

Open wedge tibial osteotomy by callus distraction in gonarthrosis

Operative technique and early results in 36 patients

Göran Magyar, Sören Toksvig-Larsen and Anders Lindstrand

Proximal tibial osteotomy is indicated in cases of medial gonarthrosis with varus deformity in the active, younger patient. We report our experience of the hemicallotaxis technique in 36 patients and the early clinical results after a median follow-up of 14 (11–16) months. The median patient age was 54 (33–64) years. The median hip-knee-ankle (HKA) angle was 172 (161–179)° preoperatively, 184 (178–187)° after completed correction and 183 (175–190)° at

follow-up. The median fixation time was 88 (61–146) days. Complications were minor. Superficial pin-site inflammation/infections occurred in one fifth of the pins. The HSS score increased from a median 71 preoperatively to 94 at follow-up, the Lysholm score from 56 to 91 and the Tegner activity score from 6 to 10. The Nottingham Health Profile showed significant improvements as regards pain and physical mobility.

Department of Orthopedics, University Hospital, SE-221 85 Lund, Sweden. Tel + 46 46-171500. Fax -130732
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Long-term outcome of tibial osteotomy for medial gonarthrosis depends on the correction achieved in the healed osteotomy, ideally an overcorrection to 3–8° of valgus at the mechanical axis of the lower extremity (Valenti et al. 1990, Odenbring 1991, Coventry et al. 1993). The commonest technique, closed wedge osteotomy, is technically difficult and even in experienced hands the degree of correction achieved may be unpredictable (Hernigou et al. 1987, Matthews et al. 1988, Koshino et al. 1989). In many cases, the rehabilitation time and sick leave period after closed wedge osteotomy are long.

During the last few years, the technique of progressive opening wedge osteotomy by hemicallotaxis has gained interest since, theoretically, it does not have these disadvantages. The operation is relatively simple to perform and it is easy to achieve the planned correction. Since the technique is based on an external fixator below the knee joint, it permits early mobilization and a high level of activity.

We present our experience and the early clinical outcome with this technique.

Patients and methods

The study is prospective and includes 36 patients (26 men) operated on for medial gonarthrosis grades 1–3, according to Ahlbäck's classification (1968). The operations were all performed at the University Hospi-

tal, Lund, Sweden between June 1993 and February 1996. The patients' median age was 54 (33–64) years, their median weight was 85 (60–113) kg and median length was 176 (155–194) cm. All patients were evaluated at a median time of 14 (11–16) months after surgery. The Orthofix® OF-Garcke ventral instrument for hemicallotaxis was used.

The joint space, both in the AP and lateral views, was located by fluoroscopy. The template of the external fixator was placed and fixed with K-wires. The upper border of the T-clamp should be located about 1 cm below the level of the tibial articular surface. Malrotation of the T-clamp must be avoided. 4 conical, threaded pins of cortical type (Orthofix® 6/5 mm), length 110–130 mm, were used, two proximally and two distally. They were inserted with the knee extended. The metaphyseal pins were inserted at a convergence angle of 20–30°. The posterior cortex was not penetrated by the K-wires and the subsequent drilling of the posterior cortex was carefully done, to avoid damaging the popliteal vessels (Zaidi et al. 1995). A Ø 3.2 mm drillbit was used for better initial pin fixation in the metaphysis. The pins must penetrate the posterior cortex with 2–3 threads for best fixation. The diaphyseal pins were inserted using a Ø 4.8 mm drillbit with a conventional technique.

The longitudinal skin incision for the osteotomy was about 5 cm in length and it was placed ventrally and medial to the tibial tuberosity. The periosteum after a sharp transverse incision, was gently separat-

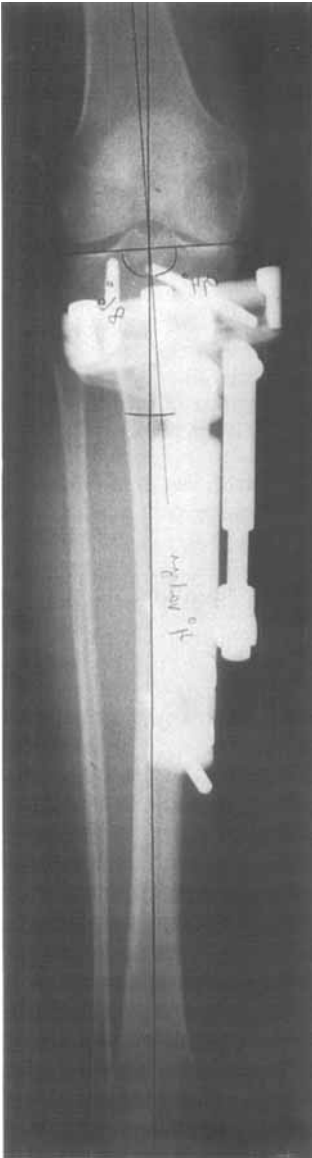


Figure 1. HKA-measurement on radiographs for evaluation of correction achieved.

