Anterior cruciate ligament reconstruction with the press-fit technique

2–5 years followed-up of 42 patients

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42 patients underwent anterior cruciate ligament (ACL) reconstruction with the press-fit technique. The ACL was reconstructed with a bone-tendon-bone graft from the medial third of the patellar tendon.The graft was stabilized without screws in the femur and tibia by press-fit. To imitate the anatomical functioning of the ACL, the femoral bone block was placed with the tendon close to the over-the-top position. The tibial block was then placed in a trough on the tibia, so that the ligament fibres were parallel and tight during extension and slightly inverted during flexion.

At evaluation mean 41 (25–61) months postoperatively, the mean Lysholm score was 93 (80–100) points, the mean activity level was 6 (3–10) points, and the mean translation of the tibia head, measured by the KT-1000 arthrometer (side-to-side difference), was 2 (0–7) mm. Only 3 of the patients suffered loss of extension (5°). Patients who underwent reconstruction at least 4 months after the injury had better results than those who were operated earlier.

The press-fit method allowed for anatomic substitution of the ACL with a stable graft without the disadvantages associated with screws. This method gave early postoperative functioning of the knee and good mid-term results.

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Anterior cruciate ligament (ACL) reconstruction using the patellar bone-tendon-bone autograft has been widely used. It is strong and can be stably fixed, normally with screws (Feagin and Curl 1976, Feagin et al. 1995, Kurosaka et al. 1987, Johnson and Van Dyk 1994). A new method was developed by Hertel in Berlin (Bernard et al. 1992, Hertel and Bernard 1994), who used bone blocks fixed in the femur and tibia without screws. With this press-fit technique the ligament is rotated 90° and the final transplant imitates a normal ACL.

Originally, surgery was through a miniarthrotomy. We have modified the technique (Georgoulis et al 1996) and describe an arthroscopic method and the outcome of 42 patients.

Patients and methods

Between 1991 and 1994 we used the press-fit technique in 68 patients, with ACL injury. Patients with repair of other ligaments, arthrosis, cartilage defects larger than 1 cm, severe injuries in the same leg or with ligament injuries in the other knee are excluded. The follow-up evaluation included 42 patients.

Surgical techniques: A patellar bone-tendon-bone graft was taken by making a 6–8 cm antero-medial incision over the patella to facilitate rewmoval of the patellar tendon. The tibial bone block (approximately 30 x 10 x 10 mm) had a trapezoid shape in cross section while the patellar bone block which was taken in the shape of a 'flag' (approximately 25 x 20 mm) had a triangular shape in cross section. The medial capsule was incised and the fat pad was pushed laterally. With the knee joint bent more than 120°, a hook was placed in the over-the-top position, parallel to the tibial plateau. Parallel to the hook and 5–6 mm above it, a 4.5-mm tunnel was drilled and expanded using the 9-mm AO hand piece. A 4.5-mm drill was driven into the center of the anatomical footprint of the ACL on the tibial defect produced during harvesting. A 5–6-mm bone slice was then sawed out over the drill hole, producing a trough on the anterior part of the tibial head. The starting point of the trough was rounded not to risk damage of the graft (Hertel and Bernard 1994).

With a suture placed at the end of the tibial bone block and, a needle was used to pull the suture through the femoral tunnel followed by driving the bone block into the tunnel with a hammer. Care was taken to keep the cortex of the bone block parallel with the tibial plateau so that the ligamentcould be placed close to the over-the-top position. The transplant was then rotated 90° laterally and place it into the tibial trough, pulling it with a Kocher clamp at approximately 20°–30° flexion of the knee. The patellar bone block was impounded into the end of the trough, using a hammer, and fixed by press-fit at a depth of approximately 2 cm. Before stable fixation, we ascertained that a full range of motion was possible without moving the bone block more than 2 mm. The bone slice is refixed by transosseous sutures. Now we observed whether or not there was impingement during full extension and, if so, the notch was enlarged. Finally, the knee joint was placed in a brace allowing approximately 20° flexion.

