Pain after use of the central third of the patellar tendon for cruciate ligament reconstruction

33 patients followed 2–3 years

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We performed reconstruction of the anterior cruciate ligament in 33 patients using the central third of the patellar tendon. In 20 patients we did an arthroscopically-assisted procedure, while 13 patients had an additional mini-arthrotomy through the gap in the patellar tendon. After 2–3 years the subjective knee function, according to the Lysholm score, was excellent or good in 18 knees and fair or poor in 15 knees, mainly due to anterior knee pain. Although 18 patients complained about anterior knee pain, only 1 patient required further surgery. After the operation the patella had a lower position. A flexion contracture was found in 7 patients, and 13 had heterotopic bone formation at the apex of the patella. Although stability was restored in 31 of the 33 reconstructed knees, anterior knee pain was a frequent complication. There were no correlations between the anterior knee pain and patellar height, flexion contracture or heterotopic bone formation.

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Submitted 92-12-26. Accepted 93-06-30

In 1963 Jones described the use of the central third of the patellar tendon for anterior cruciate ligament reconstruction. Since then the method has been modified and improved. Presently the method according to Clancy (1985, 1988), using the central third of the patellar tendon as a free graft, is considered to be the "gold standard" (Noyes et al. 1984, Engebretsen et al. 1990, Schepsis and Greenleaf 1990). However, patellar fracture, tendon rupture, or arthrosis, arthrofibrosis, reduction of knee motion, patella baja or alta, patellar tendinitis, infrapatellar contracture syndrome and anterior knee pain are described as complications of this method (Hughston 1985, Paulos et al 1987, Sachs et al. 1989, DeLee and Craviotto 1991, Rosenberg et al. 1992, Shino et al. 1993). Anterior knee pain seems to be the most frequent complication.

We tried in a retrospective study to find etiological factors with respect to anterior knee pain and to determine relationships of objective clinical and radiographic results to anterior knee pain.

Patients and methods

33 patients underwent reconstruction of the anterior cruciate ligament, using the central third of the patellar tendon as an autograft. The average age of the patients was 27 (17–43) years. There were 21 men and 12 women. All patients had a chronic condition, with a 3+ pivot-shift test and a symptomatic instability which did not respond to conservative treatment. The mean follow-up time was 3 (2–3) years. Lysholm and Tegner scores were obtained preoperatively and at follow-up. The patients filled in a questionnaire on the presence and localization of pain. We performed the pivot-shift and Lachmann tests on all knees at follow-up.

All underwent the same arthroscopically-assisted reconstruction (Clancy 1985, 1988), without any extra-articular procedure. At the end of the procedure the paratenon was closed with atraumatic absorbable sutures. No attempt was made to close the defect in the patellar tendon. Due to the learning curve of the endoscopic technique, a mini-arthrotomy, through the gap in the patellar tendon, was made in 13 patients, as the arthroscopic view was considered unsatisfactory.

All patients started an intensive exercise program, under supervision of a physiotherapist on the day after surgery. The knee was kept in a long leg orthosis in full extension. The orthosis was regularly taken off for exercising. On Day 1, passive motion was started with a continuous motion machine, until the patient had a comfortable 0°–90° range of motion. During the first week, active exercises were added including straight

