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FREEMAN-SWANSON ARTHROPLASTY OF THE KNEE IN RHEUMATOID ARTHRITIS: A 2–7 YEAR EXPERIENCE

P. HERBERTS & G. B. J. ANDERSSON

Departments of Orthopaedic Surgery, East and Sahlgren Hospitals, Göteborg, Sweden

Sixty-six Freeman-Swanson arthroplasties were performed on 59 patients with rheumatoid arthritis from 1972 through 1979. The patients were followed prospectively and longitudinally. Thus, a detailed protocol was filled out preoperatively and once a year thereafter. This report is based on a total of 299 observations, with a follow-up period ranging from 2 to 7 years (mean 4.4 years).

Pain was the main indication for surgery and relief of pain the most gratifying and consistent finding over the years. Of 56 knees remaining in the study in 1979, 61 per cent were considered to be good, 27 per cent satisfactory, and 12 per cent were failures.

Early complications were observed in 20 per cent of the knees, late complications in 24 per cent. The majority of the complications resolved after treatment but six knees (9 per cent) deteriorated following a late complication. Thirteen reoperations were performed, of which five were prosthetic revisions.

In conclusion, the results were good over a 7-year period provided the deformity was corrected, stability restored and the prosthetic components positioned perpendicular to the mechanical axis of the leg. Tibial component loosening was the most important reason for failure.

Key words: arthroplasty; knee joint; prosthesis; rheumatoid arthritis

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Arthroplasty of the knee is an accepted method of treatment in patients with severe knee disabilities. Gratifying short-term results have been reported particularly in rheumatoid arthritis. Publications with follow-up periods longer than 5 years are few, however, mainly because most orthopaedic centres have used total knee replacements as a routine method of treatment for less than 10 years. With the introduction of semi- and non-constrained prostheses in the early 1970s there was a significant increase in the use of knee implants.

The Freeman-Swanson knee prosthesis, which has now been replaced by the ICLH and the Freeman-Samuelson prostheses, is a partially constrained implant which substitutes for the cruciate ligaments but requires the collateral ligaments for stability. The device has been in use since 1970, but we have only seen reports of results from Mr. Freeman's own unit, and from a multi-centre study in which Mr. Freeman himself participated. We have used the Freeman-Swanson prosthesis, and later the ICLH prosthesis, as the only prostheses in reconstructive knee surgery since 1972. The purpose of this paper is to report on results and complications in 66 consecutive arthroplasties. The patients have been followed longitudinally in a prospective manner.

PATIENTS AND METHODS

A total of 66 arthroplasties in 59 patients, 51 women and 8 men, were followed. All patients had definitive rheumatoid arthritis. The study comprised all knees in

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Table 1. Number of knees included in each postoperative period

Follow-up period (y)	Number included	Number dead	Lost to follow-up	Total number[1]
0.5	65	1		66
1	65	1		66
2	61	4	1	66
3	44	7	1	52
4	30	5		35
5	20	6		26
6	13[2]	5		18
7	1	4		5

1. The number refers to the knees that could have been observed at each follow-up period if the patients were still alive. All knees were observed at 6 months and then yearly. Thus, the knees observed at 6 years are also included in the 1–5 year numbers etc.
2. One arthrodesed knee.

patients with rheumatoid arthritis operated on with total knee replacements at the Department of Orthopaedic Surgery I, Sahlgren Hospital, Göteborg, Sweden from 1972 through December 1977. The age range of the patients was 40 to 82 years (mean age 60 years). One knee was replaced in 52 patients, both knees in seven. A detailed description of the patients' condition at the time of surgery is given below.

The study was a prospective longitudinal follow-up in which a detailed protocol was filled out preoperatively, 6 months postoperatively, and each year thereafter. The present report is based on a total of 299 observations, with a follow-up period ranging from 2 to 7 years (mean 4.4 years). The number of knees studied at each postoperative interval is given in Table 1.

The clinical form used in the study was the same as that described by Todd et al. (1980). It includes information about the patients' pain history and functional ability and clinical data on stability, range of motion and joint alignment. Antero-posterior and lateral radiographs were taken at each visit. An overall assessment of the function of the knees remaining for examination in 1979 (56 knees) was made using a point scoring system (Todd et al. 1980).

