

Seventy-four Attenborough knee replacements for rheumatoid arthritis

A clinical and radiographic study

Seventy-four Attenborough total knee replacements in patients with severe classical rheumatoid arthritis were followed for 2–5 years. The preoperative radiograms were evaluated according to two different scoring systems. At follow-up, radiographic whole leg examinations were performed. Mean malalignment was 7°. The overall results were not encouraging with definite failure in eight knees and probable failure in another 21 knees. Failure was significantly correlated with postoperative malalignment.

Key words: knee arthroplasty – Attenborough prosthesis; radiological classification; rheumatoid arthritis

**Torsten Boegård,
Håkan Brattström¹ &
Lars Lidgren¹**

Department of Diagnostic
Radiology, University
Hospital in Lund,
S-221 85 Lund,
Sweden

A great variety of total knee arthroplasties are currently available; however, only short-term follow-up results reported by the originator are available for many of the prostheses. There are few types of semi-constrained knee prostheses. Since Attenborough (1976) described his prosthesis, it has only been presented in one large series by Vanhegan et al. (1979) with an average follow-up of 2½ years in 100 cases. It is therefore of great importance to report even the short-term results, especially if alterations in technique and prosthetic design have been proved necessary.

The aim of this study is to report the operative technical errors and the short-term results in 74 Attenborough prostheses in patients with classical rheumatoid arthritis (RA).

Material and methods

This review consists of 74 consecutive Attenborough knee replacements in 63 patients with classical RA (Golding 1966) performed at Lund Hospital, Sweden from June 1977 through December 1979. There were 51 women and 12 men with an average age of 59 (19–79) years.

Attenborough's technique (1976) was followed in general. The standard prosthesis was used in 56 knees, the medium prosthesis in eight knees and the small prosthesis in 10 knees. Twenty operations were revisions from unconstrained arthroplasties, 17 of these in both compartments.

Sixty-four knees were available for clinical follow-up at an average of 43 (26–61) months. The functional capacity of the patients was evaluated preoperatively and at follow-up according to the classification of the American Rheumatoid Association (ARA) (Steinbrocker et al. 1949). Radiographic follow-up was performed in 71 knees at an average of 22 (5–40) months.

The preoperative radiographic examinations included standard frontal and lateral projections of the knee in supine position, an axial projection of the patellar joint in semiflexion and standing frontal projections on weight-bearing stressed in varus and valgus, according to Norman (in Hagstedt 1974). The preoperative radiograms were evaluated according to two different scoring systems for the femoro-tibial joint:

The system of Larsen et al. (1977) was used by comparing the AP radiogram with a standard film series. Fifty-four knees were classified (Table 1).

The system of Ahlbäck (1968) is based on AP radiographs in standing weight-bearing position and according to Norman (in Hagstedt 1974) with stress in varus and valgus. Each compartment was evaluated. Forty-nine knees were classified (Figure 1). The arthritic destructions were more pronounced in the lateral compartment. In addition, translation between the femur and tibia in the frontal plane was measured. The translation in the knee joint exceeded 10 mm in five knees, all with large bone destruction.

Forty-three knees were examined with an acceptable axial patellar view. Five patellar joints were normal. Patellar luxation was found in four knees.

Table 1. Classification of 54 rheumatoid knees according to Larsen et al. (1977)

Stadium	No.
0	1
1	—
2	1
3	2
4	17
5	33
Total	54

The aim was to examine the patients radiographically on the day after operation, after 3 and 6 months and after 1, 2 and 5 years.

The first three controls were made in a supine position with true frontal and lateral exposures. If possible, a whole limb radiograph was taken at the 1-year and following controls. This included the hip, knee and ankle joint in the frontal plane. The examination was done using a film-focus distance of 2 m with the patient standing only on the examined leg. The frontal radiograph was perpendicular to a side exposure defined by a tangential appearance of the dorsal aspects of both condyles of the femoral component (Egund & Norman 1979). On these radiographs lines were drawn from the center of the knee to the centers of the femoral head and the ankle joint. The lateral angle between these two lines is called the Hip-Knee-Ankle angle (HKA) and is ideally 180° (Maquet 1976) (Figure 2). The short femoro-tibial angle (FT) was also measured (Figure 3a).

