Knee Surg, Sports Traumatol, Arthrosc
(1998) 6 [Suppl 1]: S13–S15

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Drill hole position in endoscopic anterior cruciate ligament reconstruction

Results of an advanced arthroscopy course

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Abstract In 24 cadaver knees the anterior cruciate ligament (ACL) was replaced by a bone-tendon-bone patellar tendon autograft in an endoscopic technique. This was carried out during an advanced arthroscopy course after intensive instruction and practice on a plastic model. When the knees were opened and evaluated according to the recent orthopaedic literature, only four good results with correct tunnels and a non-impinging graft were found. In 12 knees the femoral tunnel was too far anterior (10) or had broken through the posterior femoral cortex (2). In 6 knees the tibial tunnel was too far anterior (2) or too far posterior (4). The notchplasty was insufficient in 6 knees. We conclude that endoscopic ACL reconstruction cannot be mastered after attending a course alone. Expert help is necessary during the first clinical cases.

Key words Anterior cruciate ligament · Tunnel placement · Endoscopy

Introduction

Endoscopic reconstruction of the anterior cruciate ligament (ACL) has become a standard procedure over the past few years [1]. Because of the decreased postoperative morbidity, patients tend to prefer this type of ACL reconstruction. However, it is technically demanding. An advanced arthroscopy course, held at the Orthopaedic Hospital of Hannover Medical School, enabled us to evaluate the capability of surgeons to place tunnels correctly after intensive instruction but without clinical practice.

Materials and methods

The course was held on two successive days. A video recording of an endoscopic ACL reconstruction carried out by a recognized leader in this field of surgery formed the first part. It was followed by an afternoon of lectures and discussions. The next day all course attendants carried out two ACL reconstructions: the first was done on a plastic model, the second on a cadaver knee under conditions similar to an operating theater.

Only orthopaedic surgeons who had already performed at least 500 knee arthroscopies were invited to participate in this course. Full video-arthroscopic equipment, a motorized shaver system and an endoscopic drill guide with an isometry measurement device were provided.

Twenty-four knee joints from 18 donors (10 women, 8 men; age 17–56 years; median 38 years) were operated on. The specimens included 20 cm long parts of the distal thigh and the proximal tibia. The femur was securely fixed with polymethylmethacrylate (PMMA) bone cement and screws to an iron bar which was clamped to the table. The knees were fully mobile, and the entire specimen was covered by an artificial watertight skin. Middle thirds of the patellar tendon with bone blocks on both ends that could pass through 10 mm and 9 mm drillholes were provided separately. The surgeons had enough time for the cadaver lab. Everybody was able to finish his exercise. Intraoperative isometry testing was uniformly carried out before the 9 mm femoral hole was drilled, and no length change of more than 3 mm between full knee extension and 100° of flexion was tolerated.

After the course all knee specimens were dissected in our laboratory. Before separating the femur and tibia an impingement test was carried out by first inserting a 9 mm drill through the tibial drillhole and then extending the knee (Fig. 1). The drill should pass freely within the notch. This was checked by looking at the specimen from behind. After separating the bones, photodocumentation was begun.

Three photos were taken of the proximal tibia: from the front, from the side and from above. Three photos were taken of the femur: from the side, from the front and from underneath (Fig. 2).

Fig. 1 Tibial drillhole exits in the anterior part of the ACL footprint causing notch impingement. Specimen of a left knee with 9-mm drillbit

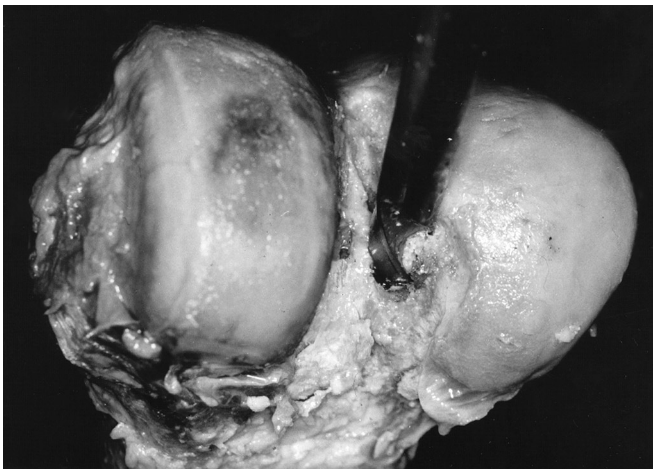


Fig. 2 Femoral drillhole. Entrance too far anterior in the intercondylar fossa. Specimen of a left knee, with 9 mm drillbit

The results were evaluated according to recent literature about the anatomy of the ACL [2, 3, 10] and drill hole position [4–9] (Figs. 3, 4).