Table 1. 33 patients with reconstruction of anterior cruciate ligament

No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	1	37	1	1	28	59	94	7	4	6	0.97	0.63	0.34	0	1	0	0	0
2	2	25	1	1	24	22	82	8	4	5	0.79	0.8	–0.01	0	0	0	0	0
3	1	24	1	1	31	38	86	9	2	6	0.89	1	–0.11	8	0	2	1	0
4	1	17	1	1	29	27	93	9	3	7	1	1.05	–0.05	4	0	2	0	0
5	1	27	1	2	34	48	81	7	3	6	0.97	1	–0.03	3	1	0	0	0
6	2	40	2	2	36	55	91	9	2	8	1	1	0.00	0	0	0	0	0
7	2	34	2	1	29	32	66	6	1	4	0.91	0.78	0.13	4	0	2	1	0
8	1	20	2	2	28	38	85	9	0	5	0.78	0.76	0.02	2	0	2	0	0
9	1	29	1	2	29	36	76	9	4	5	0.82	0.77	0.05	1	1	2	2	0
10	1	23	1	1	31	69	95	10	3	9	0.82	0.73	0.11	0	0	0	1	0
11	2	28	2	1	30	40	100	7	3	7	1.16	1.09	0.07	0	0	2	0	0
12	1	33	1	1	33	36	60	5	0	4	0.91	0.87	0.04	0	0	2	2	1
13	1	17	1	2	28	38	82	7	3	6	0.7	0.6	0.10	4	0	0	0	0
14	1	21	2	1	35	48	100	8	2	4	0.9	0.75	0.15	4	0	1	0	0
15	1	25	1	2	34	52	75	8	4	6	0.9	0.72	0.18	4	0	0	1	0
16	1	25	1	1	31	46	83	7	3	6	0.64	0.73	–0.09	0	1	2	0	0
17	1	27	1	2	31	76	80	9	3	7	0.95	0.98	–0.03	0	0	0	0	0
18	2	23	1	2	35	40	85	7	1	6	0.97	0.84	0.13	0	0	1	0	0
19	2	25	2	1	28	46	78	7	2	4	0.74	0.64	0.10	3	0	2	0	0
20	1	23	1	1	30	61	84	9	4	5	1.05	0.97	0.08	7	0	2	0	0
21	1	39	2	2	36	27	89	5	0	5	0.71	0.61	0.10	4	0	0	1	0
22	1	23	2	2	34	40	79	8	2	5	0.88	1	–0.12	1	0	0	1	0
23	2	30	2	1	34	48	97	9	4	9	0.79	0.66	0.13	0	1	2	0	0
24	1	24	2	1	33	56	98	7	3	6	0.93	0.86	0.07	0	0	2	0	0
25	2	40	1	2	30	40	59	8	2	4	0.97	0.92	0.05	0	0	2	2	1
26	2	22	1	2	25	36	85	8	4	5	0.77	0.83	–0.06	0	0	0	0	0
27	2	19	2	1	33	40	77	7	1	6	1	1	0.00	4	2	2	1	0
28	1	24	1	2	36	55	91	8	4	7	1.08	0.74	0.34	3	0	0	0	0
29	2	43	1	1	25	40	100	8	1	8	0.92	0.89	0.03	0	0	1	0	0
30	1	23	1	1	24	26	61	6	0	3	0.77	0.79	–0.02	16	0	2	0	0
31	1	28	1	1	31	42	88	9	3	8	0.95	0.73	0.22	0	0	0	1	0
32	2	35	1	1	29	46	86	8	4	7	0.85	0.86	–0.01	0	2	0	0	0
33	1	28	1	1	26	56	82	7	3	6	1.05	1.03	0.02	0	0	0	0	0

A Sex
  1 male
  2 female
B Age at operation
C Side of reconstruction
  1 right
  2 left
D Additional mini-open arthrotomy
  1 no
  2 yes
E Months of follow-up
F Lysholm score preoperative
G Lysholm score at follow-up
H Tegner score pretrauma
I Tegner score preoperative
J Tegner score at follow-up
K Patellar height preoperative, Linclau's index
L Patellar height at follow-up, Linclau's index
M Change in patellar height (K minus L)
N Heterotopic bone formation, size in mm
O Knee flexion contracture
  0 none
  1 5°
  2 10°
P Anterior knee pain
  0 none
  1 diffuse around the patella
  2 at the apex
Q Lachmann's test at follow-up
R Pivot-shift test at follow-up

leg raises, flexion-extension exercises and hamstring curls. Active quadriceps work was encouraged with a limit of 45° of extension. Ice pads were used in case of pain and swelling. Weight bearing, as tolerated by the patient, was started Day 3. After 6 weeks full weight bearing without orthosis was permitted, and a full range of motion was permitted. Normal jogging was allowed at 4 months, and by 6 months a gradual return to activity occurred. The return to full activity was delayed untill 12 months.

We used Linclau's index (Linclau 1984, Caton 1989) to assess the patellar height: on the standard lateral radiograph, the shortest distance between the articular surface of the patella and the tibial plane is divided by the length of the articular surface of the patella. We used this method because of the readily identifiable and reproducible anatomical landmarks with the lowest risk of interference by the donor site, calcifications and fixation materials (Noyes 1991). The normal index value is 1 (0.80–1.20). We compared the Linclau index at follow-up with the preoperative value. If the difference was more than 0.2, we considered this as a change in patellar height. The differences between the pre- and post-operative values were examined using the *t*-test.

On the follow-up radiographs, we also looked for calcifications in the track of the patellar tendon. Both the size and the amount were measured and the locali-

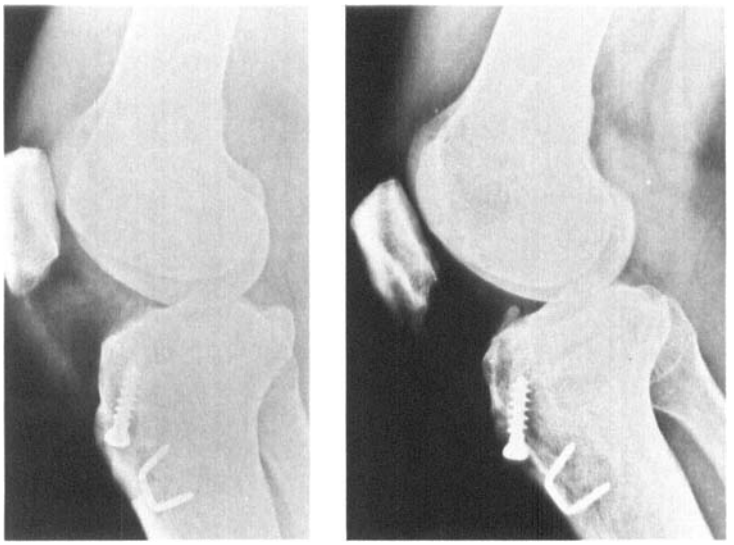

Figure 1. Case 15. One week postoperative and after 2.5 years, showing development of heterotopic bone at the apex of the patella and a decreased patellar height.

zation was determined. Anterior knee pain was defined as pain located on the anterior side of the knee, reaching from the upper pole of the patella down through the level of the tibial tuberosity. Apart from pain during activity, pain at rest and with direct pressure, e.g., kneeling, was also included.