Varus and valgus instability between the femoral

MEDIAL

5	1			3	3	3
4		1		2	6	2
3				4	2	4
2				2	1	1
1		2		2	6	
0	1			1	1	1
	0	1	2	3	4	5

LATERAL

Figure 1. Stage of loss of substance according to Ahlbäck (1968) in medial and lateral femoro-tibial joint in 49 rheumatoid knees.

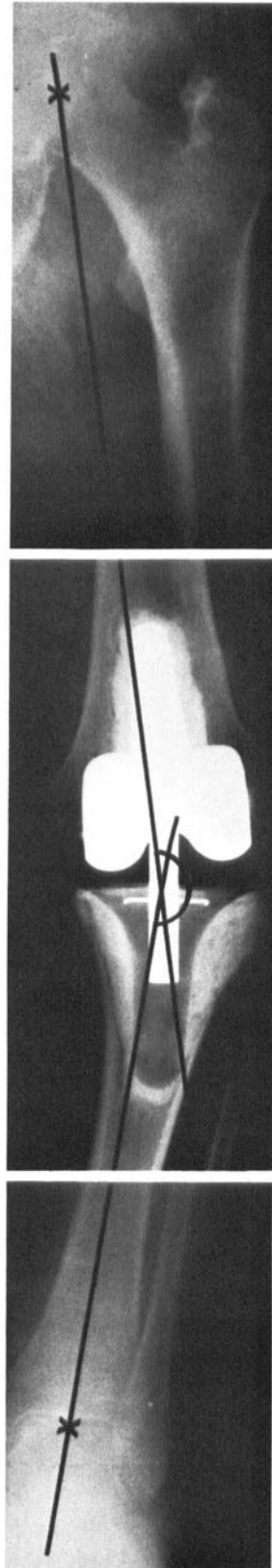


Figure 2. Drawing of the Hip-Knee-Ankle-angle (HKA).

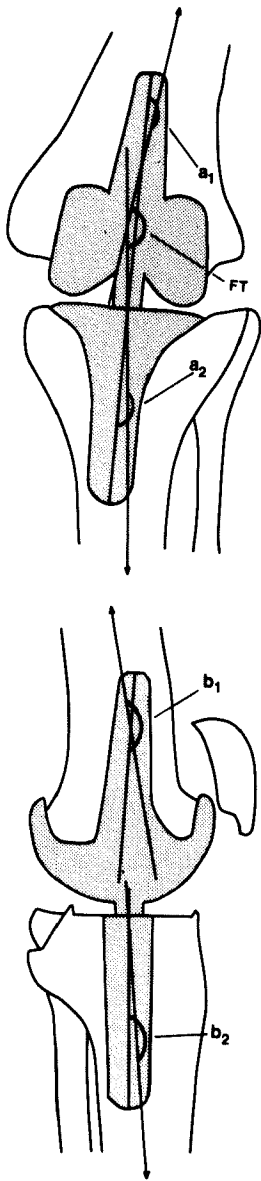


Figure 3. Schematic drawing of the FT-angle (FT) and angles (a and b) used for detection of angular migration.

and tibial components was measured in the frontal plane on the whole limb radiograph.

The angular deviation of the longitudinal axis of the prosthetic components was measured from the short axis of the distal femur and proximal tibia on both frontal and side exposures (Figure 3). Angular migration was said to exist if any of the angles obtained had changed 3° or more from the postoperative examination and to the examination at follow-up. Translation between the femur and the tibia in

the frontal plane was evaluated with respect to the centers of the femoral and tibial condyles.

