# Advancement of the tibial tuberosity for patellar pain

## A 5-year follow-up

**Lars Engebretsen, Svein Svenningsen and Pål Benum**

During the period 1978–1984, 38 patients aged 23–55 years were treated for patellofemoral pain by the Maquet procedure. The mean postoperative observation time was 5 (3–9) years. Thirty-three of the 38 patients were available for follow-up including functional and activity scoring, clinical examination, and Cybex II dynamometer muscle-strength measurement. Ten patients improved, 17 were unchanged, and 6 were worse. Characteristic for the improved group was Grades III and IV chondromalacia – mainly involving the lateral facet – whereas the group with no improvement or deterioration exhibited a low-grade chondromalacia, chiefly affecting the medial patellar facet.

Maquet (1963) described a procedure with anterior advancement of the tibial tubercle for patients with patellar chondromalacia. In his theoretical model, he demonstrated that by moving the anterior tibial tubercle 20 mm anteriorly, the overall force of the patellar articulation decreased by approximately 50 percent. The results reported after the Maquet procedure vary from good to poor (Maquet 1976, Sudman 1980, Lund and Nilsson 1980, Ferguson 1982, Uppheim et al. 1984). There is no agreement on the indications for the procedure. In studies presented the observation period has been short, and only one randomized prospective study has been published (Heijgaard and Waat Bolsen 1982). However, the latter study was based on an observation period of only 14 months. We report 33 cases followed for an average of 5 years.

## Patients and methods

Thirty-eight patients underwent anterior advancement of the tibial tuberosity during the period 1978–1984. The age of the patients ranged from 23 to 55 years. There were 24 women and 14 men. Eight patients had bilateral surgery; all 8 were available for follow-up. The knee giving the patient the highest loss of function was used for the follow-up study. Inclusion criteria for surgery were 1) patellofemoral pain for more than 1 year not responding to conservative treatment, 2) inability to work, and 3) absence of a diagnosis other than patellar chondromalacia.

*Operative procedure.* Arthroscopically, the degree and location of chrondromalacia was assessed. A lateral, parapatellar approach was used. The altered cartilage was excised, and all the fibrillated tissue was removed. An anterior tibial shingle was then elevated from the medial side and kept in place with a bone block from the anterior iliac crest. No screw was used to fix the bone block. The advancement measured by radiography was < 15 mm in 5 cases, 15–20 mm in 19 cases, and > 20 mm in 1 case; 8 cases were not measured. Postoperative management included full weight bearing and unrestricted motion.

*Follow-up.* Thirty-three of the 38 patients were available for follow-up after a mean of 5.4 (3–9) years. One patient had died and 4 could not be traced. The patients were evaluated by the Lysholm (1982) functional score (Table 1) and Tegner (1985) activity score. The patients were examined clinically, and the muscle strength was measured in a Cybex II dynamometer.

## Results

According to the patients' self-assessment of the results, 10 improved, 17 were unchanged, and 6 deteriorated (Table 1). Seven of the patients in the unchanged group had a temporary improvement lasting up to 2 years. All the knees had a full range of motion. The function improved slightly for the group as a whole, but the activity level dropped from strenuous to moderate (Table 2). The improved group had better function,

Department of Orthopedics, Trondheim University Hospital, N–7000 Trondheim, Norway

Table 1. Preoperative, postoperative, and follow-up data on 33 patients with advancement of the tibial tubercle