ed from the bone over a distance of 3–5 mm, where the osteotomy was to be performed. A retractor on the posteromedial side of the tibia was used for soft tissue protection. The osteotomy was performed, slightly obliquely, at the level of the distal third of the tibial tuberosity. A reciprocal saw was used, sawing from "inside and out" in an attempt to preserve as much of the bone marrow as possible. The osteotomy, controlled by fluoroscopy, extended to about the medial 3/4 of the tibial circumference. This left

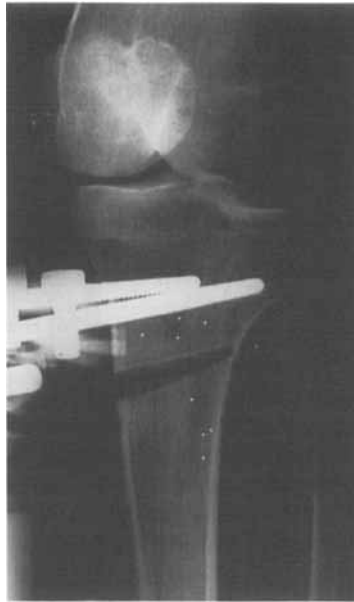


Figure 2. Close-up of osteotomy area after angular callus distraction.



Figure 3. Example of callus formation at time of removal of fixator.

intact the lateral cortex which acted as a hinge during the distraction phase. No fibular osteotomy was performed, even in corrections exceeding 15°.

The extent of the osteotomy was considered sufficient when the gap could easily be opened 3–4 mm. The periosteum was carefully sutured back and the wound was closed. No suction drainage was used. The leg was draped and the T-Garcke was mounted. The fixator was then locked without any tension.

The patient was allowed immediate weight bearing and was discharged after 1–2 days. The distraction process started 7–10 days after surgery. The clamp axis locking nut (the proximal locking nut) and the lengthener body locking nut (the distal locking nut) were *both* loosened, in order to allow the rotation center to be at the lateral cortex. The distraction was performed by the patient with 1/4 turn ideally 4 times per day, total 1 mm. In case of severe pain, the number of turns was reduced. During the distraction phase, the patient was seen once a week and when the desired correction was achieved, as measured on radiographs, with calculations of both the HKA angle (mechanical correction) and the osseous correction, measured as the angle between the tibial plateau and the tibial shaft, the instrument was locked (Figures 1–2). The patient returned about 10 weeks after the operation for radiographic and ultrasonic examinations to evaluate the healing. The ultrasonic examination showed the callus formation in the distracted area earlier than conventional radio-

Table 1. Clinical scores. Median (range)

	No. patients	Preop.	1 year	P-value
HSS	34	71 (56–89)	94 (69–100)	<0.01
Lysholm	26	56 (31–83)	91 (55–100)	<0.01
Tegner	26	6 (4–9)	10 (4–13)	<0.01

graphs did. The fixator was temporarily removed to facilitate the radiographic investigation. Further follow-up was planned, depending on the actual healing.

When the callus was judged to be sufficient by radiographic and ultrasonic examinations, the fixator was removed and the patient was encouraged to practice full weight bearing during 1 or 2 days (Figure 3). If this caused pain, indicating inferior healing, the fixator could easily be replaced. The pins were removed at the outpatient clinic, without any analgesics or sedatives.

The patient was treated with prophylactic antibiotics during the first week after operation and later, if there were signs of pin infection. The pins and the skin were cleaned daily and the patient was instructed to keep the wounds open. Any pin-tract infection was registered, according to Otterburn's classification (Saleh 1992).

A Nottingham Health Profile (NHP) questionnaire was sent to the patients preoperatively and immediately before follow-up. NHP is a two-part, self-administered standardized questionnaire, providing a measurement of perceived health (Jenkinson et al. 1988). Part I consists of 38 statements weighted and grouped in 6 categories—energy, sleep, physical mobility, emotion, pain and social isolation. Maximum score in each category is 100, indicating the presence of all possible problems, while the minimum score is zero, indicating no problems. Part II consists of 7 statements for evaluation of the overall impact of problems in the social situation and this part was not analyzed in the present study.

Clinically, the patients were evaluated according to three different scoring systems, HSS (Hospital for Special Surgery Knee score), the Lysholm Knee score and the Wallgren-Tegner activity score (Insall et al. 1976, Lysholm and Gillquist 1982, Tegner 1985). The first included patients were not evaluated with NHP, Lysholm and Tegner scores preoperatively and they were excluded from the clinical analysis.