The criteria for radiological failure used in this article were one or more of the following: increasing radiolucency between cement and bone of at least 2 mm, bone- or cement-fractures, axial migration, angular migration of prosthetic components of at least 3° and instability between prosthetic components of at least 3° .

The criteria for proven infections were one or more of the following: fistulation from the joint or bone, growth in at least three of five tissue biopsies taken at revision, septicemia with growth or identical bacteria in blood and knee aspirate.

All data were computerized. The statistical analyses were performed by Claes Svensson, Department of Statistics, University of Lund, Lund, Sweden.

Results

Clinical

In 41 knees, adequate examinations were carried out both preoperatively and at follow-up of the range of motion, stability and deformity; these were mainly unchanged.

The ARA score was on average 3.1 preoperatively and 2.5 at follow-up. Thirty-three of 64 patients were improved, 30 patients were unchanged and one had deteriorated.

Twenty-two early postoperative complications were found in 20 knees. Delayed wound healing occurred in 12 knees; five of these developed loosening radiologically. Two perioperative fractures occurred; both healed without complications. Patellar dislocation was found in four knees; one was present already before the operation and later signs of radiographic loosening were seen. Peroneal palsy developed in two patients and in another two knees loose cement pieces were found.

In eight knees there were nine late (after 3 months) complications (actual failure rate). Fracture of bone occurred in two knees. There were three deep infections, one postoperative and two hematogenous. There was one luxation of a prosthesis. Mechanical loosening occurred in three knees.

At follow-up, the patients' opinion was asked for. The patients were satisfied with the outcome in 56 knees and dissatisfied in eight.

Radiological

Whole leg examinations were performed at follow-up for 51 knees. There are no data from 20 knees either because the patient was unable to stand on the operated leg at the examination or because the follow-up examination was carried out in another hospital. The *HKA-angle* was measured. The mean angle was 185° (range 168–200°) (Table 2). Mean malalignment was 7.1°.

The *FT-angle* could be measured in 70 knees. The mean FT-angle was 180° (Table 3). For knees where the whole leg examination was performed, the difference between the HKA- and FT-angle for each knee was calculated. The mean difference was 6° (range -1 to +10°, SD ± 3°).

Instability between the femoral and tibial components occurred in 26 knees. If the HKA-angle was greater than 180° there was always a varus instability and if the HKA-angle was less than 180° there was always a valgus instability. The instability was at least 3° in seven knees, all with malalignment of more than 10°; four of those had signs of loosening.

The preoperative loss of substance had no influence on the insertion of the prosthesis measured as malalignment.

In 24 knees instability was examined preoperatively and a whole leg examination was performed at follow-up. If instability exceeded 20° there was a mean malalignment of 12°. Mean malalignment for those with instability less than 20° was 7°.

Table 2. The postoperative HKA-angle in 51 rheumatoid knees

	HKA (°)	No.
Valgus	168–171	2
	172–175	1
	176–179	10
180		1
Varus	181–184	10
	185–188	9
	189–192	10
	193–196	4
	197–200	4
Total		51

Table 3. The postoperative FT-angle in 70 rheumatoid knees

	FT (°)	No.
Valgus	162–165	2
	166–169	2
	170–173	8
174		6
Varus	175–178	16
	179–182	11
	183–186	13
	187–190	6
	191–194	3
	195–198	3
Total		70

In 51 knees the *translation* postoperatively was less than 5 mm. In four knees there was a lateral translation of the tibia of more than 10 mm, at most 14 mm. One of these had a patellar dislocation, and the other three showed no complications.

Angular migration of at least 3° between the longitudinal axes of the bone and the prosthetic component was found in altogether 10 knees.