Surgical procedure

The prostheses were inserted using a standardized technique, a full description of which is available in the literature (Freeman et al. 1973). The majority of the operations (55 arthroplasties) were performed by one surgeon. The operative conditions and prophylactic procedures were changed over the years studied which can be divided into three periods. From May 1972 through July 1975, surgery was performed in a standard operation theatre. Antibiotic prophylaxis was not given until October 1973 (11 knees). From October 1973 through January 1975 (17 knees), prophylactic antibiotics (Dicloxacillin) were given from the morning of the day of operation and for 7 days postoperatively. In the third period, from August 1975 through January 1977 (28 knees), a clean-air room was used for surgery, and prophylactic antibiotics, with Dicloxacillin, were given as well. All patients received high molecular weight Dextran per- and postoperatively as prophylaxis against deep vein thromboses.

Following surgery the knees were immobilized in a Robert Jones bandage for 4 days. Quadriceps exercises were started on the first postoperative day, and flexion exercises on the fifth day. The patients were mobilized on the sixth day with partial weight-bearing during the first 6 weeks. Manipulation was performed under general anaesthesia if knee flexion was less than 90 degrees at 2 weeks postoperatively. Only three knees were manipulated.

Preoperative condition

All patients had moderate to severe involvement of at least one additional weight-bearing joint contributing to the functional disability (Tables 5–9).

Pain was the main indication for surgery (Tables 2–4). Thus, in 53 knees (80 per cent) there was moderate to severe pain at rest, in 57 (86 per cent) moderate to severe pain during motion when non-weight-bearing, and in 65 knees pain (99 per cent) at weight-bearing. Sixty-two knees were painful immediately on standing. Fifty-nine patients (90 per cent) used a walking aid, or were unable to walk (Table 5). All patients able to walk had a limp (Table 6). Previous surgery had been carried out on 23 knees (35 per cent); 17 synovectomies, one McIntosh arthroplasty, one tibial osteotomy, one meniscectomy and three operations for fractures about the knee.

The preoperative range of motion, and degree of deformity are given in Figures 1 and 3. Instability was present in 51 knees.

RESULTS

The results with respect to pain and functional abilities are listed in Tables 2–9. It should be noted that the study is longitudinal, and that, therefore, the knees observed at 7 years are included in all earlier follow-up periods. Relief of pain was the most gratifying and consistent finding during the whole period of follow-up. Of 53 knees with severe or moderate pain at night preoperatively none remained painful at 6 months. Similarly, of 57 knees with severe or

Table 2. Number of knees with night pain

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
None	5	64	65	56	42	28	14	10	1
Mild	8	1	–	1	2	2	6	1	–
Moderate	12	–	–	2	–	–	–	1	–
Severe	41	–	–	2	–	–	–	–	–
	66	65	65	61	44	30	20	12	1

Table 3. Number of knees with pain during motion without weight-bearing

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
None	3	47	43	40	31	17	9	6	–
Mild	6	16	17	16	8	7	10	3	1
Moderate	12	2	5	2	4	5	1	3	–
Severe	45	–	–	3	1	1	–	–	–
	66	65	65	61	44	30	20	12	1

Table 4. Number of knees with pain during walking

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
None	0	48	45	41	33	20	10	7	–
Mild	1	17	14	10	8	7	7	4	1
Moderate	3	–	6	7	2	3	3	1	–
Severe	62	–	–	3	1	–	–	–	–
	66	65	65	61	44	30	20	12	1

moderate pain on movement (non-weight-bearing) only two had moderate pain at the first follow-up period. In 16 knees there was mild pain anteriorly when the knee was moved, probably from the patello-femoral articulation. Mild pain on walking was present at 6 months in 17 knees (26 per cent) and this percentage remained about the same over the years. Walking pain was always located anteriorly.

The results with respect to night pain did not deteriorate over the years. When walking or moving the knee without weight-bearing, on the other hand, mild or moderate pain was more common on a percentage basis when the follow-up period was longer than 3 years (Tables 3 and 4). But the pain was considered severe only in a few cases. Complications had occurred in all but one knee in which pain occurred after pain-free intervals. These will be discussed in a separate section.

