) of the knee after injury to the ACL or meniscus became increasingly severe with an increase in time between joint injury and examination. The OA changes appeared sooner in older patients than in the younger. Also, in our study, the youngest patient showed only minor cartilage degeneration. Neither the age of the patient nor the length or extent of the tear seemed to affect the result of meniscal repair. We believe that in clinically asymptomatic patients, the meniscus is either healed or acts as an autograft and fulfills the biomechanical tasks of an uninjured meniscus.

Link et al. [9] concluded that cartilage lesions, bone marrow oedema pattern and meniscal and ligamentous lesions were frequently demonstrated on MRI in patients with advanced osteoarthritis. Clinical findings, however, showed no significant correlations with the Kellgren-Lawrence scale score and the extent of findings at MR imaging. Hanks et al. [8], Magee [10] and Totty [18] suggested that MRI may prove an ideal diagnostic tool in evaluating meniscal healing. The first studies using MRI after meniscal repair reported a persistent pathological signal after meniscal suture. The remaining question in these short-term studies was whether these mainly, grade 3 signals, represented persisting tears or increased water content of fresh scar tissue, which may eventually disappear. We found presence of mucoid degeneration or scar tissue in six of 20 patients after an average follow-up of more than nine years. Therefore, we believe that asymptomatic menisci produce abnormal MRI signals even though they have stable unions and that MRI signals at the site of repair represent oedematous scar tissue, not true nonunions. Eggli et al. found similar findings in their study [5].

Our current protocol for the repair of meniscal tears relies on several technical details that the authors consider to be essential for the successful repair of simple and complex meniscal tears. Degenerative, poor quality meniscal tissue is not strong enough to hold sutures and should not be considered for repair. Stable fixation of the meniscal tear decreases the possibility of motion between meniscal fragments and allows a postoperative rehabilitation program that emphasizes early motion and weight bearing. Because the location of the tear within the meniscus is not a primary consideration for which tears are amenable to repair, we no longer measure the rim width at the time of repair. All tears that undergo repair, regardless of pattern or location, are held in place with multiple, nonabsorbable sutures placed at 3- to 4-mm intervals. If

meniscal repair is performed, the long-term data in our study show that at nine years after surgery, a majority of the patients will be asymptomatic.

References

1. Cannon WD, Morgan CD (1994) Meniscal repair. *J Bone Joint Surg Am* 76:294–311
2. Dandy DJ, Jackson RW (1975) The diagnosis of problems after meniscectomy. *J Bone Joint Surg Br* 57:49–352
3. DeHaven KE (1999) Meniscus repair: current concepts. *Am J Sports Med* 27:242–250
4. Dejour H, Walch G, Neyret P, Adeleine P (1988) Résultats des laxités chroniques antérieures opérées. A propos de 251 cas revus avec un recul minimum de 3 ans. *Rev Chir Orthop* 74:622–636
5. Eggli S, Wegmüller H, Kosina J (1995) Long-term results of arthroscopic meniscal repair: an analysis of isolated tears. *Am J Sports Med* 23:715–720
6. Englund M, Roos EM, Roos HP, Lohmander LS (2001) Patient-relevant outcomes fourteen years after meniscectomy: influence of type of meniscal tear and size of resection. *Rheumatology* 40:631–639
7. Gacon G, Barba L, Lalain JJ, Laurençon M, Ray A (1992) Résultats à plus de dix ans de 54 plasties intra-articulaires du ligament croisé antérieur du genou. *Rev Chir Orthop* 78:130–131
8. Hanks GA, Trenton MG, Handal JA (1990) Meniscus repair in the anterior cruciate deficient knee. *Am J Sports Med* 18:606–613
9. Link TM, Steinbach LS, Ghosh S, Ries M, Lu Y, Lane N, Majumbar S (2003) Osteoarthritis: MR Imaging findings in different stages of disease and correlation with clinical findings. *Radiology* 226:373–381
10. Magee T, Shapiro M, Rodriguez J, Williams D (2003) MR arthrography of postoperative knee: for which patients is it useful? *Radiology* 229:159–163
11. Recht MP, Kramer J, Marcelis S (1993) Abnormalities of articular cartilage in the knee: analysis of available MR techniques. *Radiology* 187:473–478
12. Roos H, Adalbrecht T, Dahlberg L, Lohmander LS (1995) Osteoarthritis of the knee after injury to the anterior cruciate ligament or meniscus: the influence of time and age. *Osteoarthritis Cartilage* 3:261–267
13. Rubman MR, Noyes FR, Barber-Westin SD (1998) Arthroscopic repair of meniscal tears that extend into the avascular zone: a review of 198 single and complex tears. *Am J Sports Med* 26:87–95
14. Saragaglia D, Rose-Pittet L, Lebas JF, Coulomb M, Butel J (1989) L'imagerie par résonance magnétique nucléaire dans l'exploration des lésions ménisco-ligamentaires du genou: 85 examens contrôlés par arthroscopie. *Rev Chir Orthop* 75:52–458
15. Shands AR, Hutchinson JL, Ziv L (1936) Derangements of the semilunar cartilages of the knee: A clinical and experimental study. *South Med J* 29:1045–1050
16. Steenbrugge F, Verdonk R, Verstraete K (2004) Magnetic resonance imaging of the surgically repaired meniscus: a 13-year follow-up study. *Acta Orthop Scand* 75:323–327
17. Stone RG, Frewin PR, Gonzales S (1990) Long-term assessment of arthroscopic meniscus repair: a two- to six-year follow-up study. *Arthroscopy* 6:73–78
18. Totty WG, Matava MJ (2000) Imaging the postoperative meniscus. *Magn Reson Imaging Clin N Am* 8:271–283
19. Verdonk R, Meire D, Van De Velde C, Van Eetvelde G, Claessens H (1991) CT scan of the knee: correlation with clinical and arthroscopic findings. *Acta Orthop Belg* 57:49–55