

Ten-year results of tibial osteotomy for medial gonarthrosis

The influence of overcorrection

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Summary. The results in relation to the correction achieved 1 year after surgery of a series of tibial osteotomies in 50 patients (52 knees) are presented with a total observation time of 10 years. Mean age at the time of osteotomy was 56 years. Overcorrected knees had a significantly better result after 10 years. Progress of gonarthrosis occurred in 6/34 overcorrected knees compared with 3/4 in the normo- and undercorrected group. One out of 34 overcorrected knees recurred in varus. Five knees were revised by knee arthroplasty or reosteotomy, one of which was overcorrected.

The satisfactory effect of osteotomy is due to redistribution of the body weight from the arthrotic femorotibial compartment to the opposite healthy one [4, 5, 17, 18]. The results are more predictable when the osteotomy is used to correct varus than valgus deformity [8, 27].

There has been some disagreement concerning the exact postoperative alignment of the knee: Kettelcamp et al. [17] recommended at least 5° of femorotibial valgus angulation. Coventry [5] recommended a valgus femorotibial position of between 10° and 13°. Tjörnstrand et al. [29] suggested 4° of overcorrection of the hip-knee-ankle angle (HKA).

The immediate postoperative correction is often lost during the healing period [5, 8, 13, 25]. A loss of correction is with few exceptions within $\pm 4^\circ$ as measured on ordinary roentgenogram [8], and this was confirmed in a study using roentgenstereophotogrammetry [26, 31]. Therefore, Tjörnstrand et al. [29] presented a prospective study with an operative procedure aiming at an overcorrection of the HKA of 4°.

It has been suggested that the passage of time is the most important factor in determining the long-term result and that the alignment obtained is of less importance [14, 28, 32]. Others stress the importance of adequate in-

itial correction for good long-term results [4, 10, 11, 21, 29].

We have reexamined the Tjörnstrand series [29] of 52 knees, of which 42 were healed in overcorrection of the HKA at the 1-year follow-up, with a report on the clinical findings and radiographic development 6 and 10 years after surgery.

Patients and methods

From 1976 to 1978 50 patients (52 knees) with medial gonarthrosis were subjected to high tibial osteotomy at the Departments of Orthopedic Surgery in Lund and in Eksjö. There were 21 women and 29 men with a mean age of 56 (range 37–76) years at the time of osteotomy. Preoperatively the radiographic stages of gonarthrosis were I–III [2] with one exception (Table 1). One year postoperatively these patients were re-examined [29]: a total of 42 knees in 40 patients had an overcorrection of the HKA, of whom 37 patients (38 knees) and 35 patients (36 knees) were available 6 and 10 years after osteotomy, respectively. One patient was excluded because of rheumatoid arthritis (Fig. 1.). Ten knees in 10 patients were aligned at normo- or undercorrection of the HKA 1 year after surgery, and 9 of them participated in the follow-up 6 and 10 years postoperatively (Fig. 1). Some 37 patients participated in the radiographic examination at the three follow-up examinations (Fig. 2).

Clinical examination

The pain-free walking distance was recorded. Pain at rest was recorded as continuous or after exercise. Knee extension and active

Table 1. Preoperative staging of patients with medial gonarthrosis [2]