Results

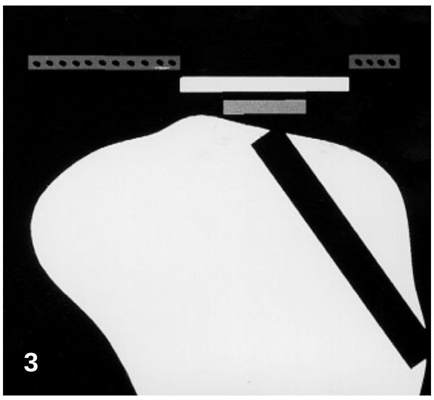
Excellent results were found in only 4 of the 24 specimens: both tunnels were correct, and the graft did not impinge in the intercondylar fossa during full extension of the knee (Table 1). In half of the cases the femoral tunnel was unacceptable. This includes 2 tunnels that had broken through the posterior femoral cortex or ran subperiosteally, as well as 10 specimens where the position of the femoral drill hole was too far anterior in the intercondylar notch. In 8 knees the femoral exit hole was in an 'acceptable' position. On the tibial side, the exits of 6 tunnels were completely wrong: 4 times the exit was positioned in the posterior intercondylar area, 2 times it was so far anterior that impingement of the graft was predictable. Tibial tunnels were 'acceptable' within the footprint of the ACL where a posterior position of the graft allowed for a course without impingement. Ten times the position and the exit of the tibial canal were 'excellent', but in 6 of these knees the notchplasty was either insufficient or in the wrong location.

Discussion

There are limitations as to what we can say based on our results. First, the cadaver knees were not ACL-deficient and therefore not an exact model for the clinical situation.

Fig. 3 Classification of tibial tunnel exit according to Howell and Clark [6]: excellent, within posterior half of the ACL footprint (*short bar*); acceptable, within ACL footprint (*longer bar*); unacceptable, outside ACL footprint (*interrupted, dotted bar*)

Fig. 4 Classification of femoral tunnel entrance according to Harner et al. [5]: excellent, totally beneath posterior quarter of the roof-line (*left circle*); acceptable, partly beneath posterior quarter of the roof-line (*middle circle*); unacceptable, not beneath the posterior quarter of the roof-line (*right circle*)



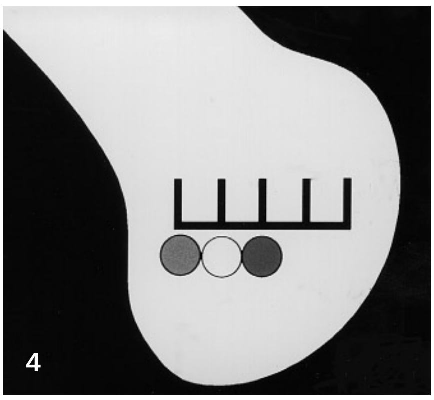


Table 1 Summary of results according to tunnel placement (tunnel diameter: tibial 10 mm, femoral 9 mm)

	Tibial	Femoral
Excellent	10	4
Acceptable	8	8
Unacceptable	6	12
Total	24	24

Second, stability testing could not be performed on the cadavers. Third, the hardware together with the patellar tendon grafts had to be removed during the course, and thus the state of the graft itself could not be evaluated in the laboratory. Finally, we had no possibility of documenting the arthroscopic result intraoperatively during the course.

In conclusion, even after intensive theoretical instruction, practical exercises on plastic models, live transmission from the operating room and the use of standard equipment, the majority of otherwise experienced arthroscopic surgeons did not place the tunnels correctly in the cadaver laboratory. Exact placement of the femoral tunnel was the foremost problem.

Given the limitations mentioned above, we conclude that endoscopic ACL reconstruction is associated with a considerable learning curve and that the technique cannot be mastered after attending a course alone. Intraoperative isometry testing [11] cannot guarantee anatomically correct tunnel placement. For placement of the femoral tunnel, additional guidance by drillguides or lateral fluoroscopy is necessary. During the first clinical cases expert help is required to avoid misplacement of the tunnels and graft impingement.

References

1. Aglietti P, Buzzi R, D'Andria S, Zaccherotti G (1992) Long-term study of anterior cruciate ligament reconstruction for chronic instability using the central one-third patellar tendon and a lateral extraarticular tenodesis. Am J Sports Med 20:38–45
2. Amis AA, Dawkins GPC (1991) Functional anatomy of the anterior cruciate ligament. J Bone Joint Surg [Br] 73: 260–267
3. Arnoczky SP, Warren RF (1988) Anatomy of the cruciate ligaments. In: Feagin JA (ed) The crucial ligaments. Churchill Livingstone, New York, p 179
4. Graf B (1987) Isometric placement of substitutes for the anterior cruciate ligament. In: Jackson DW, Drez D (eds) The anterior cruciate deficient knee. Mosby, St Louis, pp 102–113
5. Harner CD, Marks PH, Fu FH, Loogang JJ, Silby MB, Mengato R (1994) Anterior cruciate ligament reconstruction: endoscopic versus two-incision technique. Arthroscopy 10: 502–512
6. Howell SM, Clark JA (1992) Tibial tunnel placement in anterior cruciate ligament reconstructions and graft impingement. Clin Orthop 283:187–195
7. Howell SM, Taylor MA (1993) Failure of reconstruction of the anterior cruciate ligament due to impingement by the intercondylar roof. J Bone Joint Surg [Am] 75:1044–1055
8. Howell SM, Clark JA, Farley TE (1991) A rationale for predicting anterior cruciate graft impingement by the intercondylar roof. Am J Sports Med 19:276–282
9. Howell SM, Clark JA, Farley TE (1992) Serial magnetic resonance study assessing the effects of impingement on the MR image of the patellar tendon graft. Arthroscopy 8:350–358
10. Odensten M, Gillquist J (1985) Functional anatomy of the anterior cruciate ligament and a rationale for reconstruction. J Bone Joint Surg [Am] 67:257–262
11. Sapega AA, Moyer RA, Schneck C, Komalahirnaya N (1980) Testing for isometry during reconstruction of the anterior cruciate ligament. J Bone Joint Surg [Am] 72:259–267