Twenty prosthetic components in 17 knees were surrounded by a *radiolucency* greater than 2 mm. Radiolucency was found to a greater extent in the tibia. Radiolucency between the prosthesis and cement developed in four knees. In one knee this developed around both components and in the other three knees

Table 4. Failure rate in 51 rheumatoid knees in relation to postoperative HKA-angle

HKA (°)	Total	No. of failures
168–171	2	2
172–175	1	–
176–179	10	3
180		1
180		–
181–184	10	5
185–188	9	1
189–192	10	4
193–196	4	4
197–200	4	4
Total		51
Total		23

only around the femoral prosthesis. All except one knee showed signs of loosening around the cement as well. Periosteal reaction was found along the femur in five cases and along the tibia in three.

Eight *cement fractures* were noticed, one in the femur and seven in the tibia. One cement fracture occurred peroperatively but no further complications were found. The other seven all showed signs of loosening and the mean malalignment for these knees was 14°.

Migration of the tibial component into the tibia was found in nine knees. The migration was at most 5 mm. Other signs of loosening were also found in the knees.

Failure was found radiologically in 26 knees, five out of which have been operated, leaving 21 knees with probable failure. Six out of 10 small prostheses showed an actual or potential failure. A significant correlation was found ($p < 0.01$) between malalignment of more than 8° and failure (Table 4).

Discussion

Long-term results (10 years or more) after knee arthroplasty with the same prosthetic design are not available but intermediate results indicate an actual and/or probable failure rate in one third after 5 years (Tew & Waugh 1982). The long-term result for revision arthroplasty is not available for good or bad bone stock.

Reports with a short-term follow-up are necessary when a new prosthesis reveals a high frequency of early technical complications or an unacceptably high early failure rate.

All patients in this study had classical RA with severe involvement of the operated knee. Considerable involvement was also found in the patellar joint. In five knees the translation exceeded 10 mm and in no less than 20 knees the operation was performed as revision of earlier bi- or unicompartamental prosthesis.

The preoperative radiograms were evaluated according to two different scoring systems. As many surgeons today use different prostheses, depending on the severity of bone attrition and translation, it is of great importance to obtain the most detailed possible pre-

operative information. This seems to give the Ahlbäck system the advantage.

The femoro-tibial translation should be measured. The patellar joint should be evaluated separately as patellar prostheses are increasingly used in combination with femoro-tibial replacement. In this material four patellar dislocations were found postoperatively.

There was no increase in extension or flexion after the operation but improvement of the functional capacity was found in half of the number of patients. The postoperative malalignment exceeded 4° from an optimal HKA-angle of 180° in no less than 30 knees and the mean malalignment in this material was 7.1°. The preoperative bone deformation and translation did not have any influence on postoperative malalignment. This indicates that the technical devices for inserting the Attenborough prosthesis and/or the prosthetic design allows for an inexact positioning. There are two published reports on the Attenborough prosthesis: one with an average follow-up of 2½ years (100 prostheses) (Vanhegan et al. 1979) and another one with 1½ years (25 prostheses) (Kofoed 1981). Both reports are optimistic. Thirty-nine of the 100 knees had been analyzed postoperatively by weight-bearing radiographs and 34 showed some malalignment; in 12 knees this exceeded 7° of valgus or 5° of varus. Frequent minor malalignments occurred indicating difficulties in the technical performance, despite the fact that the authors were familiar with the prostheses.

In the present study there was a high (¼) initial postoperative complication rate, probably due to the severely destroyed knees that were operated on. In the group with delayed wound healing, five of 12 knees showed later signs of radiographic loosening. There were two peroneal palsies, one of which was reversible, which corresponds well with what could be found in the literature (Knutson et al. 1982).

Eight patients had severe late complications (after 3 months), leading to revision, arthrodesis or a new prosthesis. One of the eight patients was not revised but was continuously treated with antibiotics because of the hematogenous infection. Both hematogenous infections probably originated from foot ulcers.