Stage of medial gonarthrosis	No. of knees
I	17
II	22
III	12
IV	0
V	1

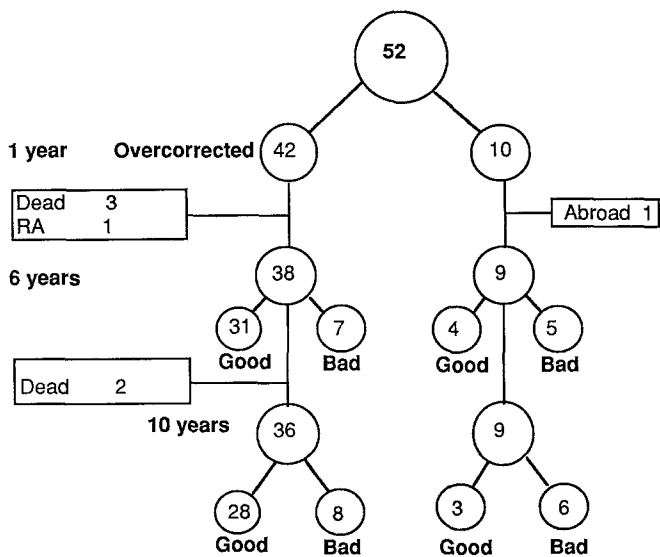


Fig. 1. Flow chart of clinical examination. RA, rheumatoid arthritis

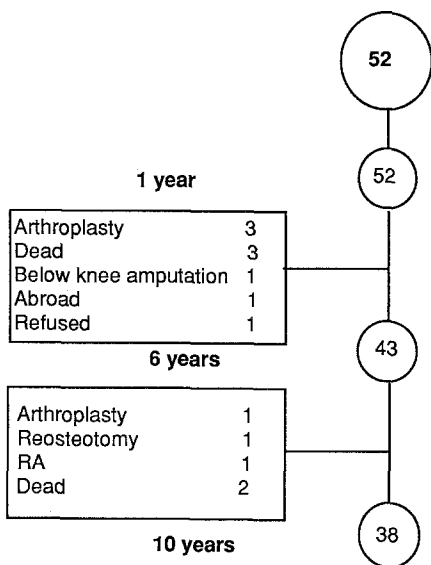


Fig. 2. Flow chart of radiographic examination. RA, rheumatoid arthritis

knee flexion were recorded. Stability was recorded as the lateral thrust on walking [4, 8]. A satisfactory result is defined a knee which is stable at walking, has a range of motion of at least 5°–90°, has a pain-free walking distance of more than 500 m [16] and has not been subjected to revision surgery.

Radiographic examination

The following examinations were performed preoperatively and at the follow-up examinations: (1) anteroposterior radiographs including both knees in the standing position to visualize the height of the articular cartilage; (2) a whole lower limb anteroposterior radiograph including the hip, knee and ankle obtained in full weight-bearing [7, 9, 18, 33]. The varus or valgus alignment of the knee was defined as the angle between the lines from the tibial eminence to the centre of the femoral head and the head of the talus, respectively (HKA; Fig. 3.). Overcorrection is defined as an

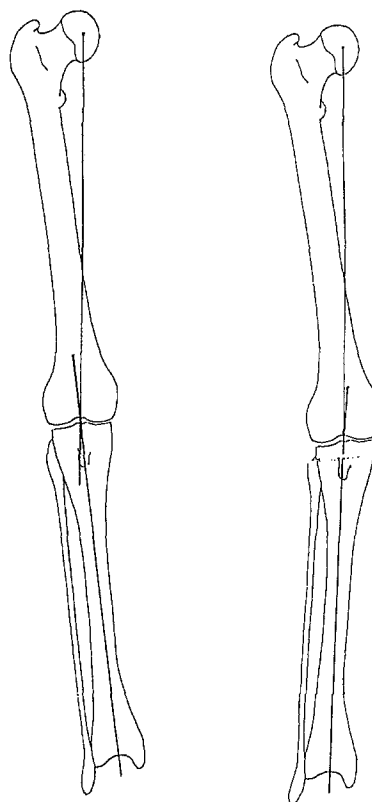


Fig. 3. Recording of the hip-knee-ankle angle on a whole lower limb frontal radiograph

angle $\leq 179^\circ$. Preoperatively and at the 1- and 6-year follow-ups some of the knees were examined in full weight-bearing in full extension, which might influence the staging of arthrosis and the recording of the knee alignment [24].

Staging of gonarthrosis was performed according to Ahlbäck [2]:

- I Narrowing of the joint space to at least half of the width
- II Obliteration of the joint space
- III Attrition less than 0.5 cm
- IV Attrition between 0.5 and 1 cm
- V Attrition exceeding 1 cm

Results

Undercorrected group (knees aligned at $\geq 180^\circ$)

Nine knees (nine patients were aligned at $\geq 180^\circ$ 1 year after surgery. Five of them were satisfactory at 6 years and three, at 10 years after surgery (Fig. 4, 5). At the last follow-up three knees had been revised by knee arthroplasty and one by reostectomy (patients 1–10 in Table 2).