The patients became somewhat less dependent on walking aids following surgery (Table 5).

Table 5. Use of aids

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
None	7	14	16	19	10	8	3	4	1
Stick, long walks	7	17	17	9	10	8	8	1	–
Stick or crutch	24	13	13	16	6	13	6	6	–
Two sticks or crutches	24	19	18	15	16	1	3	1	–
Unable to walk	4	2	1	2	2	–	–	–	–
	66	65	65	61	44	30	20	12	1

Table 6. Limp

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
None	0	16	19	10	8	5	1	1	–
Slight or moderate	25	40	33	38	25	21	14	8	–
Severe	37	8	12	11	10	4	5	3	1
Unable to walk	4	1	1	2	1	–	–	–	–
	66	65	65	61	44	30	20	12	1

Table 7. Distance walked without stopping

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
Unlimited	–	–	–	–	2	1	1	1	–
Outdoor but limited	35	55	54	53	34	26	16	10	–
Indoor only	25	9	10	5	7	3	3	1	1
Bed to chair	2	–	–	1	–	–	–	–	–
Unable to walk	4	1	1	2	1	–	–	–	–
	66	65	65	61	44	30	20	12	1

Thus, at 6 months 48 per cent could walk without aid or used aids only when walking long distances, compared with 21 per cent preoperatively. These results remained stable over the years. The patients' limp was also improved (Table 6). A small deterioration occurred over the years.

More patients were able to walk outdoors, and the walking distance had usually increased (Table 7). The results were consistent over the years. The ability to go upstairs and to get out of a chair did not change dramatically following surgery (Tables 8 and 9).

Range of motion increased slightly in 41 knees, decreased slightly in 15, and was unchanged in 9 at 1 year (Figure 1). Deterioration thereafter was usually caused by a complication. The ability to extend the knee improved markedly as seen in

Table 8. Ability to walk up stairs

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
Normally	–	4	2	1	–	1	–	1	–
One at a time, no banister	–	4	8	3	6	2	2	–	–
Banister	36	44	42	40	29	21	13	5	–
Any other method	15	7	4	8	2	4	4	5	–
Unable	15	6	9	9	7	2	1	1	1
	66	65	65	61	44	30	20	12	1

Table 9. Ability to get out of a chair

	Preop.	Postoperatively (years)							
		0.5	1	2	3	4	5	6	7
Able to with ease	–	5	2	2	2	2	–	1	–
Able to with difficulty. No push-off	3	7	10	6	4	2	1	1	–
Push-off only	54	47	50	47	33	26	18	10	1
Unable	9	6	3	6	5	–	1	–	–
	66	65	65	61	44	30	20	12	1

Figure 2. Thus, preoperatively an extension lag of more than 10 degrees was present in 50 per cent of the knees, 1 year postoperatively in only a few knees.

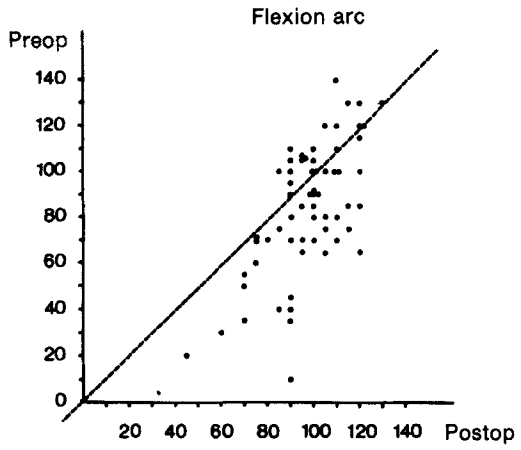

Figure 1. Range of motion at 1 year postoperatively.