A probable failure rate could be found in one

third of the knees radiologically. These radiographic changes were noted already after an average of 2 years. A significant correlation between malalignment and the actual and probable failure rate could be found. Thus malalignment leads to local stress concentration, microtrabecular fractures and increased deformity. This could also be verified by an increasing instability in one tenth of the knees. It indicates abrasion of the High Density PolyEthylene (HDPE) device used between the stabilizing pin and the femoral prosthesis or the HDPE tibial prosthesis.

The small prosthesis used in about one seventh of the knees in this material had a slightly higher failure rate, perhaps because of the high stress loads on the tibial plateau.

A comparison was made between the HKA- and FT-angle. The FT-angle deviated from the HKA-angle by 6°, being on average 179 and 185°, respectively. The individual difference was too inexact with a standard deviation of 3°. It can thus be concluded that the FT-angle is not optimal for calculating the actual load-bearing line. It can, however, be used for checking the patients once an initial postoperative HKA-angle and the deviation of the FT-angle have been measured.

An exact technique by which the prosthesis is inserted with an optimal HKA-angle of 180° is important, and the HKA-angle is of prognostic value for early failure in knee surgery.

The use of the Attenborough prosthesis should be restricted to severely destroyed rheumatoid knees when no other surgical solution is possible. A change in instrumentation is necessary, allowing for a more precise bone cut and insertion. Compared with a hinged prosthesis with a long intramedullary stem, the Attenborough prosthesis does represent a small but certain advantage. However, as three of our 74 patients ended up with an arthrodesis after 3 years, this must be discussed preoperatively and in some cases proposed as the primary solution. A salvage arthrodesis following a failed stabilized or semi-stabilized stemmed prosthesis is a demanding operation.

Acknowledgements

Grants were received from Stiftelsen för bistånd åt vanföra i Skåne, Konsul Thure Carlsson Foundation and Greta och Johan Kocks stiftelser.

References

- Ahlbäck, S. (1968) Osteoarthritis of the knee. A radiographic investigation. *Acta Radiol. Suppl.* 277.
- Attenborough, C. G. (1976) Total knee replacement using the stabilized gliding prosthesis. *Ann. R. Coll. Surg. Engl.* 58, 4-14.
- Egund, N. & Norman, O. (1979) Pre- och postoperativ röntgenundersökning vid hög tibiaosteotomi. Nord. Kongr. Med. Radiol. Stockholm.
- Golding, D. N. (1966) *A synopsis of rheumatic diseases*, pp. 41. John Wright and Sons Ltd., Bristol.
- Hagstedt, B. (1974) *High tibial osteotomy for gonarthrosis*. Thesis, Lund.
- Knutson, K., Leden, I., Sturfeldt, G., Rosén, I. & Lidgren, L. (1983) Nerve palsy after knee arthroplasty in patients with rheumatoid arthritis. *Scand. J. Rheumatol.* 12, 201-205.
- Kofoed, H. (1981) The Attenborough total knee prosthesis. *Acta Orthop. Scand.* 52, 561-568.
- Larsen, A., Dale, K. & Eek, M. (1977) Radiographic evaluation of rheumatoid arthritis and related conditions by standard films. *Acta Radiol. Diagn.* 18, 481-491.
- Maquet, P. (1976) *Biomechanics of the knee with application to the pathogenesis and surgical treatment of osteoarthritis*. Springer Verlag, Berlin, Heidelberg, New York.
- Steinbrocker, O., Traeger, C. H. & Batterman, R. C. (1949) Therapeutic criteria in rheumatoid arthritis. *J. Am. Med. Assoc.* 140, 659-662.
- Tew, M. & Waugh, W. (1982) Estimating the survival time of knee replacements. *J. Bone Joint Surg.* 64-B, 579-582.
- Vanhegan, J. A. D., Dabrowski, W. & Arden, G. P. (1979) A review of 100 Attenborough stabilized gliding knee prostheses. *J. Bone Joint Surg.* 61-B, 445-450.