The radiographic assessment included radiographs of the knee and HKA-angle measurement, both in a weight-bearing position. The HKA-angle measure-

Table 2. Result of NHP evaluation. Median (range), n 27

	Preop.	1 year	P-values
Emotion	0 (0–100)	0 (0–72)	0.08
Energy	0 (0–100)	0 (0–100)	0.8
Pain	62 (18–100)	4 (0–53)	<0.01
Physical mobility	31 (10–53)	5 (0–52)	<0.01
Sleep	11 (0–75)	11 (0–100)	0.2
Social isolation	0 (0–82)	0 (0–25)	0.3

ments were performed with a slight flexion of the knee joint. The AP projection is based on a 90-degree anterior position from a true lateral radiograph, projecting the two femoral condyles overlaying each other. We used radiographs, including the hip and ankle joints and a ruler frame, to calculate the HKA angle. In this way, the measurements were standardized. A line from the center of the head of femur to the center of the tibial eminentia and another line from the center of the tibial eminentia to the center of the tibial surface of the ankle joint were drawn. The angle between these 2 lines forms the HKA-angle. We measured the HKA on the medial angle, meaning that angles of less than 180 degrees indicate varus angulation.

The Wilcoxon signed-rank test was used in comparing clinical scores and in the evaluation of the Nottingham Health Profile.

Results

The preoperative median HKA-angle was 172 (161–179)°. The correction achieved was a median 11 (5–24)°, and the alignment when the fixator was locked was 184 (178–187)°. The median distraction time was 14 (5–35) days, with a correction of 1.4 (0.5–2.4)°/turn on the distractor.

The patient stayed at the hospital for median 1 (1–4) day and the fixator was applied for 88 (61–146) days. The median sick-leave period was 99 (1–257) days. Pin-tract infections occurred in 30/144 (21%) pins and all were superficial (grade 1–2). There were no deep infections. No joint infections or effusions were seen. At follow-up, the median HKA angle was 183 (175–190)°. The HSS, Lysholm and Tegner scores were significantly improved (Table 1). Significantly less pain and greater physical mobility were also noted, according to the NHP evaluation (Table 2).

2 complications occurred during the early part of the study. In 1 patient, the lateral bony hinge was fractured in a falling accident. There was an ad latus displacement of about half the tibial width. The angular

correction was maintained, but bone healing was delayed and the patient had to be treated with the frame for 5 months. The HKA angle was measured as 178° at the end of the distraction period and as 175° at follow-up. The sick-leave time was 8 months. However, the patient had no pain at follow-up. In another patient, a deep vein thrombosis was diagnosed 5 weeks after surgery, although the patient was well mobilized. There were no knee joint problems or neurovascular complications in any of the patients.

Discussion

Even for experienced surgeons, closed wedge osteotomy may be difficult to perform (Port et al. 1993). This may lead the surgeon to choose a knee replacement, even in young and active patients. After osteotomy, the rehabilitation and sick leave periods are long, often between 6 and 12 months. The possibility of reoperating on a failed tibial osteotomy with a new proximal closed wedge osteotomy is very limited while conversion to a knee prosthesis is, in many cases, a more appropriate solution. Technically, prosthetic surgery after a previous closed wedge osteotomy is demanding (Katz et al. 1987, Windsor et al. 1988), it is often difficult to obtain good access to the lateral compartment and an adequate ligament balance.

Progressive opening wedge osteotomy has the advantage of being relatively simple to perform and it is easy to achieve the planned correction. The patient can also have a high activity level, with a free range of knee movement during the treatment. Hemicallotaxis can be repeated, if the correction fails, and it may then be easier to insert a knee prosthesis later, if necessary. There are hardly any contraindications to the callus distraction technique.

The main drawback of hemicallotaxis is the risk of pin-tract infection. The grade 1 infection is a matter of definition in the clinical practice and mild serous discharge is not unusual, especially from the proximal pins. This should not be regarded as an infection and the condition responds to good hygiene. The frequency of pin-site infections in our study was at the same level or better than that reported (Mahan et al. 1991, Pouliquen et al. 1993).

We have used a ventral instrument placement mainly to achieve better patient comfort, despite more difficult radiographic investigations during the fixation period. However, similar results can be achieved with a medial instrument placement (Fowler et al. 1991). The degree of correction can be difficult to assess with standing radiographs alone, as some patients could not bear full weight during the distraction

phase. This was why we used both the HKA and the osseous correction, measured as the angle between the tibial condyles and the tibial length axis, to evaluate the degree of correction.

In our experience, the Orthofix OF-Garche is well tolerated, even by older patients. Hemicallotaxis seems to be a valid alternative to conventional osteotomy. However, this method is time-consuming, with frequent outpatient examinations.

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