Postoperatively, the patient was allowed to bend the knee between 10° and 90° and walk with two crutches. Full movement and weight bearing were allowed after 6 weeks.

The femoral tunnel was constructed arthroscopically through a medial parapatellar arthroscopic approach using the same instruments. The graft was pull through as described above until it reached the beginning of the femoral tunnel, by removing the fat pad from the anterior part of tibia only. Then it was impacted using the AO convex bone plunger through the medial parapatellar arthroscopic approach. The drilling at the tibia was also performed arthroscopically, however, the bone slice was sawed over the drill hole, after pulling the fat part from its surface with a small retractor. This variation has been performed over the last 2 years.

Follow-up study: At follow-up patients were physically examined, questioned about their activities and symptoms, and classified by the Lysholm questionnaire (Lysholm and Gillquist 1982), and the Tegner activity score (Tegner and Lysholm 1985). Range of motion was measured against that of the opposite normal knee with special care being given to the heel-height difference with the patient in prone position. We used the quick estimate proposed by Sachs (Sachs et al. 1985), in which each centimeter of heel deference is equal to one degree of knee flexion contracture. Patellar crepitance was estimated during active extension from 90° to 0°, while the examiner had his palm on top of the patellar. Anterior tibial translation was measured using the KT-1000 knee arthrometer and the side to side difference was measured at 68N and 90N (Daniel and Stone 1994). We also performed the Lachmann-Noulis test and the jerck test (Noulis 1875, Pæssler and Michel 1992, Torg et al. 1976). AP and lateral radiographswere also taken.

Table 1. Results after ACL reconstruction using press-fit technique

Measure	Mean ± SD	Range
Tegner Activity score	6 ± 3	3–10
Lysholm score	93± 6	80–100
KT-1000 measurement (side to side difference)	2 ± 2	0–7

Results

34 men and 8 womenwith a mean age of 30 (23-41) years were examined. Average mid-term follow-up was 41 (25–61) months. 31 of the 42 patients were athletes (3 basketball players, 2 handball players and 27 soccer players) who trained at least 3–4 times a week. Both the Lachmann-Noulis test and the jerck test were positive preoperatively. In addition to the ACL reconstruction, a partial meniscectomy was performed in 6 patients, meniscus suturing in 12 and shaving of the damaged cartilage in 6 patients. The patients were hospitalized for an average of 6 (3–10) days postoperatively, and returned to full activity after an average of 5 (2–7) months.

The position of the bone blocks was examined postoperatively on standard AP and lateral radiographs immediately after the operation and again after 1.5 months and 3 months. The femoral and tibial bone blocks were in the correct position according to the methods of Bernard and Hertel (1996) and that of Dijan et al. (1995). Radiographic examination did not indicate any movement of the bone blocks or tunnel enlargement.

All of the patients experienced an improvement in knee function (Table 1), noting that the feeling of instability had disappeared and that they would undergo this procedure again if suffering from the same injury. All of the 32 patients who were involved in sports returned to their previous activities and played at least at the same level. 4 young athletes (2 soccer players, 1 basketball player, and 1 handball player) are playing at a higher professional level now than they were preoperatively. Of the other 10 patients, 5 occasionally continued to take part in sports activities, while 5 were not involved in sports either pre- or postoperatively. Crepitus was found in 7 patients, 2 with an extension deficit of 5°. No other complaints were noted and signs of arthrosis were not observed on radiographs. All of the patients, except 3, achieved full

Table 2. Results (mean ± SD) of the Lysholm score and the KT-1000 measurement in patients operated on within 4 months of the injury or later

Time of operation	Patients n	KT-1000 (mm)	Lysholm score (points)
within 4 months	6	3.8 ± 1.7	89 ± 9
after 4 months	36	1.7 ± 1.8 [a]	94 ± 5

[a] p = 0.01

Table 3. Results (mean ± SD) of the Lysholm score and the KT-1000 measurement in patients with cartilage injury

Cartilage defect	Patients n	KT-1000 (mm)	Lysholm score (points)
with	8	3.5 ± 1.9	87 ± 8
without	34	1.7 ± 1.8 [a]	95 ± 5 [b]

[a] p = 0.01, [b] p = 0.005

range of motion. 2 of the 3patients with contracture of 5° also underwent a meniscus repair.

