Early knee mobilization after osteotomy for gonarthrosis

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In a prospective study, 32 knees in 32 patients were randomized to either a cylinder plaster cast (17 knees) or hinged cast-brace (15 knees) after high tibial osteotomy for medial gonarthrosis. At 6 weeks, 3 months, and still 1 year after surgery, the range of motion was better in the cast-brace group. There was no difference in the other clinical results at 3 months and at 1 year after surgery, nor in changes of osseous correction or in the final knee alignment. All the patients in the cast-brace group were satisfied with early motion.

Krighshauser and Bryan (1985) and Hofmann et al. (1987) have reported good results with early motion after high tibial osteotomy for gonarthrosis. After this operation, we have compared early knee mobilization using a hinged cast-brace as external support and a control group with plaster-cast immobilization.

Patients and methods

Thirty-two patients with Stages I–III medial gonarthrosis (Ahlbäck 1968) were randomized into a brace group (15 knees) and a plaster-cast group (17 knees). Osteotomy was performed as a closing wedge using the medial cortex and periosteum as a hinge. The Tjörnstrand guide was used (Odenbring et al. 1989). The osteotomy was stabilized with a staple (Figure 1). After wound closure, the randomization code was opened. Preoperatively, there was no difference between the two groups in knee extension and flexion (Table 1).

In patients randomized to the brace group, a hinged cast-brace was applied on the first postoperative day, and early passive motion was started with the help of a continuous passive-motion machine for 3–5 days. Full weight bearing was allowed as in patients in the plaster cast group (Figure 2). The brace and the plaster cast were removed after 6 weeks.

Preoperatively, a whole lower-limb radiograph was performed for determination of varus alignment (Hagstedt et al. 1980, Lindstrand et al. 1982, Waugh 1986) and stage of arthrosis (Ahlbäck 1968). The alignment of the knee was measured as the angle between the lines from the tibial eminence to the center of the femoral head and the talocrural joint, respectively. An angle less than 180° signifies a valgus alignment. The intended wedge was calculated from the radiograph aiming at an overcorrection of 4° in valgus (Hagstedt et al. 1980, Waugh 1986). The same radiograph was obtained at 3 months and 1 year after surgery. Preoperatively, immediately postoperatively, and 1 year postoperatively, the angle between the tibial articular plane and the line from the tibial eminence to talus was recorded on a frontal radiograph (Tjörnstrand et al. 1981). The difference between the immediate postoperative and the 1-year recording was the change in osseous correction during healing.

Painfree walking distance, pain at rest, and a functional knee score (Lysholm et al. 1982) were recorded preoperatively, at 3 months, and 1 year postoperatively. Active range of motion was recorded preoperatively, at 1 weeks, 3 months, and 1 year postoperatively. Stability was tested as lateral thrust while walking. A satisfactory knee according to Jónson (1981) has a painfree walking distance up to 500 meters, is stable during walking, and has a range of motion of at least 5–90°.

All the clinical examinations were conducted by one of the authors (S.O.).

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Table 1. Data for 32 osteotomies

