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High tibial osteotomy for valgus and varus deformities of the knee

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Abstract In 53 patients with a mean age of 38 (17–73) years, 71 high tibial osteotomies were performed. Twenty-three patients had no radiological signs of osteoarthritis (Ahlbäck grade 0), whereas 26 patients had primary and 22 patients secondary osteoarthritis. Follow-up was 10.5 (5.8–16.6) years. The patients without radiological osteoarthritis achieved almost exclusively good or very good scores using the Lysholm-Gillquist (96%) and the Insall scale (83%). By contrast, only 29% of the patients with radiological osteoarthritis achieved good or very good scores. Whether the patient had primary or secondary osteoarthritis was of no influence. Neither was the preoperative axial deviation.

Résumé Chez 53 patients, d'âge moyen 38 (17–73) ans, 71 ostéotomies hautes du tibia ont été effectuées. Vingt-trois malades n'avaient pas de signes radiologiques d'arthrose (Ahlbäck grade 0), alors que 26 malades avaient une arthrose primaire et 22 une arthrose secondaire. Le suivi était de 10.5 (5.8–16.6) années. Les malades sans arthrose radiologique ont atteints presque exclusivement des bons ou très bons scores selon les échelles de Lysholm-Gillquist (96%) et d'Insall (83%). Par contraste, seulement 29% des malades avec arthrose radiologique ont atteints de bons ou très bons scores. Le caractère primaire ou secondaire de l'arthrose et la déviation axiale préopératoire n'avaient aucune influence.

Introduction

The good results with uni- and bicondylar knee arthroplasty for degenerative joint disease reported in the past few years [4, 15, 16] call for reassessment of the value of joint-preserving procedures. The fact that knee replace-

ment probably has a higher complication rate and a poorer clinical outcome when it follows corrective osteotomy must also be borne in mind [11, 19]. Various types of internal and external fixation have been used [3, 5, 6, 21, 23]. Nevertheless, the studies available on the effectiveness of high tibial corrective osteotomy are of limited value as they either fail to consider the indication or refer to a number of different surgical techniques. In the present study the patients were grouped according to indication and underwent the same surgical procedure, high tibial osteotomy without fixation. Postoperative immobilization was by means of a plaster cylinder. The aim of the study was to assess the long-term results and the current value of this surgical technique.

Patients and methods

Between 1983 and 1993 53 patients underwent 71 high tibial osteotomies. There were 24 women and 18 patients had bilateral osteotomies. The mean age at operation was 38.7 (17–73) years. Inclusion criteria were acute or chronic pain in the knee and tibial axis deviation of at least 10°; either without osteoarthritis changes or with only mild to moderate unicondylar osteoarthritis changes. The ligamentous apparatus had to be stable and the knee able to flex by at least 90°. Valgus deviations >20° were excluded. The severity of the osteoarthritis of the affected knee was evaluated in accordance with Ahlbäck [1, 2]. Group A (23 knee joints) included all cases with no radiological evidence of osteoarthritis (stage 0). Group B (26 knee joints) included all cases of primary, and group C (22 knee joints) all cases of secondary osteoarthritis (Fig. 1). Varus deformity was present in 52 cases and valgus deformity in 19 cases. The mean range of motion was 127° (90°–150°). In 50 cases the patients complained of constant pain. In 16 cases the patients reported recurrent swelling, and in 13 cases exercise-related instability. In 15 cases one, and in 11 cases more than one previous operation had been performed on the affected joint. The leg axes were measured in standing roentgenograms and were determined in two planes. The osteotomy plane was determined via a planning sketch. It was the aim of the operation to correct the deformity and achieve a 2° overcorrection.

In 29 cases a varus deformity was corrected by a closing wedge technique and in 23 cases by an opening wedge technique. In ten cases a valgus deformity was corrected by a closing wedge technique and in nine cases by an opening wedge technique. The osteotomy was performed 1.5 cm below the knee joint. Allogeneic

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Fig. 1 **a** Post-traumatic varus deformity of left tibia after fracture 4 years earlier. **b** Eight years after opening wedge osteotomy

Table 1 Complications after high tibial corrective osteotomy (71 cases)

Complication	No. of complications (n=14)
Thrombosis	4
Temporary peroneal nerve palsy	4
Wound infection	2
Delayed union	2
Tibial pseudarthrosis	1
Haemarthrosis	1

corticocancellous femoral head wedges were used for the opening wedge technique. Postoperatively the leg was immobilized in a plaster cast. Standard heparin was given in 57 cases and low-molecular-weight heparin in 14 cases as prophylaxis for thrombosis. The patients were from the first postoperative day allowed to walk with two crutches without weight bearing on the operated limb. The plaster cast was removed after a mean of 38 days. Partial weight bearing was started after a mean of 19 days and full weight bearing after a mean of 58 days. Clinical evaluation at follow-up was based on axial alignment, range of motion, joint stability (anteroposterior, mediolateral), muscle atrophy, local findings, and subjective symptoms.

Functional evaluation of the results obtained at follow-up was by means of the Lysholm-Gillquist score [10] and the Insall score [9].

Radiological evaluation of the severity of arthritis was by means of the Ahlbäck score [1, 2]. Evaluation of the postoperative patellar position was by means of the Insall and Salvati index [7]. Statistical analysis was by means of the Mann-Whitney *U*-test using the statistical program SPSS for Windows (version 7.5).

Results

The mean follow-up time was 10.5 (5.8–16.6) years. Of 53 patients 47 (62 knee joints) were followed clinically and radiographically. Three patients (five knee joints) had to be excluded either because of subsequent trauma or because of an additional operation during the follow-up period. Two patients (three knee joints) died and one patient (one knee joint) was lost to follow-up. Therefore 57 knee joints were included in the analysis.