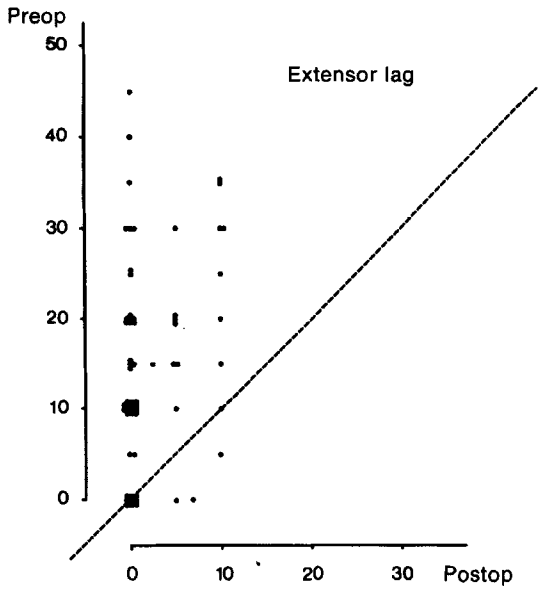

Figure 2. Ability to extend the knee at 1 year postoperatively.

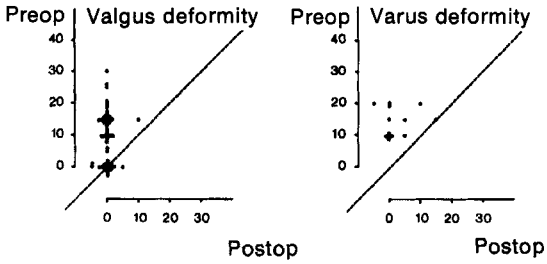

Figure 3a, b. Varus and valgus deformities at 6 months postoperatively.

The surgeons ability to correct varus – valgus deformities can be seen from Figure 3a and b. Evaluation was made at 6 months, since as described under complications loss of correction was found in seven knees at later intervals. Full valgus correction was obtained in all but two knees, full varus correction in all but four. An over-correction of 5 degrees was found in two valgus and one varus knee. Instability was present in 51 out of 66 knees preoperatively, compared with 8 out of 65 at 6 months. Of the 56 knees evaluated in 1979, one was grossly unstable (30 degrees) and six showed a slight instability of 10 degrees.

An overall assessment of our results using the point scoring system was made on the 56 knees that remained in the study in 1979. The system gives 110 points to a perfect knee. The mean preoperative score was 33 points (range 5–50) and the mean postoperative score 90.4 points (range 35–110). Good results (90–110 points) were found in 34 knees. Included in the good results were also patients with scores down to 70 if the only reason for their lower score was a reduced motion to between 70 and 90 degrees. Acceptable and improved were 15 knees with scores between 60–90 points. Poor results were found in seven knees. Six of these deteriorated because of late complications. One patient had severe pain without any detectable clinical or radiographic pathological abnormalities. She had the lowest postoperative score of all (35 points) and was the only patient with a lower score after surgery.

Complications

An early complication was observed in 20 per cent of the knee operations (Table 10). Most of them have not been harmful and the great majority resolved. One knee replacement (1.5 per cent) was unsuccessful because of pneumonia and senility and the patient became wheelchair bound.

The technical error was a malaligned tibial component which was forced down anteriorly into the tibia so that a 20 degree anterior tilt occurred in the sagittal plane. It was decided to leave the prosthesis in that position and the patient has made an uneventful recovery.

Two superficial infections resolved without any specific treatment, as did one small wound haematoma. Deep vein thrombosis occurred in one patient and was successfully treated with anticoagulants. Two patients were noted to have peroneal palsies after surgery; one recovered fully within 3 months, the other only partially.

We encountered 24 per cent late complications which could be related to the knee arthroplasty. Most of these complications were treated and resolved (see Table 11). In six cases the knee deteriorated due to the complication, which corresponds to 9 per cent of the knees. One deep infection occurred following a reoperation because of loose cement particles inside the joint. *Staphylococcus aureus* was cultivated. The patient was treated with closed suction drainage and antibiotics and the infection healed with the

Table 10. Early complications

	Number
Superficial infection	2
Wound haematoma	1
Thrombophlebitis	1
Peroneal nerve palsy	2
Cardiovascular complication	1
Gastrointestinal bleeding	1
Pneumonia	1
Lower urinary tract infection	2
Technical errors	1
Urticarial rash	1
	13 (20%)
Resolved	10 (15%)
Deteriorated	1 (1.5%)

Table 11. Late complications

	Number
Deep infection (after reoperation)	1
Loose prosthesis (both components)	4
Loose tibial prosthesis	4
Recurrent instability-deformity	5
Loose cement particles	2
	16 (24%)
Resolved	10 (15%)
Deteriorated	6 (9%)

prosthesis left *in situ*. She has now been followed for a further 3 years without any sign of loosening and is asymptomatic. A subsidence of the tibia component is apparent on radiographs, however.