Case	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
1	62	1	0	0	0	0	135	135	140	150	3	1	–2	4	1	1	0	1	1	172
2	61	1	0	0	0	0	130	130	130	130	1	1	1	7	1	0	0	3	1	177
3	53	1	0	0	0	0	120	100	100	125	2	2	0	7	1	1	0	3	1	174
4	50	2	5	5	5	0	140	40	90	90	3	1	–2	7	1	1	0	2	2	171
5	55	1	0	0	0	0	135	110	140	140	2	1	1	4	1	1	0	1	1	176
6	66	2	0	0	0	0	140	20	130	130	1	1	–1	7	4	1	0	3	1	171
7	59	2	0	0	0	0	140	10	90	130	1	0	0	7	2	1	0	3	1	171
8	63	2	0	0	0	0	140	45	130	140	2	2	3	6	1	1	0	1	1	181
9	64	1	0	0	0	0	130	110	130	140	2	2	3	6	1	0	0	1	1	175
10	64	2	0	10	0	0	125	25	120	140	1	1	0	7	1	0	0	1	1	175
11	56	1	0	0	0	0	110	110	130	135	1	1	0	7	2	1	0	2	1	178
12	60	2	5	0	0	0	140	40	130	130	3	1	–9	6	1	1	0	3	1	165
13	58	1	0	5	0	0	130	100	140	130	1	1	1	6	3	0	0	1	1	173
14	58	1	0	0	0	0	140	140	140	140	2	2	0	5	2	1	0	2	1	173
15	54	2	0	0	0	0	140	10	110	120	1	2	–2	5	2	0	0	2	1	175
16	58	1	0	5	5	5	140	115	135	135	1	1	–2	2	1	0	0	1	1	175
17	54	2	10	5	5	5	120	30	115	120	3	3	–1	1	1	1	0	2	1	175
18	60	2	0	0	0	0	115	70	125	130	3	2	–2	7	4	0	0	2	2	173
19	55	1	0	10	5	5	120	30	115	120	2	2	1	7	2	1	0	3	1	177
20	40	2	5	0	0	0	115	10	95	130	1	0	–2	7	1	1	0	3	1	169
21	68	1	10	10	10	10	125	110	135	135	1	1	0	7	2	1	0	1	1	172
22	63	1	0	0	0	0	135	110	120	140	2	1	1	6	3	1	0	1	1	173
23	58	1	0	5	5	0	130	70	120	130	2	1	6	7	1	0	0	3	1	174
24	56	2	0	0	0	0	140	60	120	125	2	2	0	5	1	1	0	1	1	178
25	57	2	0	0	0	0	135	10	110	110	2	1	3	7	1	1	0	3	1	174
26	53	2	0	5	0	0	120	55	110	120	1	1	–2	7	4	0	0	3	1	170
27	57	2	0	0	0	0	140	85	125	125	3	1	0	7	3	0	0	3	1	173
28	60	2	0	10	10	0	140	35	120	120	2	1	1	4	1	1	0	1	1	175
29	57	1	0	0	0	0	110	70	110	110	1	1	0	7	6	0	0	3	2	176
30	45	2	0	0	0	0	140	80	130	130	1	1	0	6	3	1	0	2	1	175
31	60	1	5	5	5	5	120	100	130	130	3	3	0	6	5	1	0	1	1	175
32	66	2	0	0	0	0	140	30	135	135	2	1	–3	7	1	1	0	1	1	171

Case 8 had a deep infection.
In Case 19 the staple loosened 10 days postoperatively, and the brace was replaced with a cylinder plaster cast. This patient was excluded from the final analysis.

A age at surgery
B 1 brace, 2 plaster cast
C knee extension preoperatively
D knee extension 6 weeks after surgery
E knee extension 3 months after surgery
F knee extension 1 year after surgery
G active knee flexion preoperatively
H active knee flexion 6 weeks after surgery
J active knee flexion 3 months after surgery
K active knee flexion 1 year after surgery
L stage of arthrosis preoperatively (Ahlbäck)
M stage of arthrosis 1 year after surgery (Ahlbäck)
N change of osseous correction during healing
Negative sign means change towards valgus
O painfree walking distance preoperatively
P painfree walking distance 12 months after surgery

O and P
1 > 5 km
2 3–5 km
3 1–3 km
4 0.5–1 km
5 100–500 m
6 < 100 m
7 pain at every step

Q lateral thrust preoperatively: 1 yes, 2 no
R lateral thrust 12 months after surgery: 1 yes, 2 no
S pain at rest preoperatively
T pain at rest 1 year after surgery
S and T
1 no pain at rest
2 pain at rest after activity
3 always pain at rest
U knee alignment 1 year after surgery
(Hip-Knee-Ankle angle)

Results

In 1 patient in the brace group, the staple loosened after 10 days and the osseous correction was lost (Case 19). The osteotomy was realigned manually, and a plaster cast was applied. This patient was excluded from the final functional analysis. There was one deep infection in 1 patient in the plaster group that healed after surgical drainage and gentamicin beads for 10 days (Case 8). One excessive change of correction during healing was recorded in the plaster-cast group due to a medial opening in the osteotomy (Case 12).