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | F | 30 | 6 | II | M/L | NM | 1 | 0 | 0 | 1 | 22/81 | 3/3 | Y | 55/53 |
| 2 | F | 24 | 4 | IV | M/L | 2 | 1 | 0 | 0 | 1 | 71/73 | 3/4 | Y | 102/99 |
| 3 | M | 33 | 3 | IV | M/L | 2 | 2 | 0 | 1 | 0 | 42/25 | 6/5 | Y | 155/162 |
| 4 | F | 31 | 6 | III–IV | L | NM | 1 | 0 | 0 | 1 | 79/78 | 4/4 | Y | NM |
| 5 | F | 55 | 4 | IV | M/L | NM | 2 | 1 | 0 | 1 | 37/46 | 3/3 | Y | 29/49 |
| 6 | F | 64 | 7 | IV | M/L | NM | 1 | 0 | 1 | 0 | 16/80 | 1/3 | Y | 53/60 |
| 7 | M | 25 | 3 | II | M | 1.5 | 1 | 0 | 0 | 1 | 31/64 | 7/3 | Y | 156/156 |
| 8 | M | 30 | 4 | III | M | 1.5 | 2 | 0 | 0 | 1 | 43/73 | 4/4 | Y | 127/130 |
| 9 | F | 30 | 5 | IV | L | 1.7 | 1 | 0 | 0 | 1 | 44/85 | 9/6 | Y | 94/97 |
| 10 | F | 22 | 5 | II | M | 1.7 | 2 | 0 | 0 | 1 | 38/67 | 7/7 | Y | 112/114 |
| 11 | F | 32 | 8 | III | L | 1.6 | 1 | 0 | 0 | 1 | 25/95 | 1/3 | Y | NM |
| 12 | M | 44 | 3 | IV | M/L | 2 | 2 | 0 | 0 | 0 | 55/55 | 7/5 | Y | 128/105 |
| 13 | M | 33 | 5 | II | L | 1.5 | 1 | 0 | 1 | 0 | 40/99 | 7/7 | Y | NM |
| 14 | F | 20 | 3 | III | L | 1.6 | 1 | 0 | 0 | 1 | 35/86 | 9/7 | Y | NM |
| 15 | F | 45 | 3 | II | M | 2 | 2 | 0 | 0 | 0 | 14/47 | 1/2 | Y | 67/79 |
| 16 | F | 29 | 5 | II | M | 2 | 2 | 1 | 0 | 1 | 9/32 | 3/3 | Y | 22/53 |
| 17 | M | 21 | 4 | II | M | NM | 1 | 0 | 0 | 0 | 39/95 | 4/7 | Y | 104/158 |
| 18 | F | 44 | 3 | I–II | M/L | 1.5 | 2 | 1 | 1 | 1 | 49/31 | 4/4 | N | NM |
| 19 | F | 20 | 6 | III | M | NM | 2 | 0 | 0 | 0 | 39/39 | 4/4 | N | NM |
| 20 | F | 36 | 3 | I–II | M | 1.5 | 2 | 0 | 0 | 1 | 38/33 | 5/5 | N | 67/84 |
| 21 | M | 33 | 5 | III | L | NM | 2 | 0 | 0 | 0 | 66/57 | 4/4 | N | 109/123 |
| 22 | F | 34 | 5 | III | M | 1 | 3 | 0 | 0 | 1 | 59/34 | 7/2 | N | 65/96 |
| 23 | F | 31 | 9 | I | M | 1.3 | 3 | 1 | 1 | 1 | 59/25 | 3/3 | N | 10/10 |
| 24 | M | 59 | 7 | I | M | 2.2 | 2 | 0 | 0 | 1 | 34/29 | 2/2 | N | 76/89 |
| 25 | F | 24 | 6 | II | M | 1.4 | 2 | 1 | 1 | 1 | 44/46 | 8/7 | Y | NM |
| 26 | M | 20 | 6 | I–II | M | NM | 2 | 0 | 0 | 1 | 45/41 | 7/3 | Y | 178/180 |
| 27 | F | 36 | 3 | I | M | 1.6 | 3 | 0 | 0 | 1 | 21/21 | 2/1 | N | 20/66 |
| 28 | M | 21 | 4 | II | NM | 1.6 | 2 | 0 | 0 | 1 | 70/61 | 4/3 | Y | NM |
| 29 | M | 38 | 6 | II | M | 1.2 | 2 | 0 | 0 | 1 | 78/78 | 4/3 | N | 50/77 |
| 30 | F | 30 | 5 | II | NM | 1.5 | 3 | 0 | 0 | 1 | 20/19 | 3/3 | N | NM |
| 31 | F | 22 | 5 | II | NM | 1 | 3 | 1 | 1 | 1 | 22/42 | 4/3 | N | NM |
| 32 | M | 35 | 3 | II | M | 1.5 | 3 | 0 | 0 | 1 | 35/52 | 7/1 | N | 75/139 |
| 33 | M | 26 | 5 | II | M | 1.5 | 2 | 0 | 0 | 0 | 44/75 | 4/4 | N | 92/119 |