The chi-square test was used for comparison of patient sub-groups.

Results (Table 1)

No patellar fractures, or patellar tendon ruptures occurred.

Both the Lysholm score and the Tegner score were improved after the ligament reconstruction: the Lysholm score was excellent in 6 knees, good in 12, fair in 12, and poor in 3 knees; the Tegner score went from 8 (5–10) pre-trauma through 2 (0–4) pre-operatively to 7 (3–9) at follow-up. None of the patients had complaints about "giving way".

18 patients complained of anterior knee pain. Further investigations and surgery were necessary in only 1 case: the removal of the staples together with the arthroscopic removal of a fibrotic Hoffa's body. The pain persisted and could not be explained.

2 types of pain were distinguished: 3 patients had dull, diffuse pain around the patella, and 15 patients had a sharp, more localized pain at the apex of the patella and in the patellar tendon region. 8 patients had 1+ Lachmann test, and three 2+. In 2 patients we could provoke a 1+ pivot-shift. A flexion contracture of 5° was found in 5 patients and of 10° in 2 patients.

The mean preoperative Linclau index was 0.90 compared to postoperatively 0.84 (P 0.05), indicating a lower position of the patella. 3 patients had a more than 0.2 difference in Linclau's index (Figure 1); one of those had had mini-arthrotomy, two arthroscopy.

1–16 mm calcification at the apex of patella was found in 13 knees. With respect to the calcifications, we found no difference between the group with the mini-arthrotomy and those with the arthroscopy only. In the arthrotomy group, calcifications were not restricted to the apex of the patella; in 1 case they were located in the middle of the tendon and in 2 cases in Hoffa's body.

With regard to anterior knee pain, no correlation with heterotopic calcifications, changed patellar height or surgical technique was detected.

Tegner scores were not influenced by anterior knee pain.

Discussion

The use of the central third of the patellar tendon as a free autologous graft is a well established method in reconstructing the ACL. Improvement of the operative technique has made dislocation of the patella unnecessary and has reduced the development of scar tissue. The damaging impact on the extensor mechanism is restricted to the removal of the graft.

Obvious complications, such as patellar fractures and patellar tendon ruptures, are rare (Bonamo et al. 1984, Hughston 1985, Burks et al. 1990, Daluga et al. 1990, DeLee and Craviotto 1991). The most frequent problem following patellar transplant removal seems to be the anterior knee pain (Shino et al. 1993). How-

ever, anterior knee pain also occurs after other reconstruction techniques which leave the extensor mechanism unharmed (Paulos et al. 1987, Sachs et al. 1989, Engebretsen et al. 1990, Sgaglione et al. 1990, Shino et al. 1990, Noyes et al. 1991, Shino et al. 1993). In our patients this pain was experienced only during maximum force on the extensor mechanism or at direct pressure. Since the pain felt by direct pressure was also taken into account, patients with Lysholm score of 100 still could provoke anterior knee pain. Only 1 patient required further intervention.

The development of scar tissue or even hypertrophic tendinous tissue within the defect of the tendon has been described (Burks et al. 1990, Berg 1992). Shrinkage of this tissue may be the cause of a lowered patellar position. Whether closing or not closing the defect in the patellar tendon influences the patellar height is not known (Coupens et al. 1992, Rosenberg et al. 1992). Furthermore, a decreased strength of the quadriceps muscle (Sachs et al. 1989) can also be an explanation for the lowered patellar position observed here.

A change in patellar height will result in different mechanical forces on the patellar articulation which might eventually cause painful arthrosis (v. Eijden et al. 1987, Paulos et al. 1987). As our follow-up was at most 3 years, we could not find any radiographic signs of arthrosis. In studies with bigger groups and longer follow-up time, deterioration of the patellofemoral surface was related to pain. However, not all patients with deterioration had pain (Shino et al. 1993). We could find no difference in outcome with respect to pain and stability between the arthroscopic and the mini-arthrotomy groups, as was also reported by Shelbourne et al. (1993).

In conclusion, we confirm that the stability of an anterior cruciate ligament-deficient knee can be restored by reconstruction with a patellar tendon autograft. However, anterior knee pain is a serious problem postoperatively. In our series the changes in the extensor mechanism could not be correlated with this pain.

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