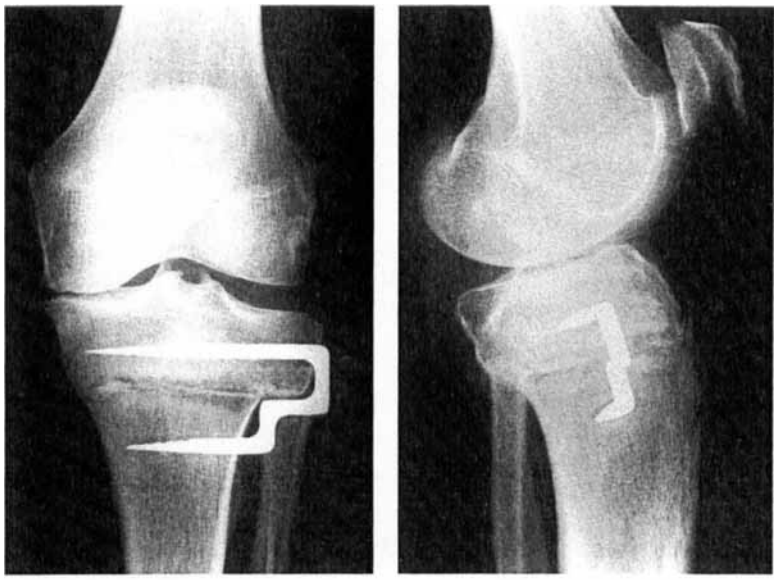

Figure 1. Stepped staple (Coventry 1973) modified by Cedell.

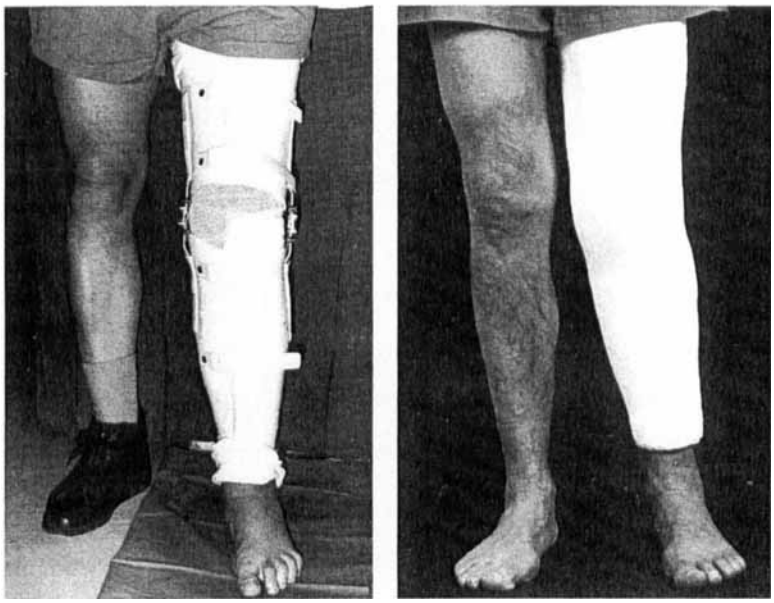

Figure 2. Cast-brace and plaster cast used in this report.

The range of motion at 6 weeks and 3 months after surgery was better ($P < 0.001$) in the hinged cast-brace group; even 1 year after surgery, the range of motion was better ($P < 0.05$; Table 2). No difference in knee extension was recorded at 1 year.

There was no difference between the groups concerning change of osseous correction during healing or the final knee alignment. Eleven of 14 patients in the brace group and all 17 patients in the plaster-cast group had a satisfactory knee (Jónson 1981; Table 1).

Table 2. Active knee flexion before and after tibial osteotomy for medial gonarthrosis. Mean *SD*

	Cast-brace (degrees)		Plaster cast (degrees)	
Preoperatively	128	*9.8*	133	*10*
Six weeks	108	*20*	38	*24*
Three months	128	*12*	117	*14*
One year	134	*9.4*	125	*12*

All the patients in the brace group liked the early motion and the possibility of skin care during the 6 first postoperative weeks.