Overcorrected group (knees aligned at $\leq 179^\circ$)

In this group 31/38 knees (37 patients) were satisfactory at 6 years and 28/36 knees (35 patients at 10 years after osteotomy, significantly better than knees aligned at $\geq 180^\circ$ ($P < 0.05$) (Chi square test). Seven knees had a poor result after 6 years caused by weight-bearing pain in four and a limited range of motion in two. In one pa-

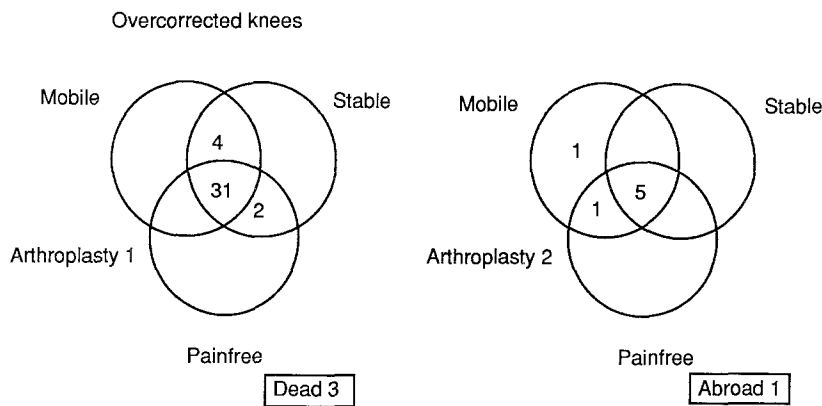


Fig. 4. Details from clinical results after 6 years in the normo-, under- and overcorrected groups

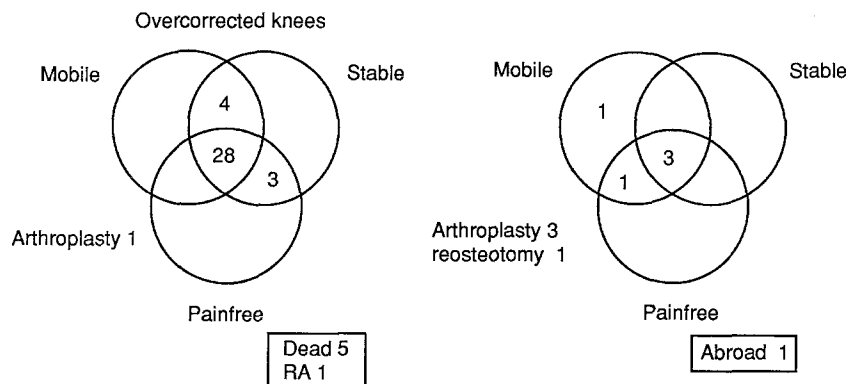


Fig. 5. Details from clinical results after 10 years in the normo-, under- and overcorrected groups

tient a knee arthroplasty had been performed (Fig. 4). After 10 years weight-bearing pain caused a poor result in four, and three knees had a reduced range of motion. One knee had been revised by knee arthroplasty (Fig. 5).

Radiographic results

In the final follow-up 38 knees (37 patients) were subjected to radiographic analysis (Fig. 2). Progress of medial gonarthrosis between the preoperative and the final examinations was recorded in 9 knees: in 6/34 overcorrected knees and in 3/4 normo- and undercorrected knees. Two knees had lateral arthrosis stage I, and one of them was excessively overcorrected. Recurrence of a varus HKA was recorded in 1 of 34 overcorrected knees after 10 years.

Discussion

Tibial osteotomy is an accepted method for treatment of early medial gonarthrosis in patients who are not too old [3, 6, 8]. Only one patient had a stage V gonarthrosis, and at the time of follow-up that knee had been revised by a medial unicompartmental endoprosthesis.