NM not measured.
A Female/Male.
B Age at surgery.
C Follow-up, years.
D Degree chondromalacia.
E Facet involvement.
F Advancement cm.
G Self-assessment: 1 improved, 2 unchanged, 3 worse.
H Effusion.
I Ability to kneel.
J Unsatisfactory scar: 0 no, 1 yes.
K Lysholm score preop/follow-up.
L Tegner score preop/follow-up.
M Ability to work.
N Quadriceps peak torque, 60°/s, injured/noninjured.

and no decrease in activity and maximum quadriceps muscle torque. The 10 patients who improved returned to work. Of the 23 patients with worse or unchanged symptoms, 10 are still working, 9 are sick-listed, and 4 are on the waiting list for a patellectomy. There was no age difference between the two groups.

In the Cybex II dynamometer, there was a 15 percent reduction in extension power (Nm/s) when compared with the unaffected knee, whereas the flexion power was essentially unaffected. In the improved group the reduction in muscle strength (peak torque NM) and power (Nm/s) was insignificant as compared with a considerable reduction in both respects in patients who were unchanged or worse.

In the improved group, 6 patients had chondromalacia Grade III to IV (Outerbridge 1975) and 8 patients had involvement of the lateral facet. Sixteen of the 23 unimproved patients had Grade I to II chondromalacia. Only 5 of these had involvement of the lateral facet

Table 2. Mean knee function before and after the Maquet procedure for patellar chondromalacia in 33 patients

| | Lysholm score | | Tegner score | | Cybex peak torque | |
|---|---|---|---|---|---|---|
| | pre-op. | follow-up | pre-op. | follow-up | op. knee | control knee |
| Improved n 10 | 40 | 84 | 4.8 | 4.7 | 94 | 104 |
| Nonimproved n 23 | 42 | 45 | 4.5 | 3.5 | 80 | 99 |

Table 3. Outerbridge chondromalacia grade and facet involvement

| | | Improved (n 10) | Nonimproved (n 23) |
|---|---|---|---|
| Grade | I–II | 4 | 16 |
| | III–IV | 6 | 7 |
| Facet | medial | 2 | 18 |
| | lateral | 8 | 5 |

(Table 3). No patients with tubercle advancement < 15 mm improved.

The complications included a cosmetically unsatisfactory scar in 24 patients, recurrent effusions in 6, osteomyelitis in 1, and fracture of the elevated tibial shingle in another. Thirty of the 33 patients were unable to kneel after the operation.

## Discussion

Previous reports on the Maquet procedure were promising. The rate of excellent and good results after a short follow-up varied from 85 percent to 100 percent (Maquet 1976, Sudman 1980, Ferguson 1982, Svartveit 1983). However, two Scandinavian studies (Lund and Nilsson 1980, Uppheim et al. 1982) with longer follow-up showed a decreasing effect of the operation with time. This tendency was confirmed in our study; only 10 of our 33 patients showed lasting improvement, while 7 patients improved temporarily for a period of up to 2 years after surgery.

Ferguson (1979) showed that 80-90 percent of the patellar stress reduction is achieved by advancement < 15 mm. None of our patients with advancement < 15 mm improved, and this may be explained by the fact that a 25-mm forward displacement of the patellar tendon reduces the stress on the lateral patellar facet twice as much as half this distance (Radin 1986).

The overall decrease in activity level was due to the nonimproved group who remained at their low preoperative functional level and had further reduction in activity level. Thus, a reduction in activity level alone does not seem to improve the results in this group. The extensor strength deficit in both maximum torque and power in the nonimproved group, as assessed by the Cybex II, probably contributed to the low functional and activity level.

In this study the pain-relieving effect was greater in patients with Grades III and IV chondromalacia involving the lateral facet. This suggests that only chondromalacia of the lateral facet is suitable for advancement of the tibial tuberosity.

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