Discussion

In a series of 78 tibial osteotomies for medial gonarthrosis (Myrnerts 1980), the knees were gently mobilized for 10 days followed by 6 weeks in a cylinder plaster cast. At the 12-month follow-up, knee flexion had increased, was unchanged, or was reduced more than 5° in one third, respectively. Tjörnstrand et al. (1981) found a knee flexion exceeding 90° in 50/52 knees preoperatively and in 47/52 one year after tibial osteotomy.

Our results showed naturally superior initial range of motion in the brace group, and this difference still existed after 1 year. The results tally with those reported by Kriegshauser and Bryan (1985) in a retrospective study with a 3-month follow-up. Von Hackel et al. (1984, 1987) reported successful healing of osteotomies in 39 and 132 osteotomies, respectively; but no clinical results were reported, and no control group was presented.

No difference was recorded in the other parameters studied. The Lysholm score was obtained preoperatively and at follow-up, and no difference was recorded between the groups. However, this score was developed for athletic knees.

In 1 patient the staple loosened in the early postoperative period; von Hackel et al. (1987) reported 3 cases with staple loosening in their 132 knees. A prerequisite for early motion is accurate medial stability and sufficient internal fixation. With long arms on the staple, we aimed at a more stable fixation.

The positive experience of the patients with a better range of motion in the cast-brace group supports the conclusion that early knee mobilization can be initiated without harm after tibial osteotomy using a staple as internal fixation and a brace as external support.

References

Ahlbäck S. Osteoarthrosis of the knee. A radiographic investigation. Acta Radiol (Diagn) (Stockh) 1968;(Suppl 277):7–72.

Coventry M B. Osteotomy about the knee for degenerative and rheumatoid arthritis. J Bone Joint Surg (Am) 1973; 55(1):23–48.

Hackel H, Schindlmaisser H. Die Verwendung einer modifizierten Stufenklammer zur gipsfreien Fixation bei der Coventry Osteotomie. Orthop Prax 1984;20(11):889–93.

Hackel H, Schindlmaisser H. Die Kremser Klammer zur Stabilizierung der Coventry Osteotomie. Erfahrungen aus 132 Fällen. Orthop Prax 1987;23(1):68–72.

Hagstedt B, Norman O, Olsson T H, Tjörnstrand B. Technical accuracy in high tibial osteotomy for gonarthrosis. Acta Orthop Scand 1980;51(6):963–70.

Hofmann A A, Dales M, Nimer B, Wyatt R. High tibial osteotomy: Use of an osteotomyjig, rigid fixation, and early motion versus conventional surgical technique and cast immobilizer. In: Proceedings of the AAOS 54th annual meeting 1987:82.

Jónsson G T. Compartmental arthroplasty for gonarthrosis. Acta Orthop Scand 1981;52(Suppl 193):1–110.

Kriegshauser L A, Bryan R S. Early motion with cast brace after modified Coventry high tibial osteotomy. Clin Orthop 1985;(195):168–72.

Lindstrand A, Boegård T, Egund N, Thorngren K G. Use of a guide instrument for compartmental knee arthroplasty. Acta Orthop Scand 1982;53(4):633–9.

Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. Am J Sports Med 1982;10(3):150–4

Myrnerts R. High tibial osteotomy with overcorrection of varus malalignment in medial gonarthrosis. Acta Orthop Scand 1980;51:557–60.

Odenbring S, Egund N, Lindstrand A, Tjörnstrand B. A guide instrument for high tibial osteotomy. Acta Orthop Scand 1989. In press.

Tjörnstrand B, Egund N, Hagstedt B, Lindstrand A. Tibial osteotomy in medial gonarthrosis. The importance of over-correction of varus deformity. Arch Orthop Trauma Surg 1981;99(2):83–9.

Waugh W. Tibial osteotomy in the management of osteoarthritis of the knee. Clin Orthop 1986;(210):55–61.