In our report we present results in relation to the knee alignment achieved when the osteotomy was considered healed 1 year after surgery. In overcorrected knees a good result was recorded in 82% after 6 years,

which tallies with other reports [1, 32, 34], and in 78% after 10 years, which is better than in other reports [1, 6, 14]. However, Insall and co-workers [14] related their results to the femorotibial alignment recorded at follow-up. They reported a 23% revision to total knee arthroplasty. In our report only 1 of 36 overcorrected knees had been revised by a knee arthroplasty after 10 years while 4 of 9 not overcorrected knees had been revised by a knee arthroplasty or a reosteotomy. In a series of 51 osteotomies in patients 50 years old or younger [12] 70% were rated as good or excellent after 10 years, which is in accordance with the overall results in this report. However, they found a slight but not significant influence of knee alignment on the outcome. A good result was reported in 75% in 789 tibial osteotomies [15]. Some 38% of the patients were older than 70 years, and in 14% osteotomy was performed for lateral arthrosis. A total of 13% of patients were observed after 10 years or more, and of these 64% had a good result. Stage of arthrosis and knee alignment were not reported.

Of the 52 knees in this series 42 were overcorrected at the 1-year follow-up. Change of alignment was at most 5° between the 1- and 10-year examinations. This tallies with other reports [9, 31]. However, a significant return to varus position was reported in patients with high adduction moment during walking 3.2 years after osteotomy [23]. In our report, return to varus position was recorded in 3 knees, 1 of which was overcorrected 1 year after surgery, which is in accordance with other data [11, 22].

Table 2. Results and details in 52 knees treated by high tibial osteotomy for medial gonarthrosis