Loosening of both components occurred in four knees and of the tibial component in another four. In two of the knees where both components became loose revision arthroplasties were performed after 1 and 3 years, respectively, using a thicker tibial component. Both revisions were successful. Three of the four patients with loose tibial components have been revised. Two of the revisions were successful. In one knee, which is described below, further deterioration occurred and an arthrodesis was finally performed. One patient sustained a compression fracture of her tibial plateau 6 weeks postoperatively. Revision arthroplasty was also performed in this case giving a good result 4 years later.

In five knees recurrent instability and/or deformity occurred. Early in the series we tried to repair one lateral and one medial collateral ligament. These procedures were unsuccessful. One of the patients had a revision arthroplasty and finally an arthrodesis. She is therefore not included among the unstable cases but listed as an arthrodesis in Table 12. This knee was reoperated three times and is of course a failure. Two of the patients with recurrent instability and deformity are not suitable for further surgery because of severe rheumatoid arthritis and old age. These patients must also be classified as failures and are now wheelchair bound. One knee with a varus deformity of 15 degrees remained stable and the deformity did not progress over 5 years.

Table 12. Reoperations after ICLH knee arthroplasty (66 knees)

	Number
Arthrodesis	1
Prosthetic revisions	5
Repair of collateral ligament	2
Repair of extensor mechanism	3
Arthrotomy and extirpation of loose cement particles	2
	13 (10 knees)

Five prosthetic revisions (7.6 per cent) were performed (Table 12) and seven other minor surgical procedures were also necessary. One arthrodesis has been performed after a revision arthroplasty where the prosthetic components came loose a second time after 2 years. The reoperations were performed on ten knees only since one of the knees has been reoperated three times. The reoperation rate in the study was 15 per cent.

DISCUSSION

Previous experiences with the Freeman-Swanson prosthesis, using the instrumentation provided up to 1977 (Bargren et al. 1976, Freeman et al. 1978, Goldberg & Henderson 1980) have indicated four main problems; patellar pain and subluxation, tibial loosening and sinkage, surface damage to the tibial component by acrylic cement particles, and problems with stability and alignment. All these problems were also encountered in the present study. During the 5-year period (1972–1977) we used essentially the original operative technique as described by Swanson & Freeman (1972). Some modifications were, however, undertaken during 1975 and 1976. Firstly, from 1975 on, we used a wide tibial component whenever possible to avoid sinkage and loosening (Freeman et al. 1978). Secondly, in the last 2 years of the study a subchondral resection of the patellar surface was performed routinely and thirdly, a special instrument, the tenser, was provided. The tenser greatly facilitated our ability to reproducibly align the knee in extension with

preserved stability. The further improvements in operative technique, with a new set of instruments, the ICLH-prosthesis including a patella surface replacement component and a cementless tibial component (Freeman et al. 1978) were introduced after the completion of the study.

The material consists of a consecutive series of RA patients and comprises all rheumatoid knees operated on with total knee replacement over a 7-year period. There is a high percentage of severely damaged knees and most of the patients are women. It has been stated that the results with the Freemann-Swanson prosthesis in RA and OA are similar (Freeman et al. 1977). As the general disease progresses in RA patients, however, many develop severe osteoporosis with increased risk of tibial component sinkage and loosening. In our opinion it is therefore necessary to separate RA and OA when reporting long-term results. Biological differences in the patient material must be considered and not different technical prosthetic aspects (Dobbs 1980) when analysing the survivorship of joint replacements. From a technical point of view we share the opinion of Freeman et al. (1977) that the prosthesis can be used to reconstruct any joint regardless of the initial pathology.

Our final results in 1979 are slightly less satisfactory than those of Bargren et al. (1976) in an unselected series of patients with both RA and OA. Their follow-up period was, however, shorter than in the present study. Summary ratings of the results can be misleading and failures can be missed (Bargar et al. 1980). For this reason we have separated pain, walking, function, and clinical findings in the description of our results over the years and also analysed our complications in detail.