The postoperative complications are listed in Table 1. The preoperative range of motion was regained after an average period of 72 (55–118) days. The clinical results are shown in Table 2. The results in groups B and C did not differ significantly from each other. By contrast, the joints in group A showed significantly less ($P<0.01$) progression to radiographical more severe osteoarthritis than did those in groups B and C. No statistically significant differences were found between any of the groups

Table 2 Results at follow-up as a function of indication for high tibial corrective osteotomy (57 cases)

	Group A (n=23)	Group B (n=19)	Group C (n=15)
Patient age (mean in years)	38.0	51.2	50.3
Axial deviation (varus/valgus)			
<3°	10	7	7
3°–10°	13	12	7
>10°	–	–	1
Femorotibial angle (mean)	177°	178°	174°
Lysholm score			
Very good	8	3	0
Good	15	3	4
Satisfactory	–	5	4
Poor	–	8	7
Insall score			
Very good	16	6	2
Good	7	3	4
Satisfactory	–	6	4
Poor	–	4	5

Table 3 Preoperative vs. postoperative radiological severity of osteoarthritis according to Ahlbäck score (57 cases)

	Group A (n=23)		Group B (n=19)		Group C (n=15)	
	Pre	Post	Pre	Post	Pre	Post
No osteoarthritis	23	–	–	–	–	–
Severity I	–	22	5	2	2	–
II	–	–	5	3	7	4
III	–	–	9	4	6	3
IV	–	–	–	4	–	3
V	–	–	–	3	–	3
Total knee arthroplasty		–		3		2

in terms of absence of irritation, range of motion, or ligamentous stability. By the time of the last follow-up, progression of the osteoarthritis had led to five total knee arthroplasties in patients in groups B and C (Table 3). The mean interval between the osteotomy and the arthroplasty was 5.6 (1.0–12.9) years.

With regard to postoperative patellar position, the mean Insall-Salvati index in all the patients was 1.07 (0.45–1.50) at follow-up. Patella infera (index <0.8) was found in four patients, all of whom had undergone osteotomy by opening wedge technique.

Discussion

Previous studies have found a high proportion of good short- to medium-term clinical results after high tibial osteotomy, but also progressive deterioration over prolonged follow-up periods [8, 18, 20]. Thus, Insall et al. [8] reported good or very good results in over 97% of cases after 2 years but only in 61% after 10 years. In cases with Ahlbäck grades III or IV Yasuda et al. [22] did not find good or very good clinical results after 11 years.

In the present study we found that on average 10.5 years after high tibial osteotomy 15% of the patients in groups B and C had undergone knee arthroplasty and a further 40% showed Ahlbäck [1, 2] grades IV or V osteoarthritis. However, the age difference between the patients with and without pre-existing osteoarthritis (mean age in groups B and C was 51.2 and 50.3 years, respectively, vs. 38.0 years in group A) must be borne in mind.

Using the Lysholm-Gillquist and Insall scores we found that only 29% and 32% of the patients with pre-existing osteoarthritis showed a good or very good clinical outcome, respectively [9, 10]. No significant difference in terms of clinical or radiological outcome was detected between the patients with primary (group B) and those with secondary (group C) osteoarthritis ($P>0.01$).

By contrast, the clinical and radiological outcome in the patients with pre-existing osteoarthritis (groups B and C) was found to differ significantly ($P<0.01$) from those without pre-existing osteoarthritis (group A). In group A 96% and 83% of patients achieved a good or very good result using the Lysholm-Gillquist and Insall scores, respectively.

In all patients the osteotomy was performed without fixation and postoperative immobilisation was achieved by means of a plaster cast. A disadvantage of this method is the long period of immobilisation and the resulting trophic changes of the knee and increased venous stasis of the operated limb. In four cases of thrombosis the rate (5.6%) is relatively high.

In the two cases of “delayed union” the patients avoided post-treatment and were mobilized with unstable plaster casts. After application of a new well-fitted cast proper union was achieved.

The cause of the tibial pseudarthrosis is unclear. Consolidation could only be reached after operative revision by means of osteosynthesis.

The transitory peroneal palsy was a consequence of intraoperative mechanical irritations. Two superficial wound infections healed after antibiotic therapy without any consequences. The cause of the haemarthrosis was never clarified [21, 23].

The fact that the mean time until the preoperative range of motion was regained was more than 10 weeks shows that immobilisation of joints with pre-existing degenerative changes delays rehabilitation. We therefore now regard this method of immobilisation as being inappropriate for patients with osteoarthritis of the knee. A better approach is to use an orthosis that allows knee joint mobility or to perform the osteotomy with minimal external fixation [14].

One unsolved problem is which femorotibial angle is required. Especially in patients undergoing bilateral operations, the femorotibial angle of 164°–168° that is recommended for successful long-term correction [22] is associated with cosmetically unsatisfactory results. Therefore, in the present series we only aimed at a slight overcorrection. As reported by other authors, however, the smaller load reduction thus led to poorer long-term results [3, 8, 13, 17].

On the basis of the present results we conclude that the indications for high tibial osteotomy in patients with osteoarthritis of the knee are now restricted. The advantage of high tibial osteotomy is that the option of a subsequent arthroplasty is still open. In view of the good long-term results achieved with arthroplasty, older patients with moderately severe osteoarthritis (Ahlbäck grades II and III) should be offered an arthroplasty. In view of the high joint forces that, especially in young

and active patients, can wear and destroy the polyethylene surface of total knee prosthesis [12], we regard high tibial osteotomy as being indicated for patients up to the age of about 50 years. Even several years ago, Insall et al. [8] reported a poor clinical outcome after high tibial osteotomy in patients over 60 years old.

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