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	AA	AB	AC	AD	Note	
1	60	F	7701	130	189	193	•	•	6	3	•	•	•	•	1	•	•	•	0	•	•	•	125	130	•	•	5	•	•	•	Endoprosthesis 39 months after surgery
2	66	F	7701	130	189	188	•	•	5	5	•	•	•	•	3	•	•	•	0	•	•	•	120	120	•	•	3	•	•	•	Endoprosthesis 33 months after surgery
3	76	M	7601	142	187	187	•	•	4	3	7	6	2	1	2	3	0	0	0	0	0	0	110	120	110	110	2	3	•	•	Lateral thrust
4	57	M	7701	131	185	181	183	183	2	2	2	2	1	1	1	1	1	0	0	0	0	0	125	130	130	120	1	2	2	3	
5	57	F	7810	111	193	180	180	180	5	3	3	3	2	2	1	1	0	0	0	0	0	0	140	130	125	125	1	1	1	1	
6	46	M	7703	13	186	180	•	•	5	1	•	•	•	•	2	1	•	•	0	•	•	•	135	130	•	•	1	•	•	•	Moved abroad 1979
7	53	F	7805	115	187	180	177	•	7	1	1	•	•	2	1	1	•	•	0	0	0	0	130	130	130	130	1	1	•	•	Reosteotomy 85 months
8	59	M	7811	110	183	180	182	183	6	1	4	1	2	1	1	1	1	0	0	0	0	0	130	125	125	125	1	2	2	2	
9	37	M	7611	132	190	180	181	•	7	1	1	•	•	3	1	1	•	•	0	0	5	•	140	140	135	•	1	1	3	•	Endoprosthesis 108 months
10	59	M	7804	117	192	180	183	183	7	5	1	4	3	1	1	2	5	0	0	0	0	0	120	120	110	120	3	3	4	4	Lateral thrust
11	56	M	7810	117	186	178	177	177	6	5	6	4	2	2	3	1	0	0	0	0	0	0	100	115	110	110	2	2	2	2	
12	60	M	7809	112	189	178	178	179	6	1	1	1	2	1	1	2	0	0	0	0	0	0	100	120	120	120	2	2	2	2	
13	63	M	7709	122	188	178	178	178	7	5	1	1	3	1	1	1	0	0	0	0	0	0	140	130	125	125	3	3	4	4	
14	46	F	7810	113	193	178	181	181	6	1	1	3	3	1	2	2	0	0	0	0	0	0	125	130	125	115	1	1	1	0	
15	52	F	7612	133	185	178	180	178	5	4	4	3	3	2	2	2	0	0	0	5	0	0	120	120	110	125	1	1	1	1	
16	49	F	7612	14	192	178	•	•	5	3	•	•	•	•	3	2	•	•	0	•	•	•	110	110	•	•	2	•	•	•	Died 1981
17	58	F	7811	120	196	178	174	175	7	1	1	1	3	2	2	2	0	10	10	10	10	10	125	110	110	110	3	3	3	3	
18	61	M	7810	111	195	177	176	176	7	1	1	1	3	1	1	1	15	5	0	0	0	0	110	100	100	105	1	1	1	1	
19	49	M	7701	131	193	177	175	174	5	1	1	3	2	1	2	1	0	0	0	5	10	100	125	100	100	3	1	1	1		
20	65	F	7801	120	186	177	176	178	4	1	1	1	2	1	1	1	5	0	0	0	0	0	120	130	120	120	2	2	2	2	Lateral arthrosis stage I
21	61	M	7708	135	190	176	176	180	7	1	1	1	1	1	1	1	10	0	0	0	0	0	140	115	110	130	3	1	1	2	
22	63	M	7709	134	184	176	178	179	7	1	1	4	3	1	1	1	0	0	0	0	0	0	140	130	130	120	2	2	3	3	
23	62	F	7702	141	189	176	176	176	7	3	1	1	1	1	1	1	0	0	0	0	0	0	130	125	130	135	2	1	1	2	
24	47	M	7702	131	194	176	178	178	2	1	1	1	2	1	1	1	0	0	0	0	0	0	130	130	130	125	2	2	2	2	
25	37	M	7809	144	184	176	176	175	6	5	3	3	2	2	1	2	0	5	5	5	5	5	30	25	25	30	1	1	1	2	
26	61	F	7706	125	186	176	176	177	5	1	1	1	1	1	1	1	0	0	0	0	0	0	120	120	120	120	2	2	2	2	
27	62	F	7702	131	191	176	177	178	7	1	5	5	2	1	2	3	10	0	5	5	5	5	120	115	100	110	2	3	3	3	Died 1988
28	70	M	7803	116	188	176	176	•	7	1	1	•	•	•	•	•	•	•	0	•	•	•	120	120	115	•	3	3	•	•	
29	39	M	7811	120	181	175	175	175	5	3	1	1	2	1	1	1	0	0	0	0	0	0	135	135	135	135	1	1	1	1	
30	66	M	7709	123	191	175	175	178	5	1	1	1	2	1	1	1	5	0	0	0	0	0	110	115	115	115	1	1	1	2	
31	39	M	7711	132	186	174	170	176	6	2	2	1	1	1	1	1	0	0	0	0	0	0	110	135	130	115	2	2	2	2	
32	68	M	7801	130	185	173	173	176	5	1	1	5	1	1	1	1	0	0	0	0	0	0	130	130	130	110	2	2	2	2	
33	54	M	7810	109	194	173	176	177	5	5	1	1	2	2	1	1	0	0	0	0	0	0	120	110	110	110	3	3	3	3	
34	53	F	7806	115	190	172	172	174	7	1	3	3	2	1	1	2	0	0	0	0	0	0	90	100	100	110	2	2	2	2	
35	58	M	7802	117	187	172	172	175	6	1	1	5	1	1	1	1	2	0	0	0	0	0	140	130	120	120	1	1	1	2	
36	51	F	7809	22	187	172	•	•	5	5	•	•	•	•	3	2	•	•	0	•	•	•	120	115	•	•	2	•	•	•	Died 1981
37	57	F	7712	119	196	172	170	•	7	1	1	•	•	•	•	•	•	•	0	•	•	•	130	130	130	•	2	2	•	•	Died 1988
38	52	M	7804	115	185	172	•	•	7	6	5	4	3	3	2	1	0	5	5	5	5	5	130	130	130	130	1	1	•	•	Below knee amputation 47 months
39	50	M	7801	119	189	172	174	172	6	1	1	3	2	1	2	2	0	0	0	0	0	0	100	120	110	110	3	3	3	3	
40	55	M	7803	122	188	172	170	172	5	1	4	4	2	1	2	2	10	5	5	5	5	5	120	115	115	120	3	3	3	3	
41	63	F	7804	117	187	172	171	175	7	1	1	4	3	3	1	2	15	10	5	5	5	5	90	120	115	90	2	2	2	2	

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