Pain was the main indication for surgery and the results with respect to pain were most gratifying over the years. The residual mild pain that we observed in some knees was almost exclusively located anteriorly in the knee and we believe it to originate from the patello-femoral articulation. The short anterior flange of the original prosthetic design, used here, obviously did not solve the problem of the patella. It was a common radiographic finding that a substantial groove had developed in the patella with crepitus, impingement, and pain as a result. The subchondral resection of the patella surface, adopted from 1975, improved the results but only to some extent and overall 25 per cent of the knees were considered to suffer from patello-femoral dysfunction.

Patients with severe involvement of at least one additional weight-bearing joint experienced a slight improvement in gait and ability to walk outdoors. It is striking that this improvement is so consistent over the whole period and most of our patients were able to continue walking outdoors even after many years. Range of movement improved slightly. Only a few patients did not achieve an acceptable final arc of movement. With improvement in surgical technique and a more extensive exposure of the top of the tibia a considerably better arc of movement has been obtained in later years.

Our reoperation rate of 15 per cent is higher than the 9 per cent reported by Bargren et al. (1976). Goldberg et al. (1980), on the other hand, reported an overall reoperation rate of 28.5 per cent. They also found that five knees ultimately required arthrodesis in a series of 70 arthroplasties.

All knees in which loosening occurred could be revised without technical difficulties. The reoperations for loosening were performed between 1 and 5 years after the arthroplasty with a mean interval of 3 years. The study indicates that for RA it is between 3 and 5 years after the operation that technical errors like malignment and faulty component positioning will show up and require reoperation or orthotic care.

Tibial component loosening and sinkage, which are usually associated, were the main problems and occurred in 12 per cent of the knees. The great majority of these knees were operated on in the early part of the study period with a small tibial component. Even with the large prosthesis with cortical support on the proximal rim of the tibia we have, however, in the last 2 years had two cases of sinkage. Even if the components were placed perpendicular to the mechanical axis of the leg from the beginning, there is a tendency for the tibial component in some patients to sink anteriorly and medially. This can be due to the moments acting on the prosthetic device when walking (Andriacchi et al. 1980).

Faulty component placement was the major factor in the development of instability and progressive deformity with ultimate loosening. In 8 per cent of our knees instability with or without progressive deformity was observed 6 months after the arthroplasty. On the other hand, subluxation in the frontal plane was not a major problem and we see no reason for a modification of the prosthesis with a curved surface on the tibial component to prevent this translational slide, as proposed by Goldberg et al. (1980).

Failure to correct a varus – valgus malalignment was not uncommon in the early years of the study because of surgical misjudgement. During the latter part of the study we appreciated the importance of releasing soft tissue contractures and also used the tenser, which made it possible to correct the deformities much more precisely.

Loose acrylic cement particles in the joint were the reason for failure in one case where both prosthetic components came loose. A pronounced aggressive synovitis was found to be caused by acrylic and plastic particles. In two additional cases loose cement particles were extracted from the joint. Furthermore, it was a consistent finding at the other reoperations that small loose acrylic particles had caused three-body wear of the surface of the tibial component. We therefore believe that one of the major improvements in the present technique is the introduction of the cementless tibial component.

In this series of rather severely damaged RA knees the results with the Freeman-Swanson knee arthroplasty were acceptably good over a 7-year period. The most important requirement for a good long-term result was that the deformity was corrected with stability and that the prosthetic components were placed perpendicular to the mechanical axis of the leg. The great problem of how to treat patients with a failed knee prosthesis remains and our procedure with revision arthroplasty using the same prosthesis but a thicker tibial component was not satisfactory. Two were good, two satisfactory but tending to slowly subside again, and two became failures. The use of hinged cemented prostheses has not been found to solve the problem permanently either (Bargar et al. 1980), and arthrodesis is known to fail in at least 20 per cent (Broderson et al. 1979).

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Correspondence to: P. Herberts, M.D., Ph.D., Department of Orthopaedic Surgery, East Hospital, S-416 85 Göteborg, Sweden.