The patients who were operated on at least 4 months after the injury showed better results ($p \leq 0.01$) than those who were operated on during the first 4 months (Table 2). In addition, patients without cartilage injury showed better results ($p \leq 0.01$) than those with damaged cartilage (Table 3). It should be noted that patients with full cartilage defects larger than 1 cm were excluded from the study. The results also demonstrated a significant a correlation ($p \leq 0.001$) between the KT-1000 measurement (side to side difference) and the Lysholm Score. In one patient, a non-dislocated fracture of the patella was observed that heeled conservatively without any instability or restriction of movement.

Discussion

The press-fit technique has demonstrated good results and offers patients a high activity potential postoperatively. The technique has two significant advantages. First, it establishes a stable fixation of the patellar BTB graft, which allows for immediate mobilization of the operated knee. Also, screws which can cause tendon damage, posterior cortical compromise and other complications are not used (Schaffer 1993, Cerullo and Puddu 1993). Second, the positioning of the graft in the femoral tunnel, its inversion, and its fixed placement in an oval space at the tibia, imitates the antero-medial bundle, and at least a portion of the postero-lateral bundle of the ACL. As a results, the graft fibers are parallel and tensein extension and twisted and somewhat loose in flexion, similar to findings in anatomical studies of the ACL (Arnoczky and Warren 1994, Bradley et al. 1988, Girgis 1975).

Stabilization of the bone block in the femur is sufficient and comparable to other fixation methods (Lois 1991). The fixation of the bone block in the tibia was also stable in our series, as no change in the position of the bone block was observed in radiographs taken immediately postoperatively and again 1.5 and 4 months. This stabilization allows for immediate mobilization of the knee joint with gradual weight tolerance of the leg, conditions which are necessary for a good remodeling of the ACL substitute (Xerogeanes et al. 1995). Measurement using the KT-1000 arthrometer, in combination with the negative jerck test, indicated the restoration of the functioning of the knee joint, allowing patients to participate in sports involving chopping, pivoting and cutting i.e. soccer.

The stable reconstruction of the Anterior Cruciate Ligament is necessary for the proper functioning of the knee joint. The correlation between the good results of the KT-1000 examination and the Lysholm Score stresses this importance.

The tibial position is important in order to tighten the graft in extension. In addition, the anatomic tibial footprint of the ACL is not circular, but more oval in shape (Girgis et al 1975, Friedmann and Feagin 1994). Our technique produced the anatomically correct oval shape of the tibial attachment of the graft, allowsing an inverted placement of the graft in the tibia, a condition which is closer to the anatomic functioning of the ACL. Additionally, the fixed position of the ligament directly after its entrance into the tibia does not allow for the movement of the graft in the tibia, thereby preventing a potentially large moment arm that could produce a very disadvantageous enlargement (Fahey and Indelicato 1994, L'Insalata et al 1996, Schulte 1995).

The timing of surgery was found to be very important. Significantly better results were observed in patients who were operated uon at least 4 months after the injury. This means that it is better to give patients time for full recovery of the injured knee and to perform the operation when no signs of inflammation or restriction of ROM are present. However, since full recovery of motion is virtually guaranteed by accelerated physiotherapy, postponement of the operation is not absolutely necessary. None-the-less, we believe that delaying the operation is a good way to ensure that the patients will develop a full ROM, particularly when adequate postoperative physiotherapeutic treatment is questionable. On the other hand, the poor results in patients with cartilage lesions does not allow the surgeon to delay for a long time before making a

decision regarding treatment. Our patients often demonstrated difficulties in deciding wether to undergo the operation. Often, they preferred to begin with conservative treatment, hoping to restart their activities earlier than ACL reconstruction would allow.

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