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Prognosis of the Müller Geradschaft total hip prosthesis—10-year results of 214 successive total hip arthroplasties

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Definition of the problem: Can the results of the Müller Geradschaft hip prosthesis after a follow-up period of 10 years be compared to the gold standard, the Charnley prosthesis?

Method: 214 total hip prostheses of the Müller Geradschaft type were implanted between 1979 and 1983 in 208 patients, using a second generation cementing technique. After a minimum follow-up period of 10 years, 149 hips could be examined clinically and 134 radiologically. 55 patients had died, 10 hips had been revised: 4 because of infection, 6 because of aseptic loosening.

Results and conclusion: The clinical results were highly satisfactory: increase in the Merle d'Aubigné score from a mean of 7.8 to a mean of 15.8. Radiologically, 13% of the hips after 10 years showed loosening of the femoral prosthesis. Bone resorption of the proximal femur, indicated by stress shielding, was observed in 61% of the hips. Survival analysis of the femoral prosthesis revealed 89% success after 10 years and a cumulative survival of 91%, which is as good as the gold standard. It is asserted that there probably exists a correlation between 'physiological' subsidence and bone resorption indicated by stress shielding, which may lead to a larger number of loosening after follow-up periods longer than 10 years.

Results of the Charnley total hip prosthesis after 8 years' follow-up

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Objective: Evaluation of the Charnley total hip prosthesis after 5 to 13 years' follow-up and investigation of the risk factors for revision.

Material: 197 Charnley hip prostheses were implanted in 171 patients during the period from April 1984 to December 1990. The mean age at operation was 70 years.

Method: The survival of the prostheses was defined as the length of time until revision. The survival was estimated with the aid of the Kaplan-Meier method.

The statistical significance of the risk factors was determined with the aid of a Cox regression model. The possible risk factors were sex, age, preoperative diagnosis, approach technique, hip-shaft contact, amount of cement under the femoral stem, number of cement inclusions, wear, endosteal clear spots (osteolysis) and demarcation lines.

The patients were clinically evaluated by means of a pain score and an ADL score.

Results: In nine of the 197 prostheses revision had taken place before the end of the study: late infection (n=3), aseptic loosening (n=5), recurrent dislocation (n=1). The 8-year survival was 94% with a 95% confidence interval (CI) of 90–98%. The survival was influenced to a statistically significant degree only by the presence of endosteal clear spots. The clinical results were excellent or good in 95%.

Conclusion: The proportion of non-revised Charnley total hip prostheses 8 years after operation is large. In this study, the only fact that had a negative influence on the survival was the presence of endosteal clear spots (osteolysis). The clinical results were satisfactory.

Survival of the cemented Stanmore total hip prosthesis—a follow-up study after 21–23 years

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The Martini Hospital of Groningen has been using cemented Stanmore hip prostheses since 1975. Question: What are the long-term results of this prosthesis?

Method: A group of 135 successive patients (146 prostheses) treated with primary total hip prostheses in 1975 and

1976 were followed up until the end of 1997. The results of all patients were known.

Results: The cumulative duration of survival of the prosthesis was 95% after 10 years and 91% after 15–16 years. After 18 years, another follow-up examination was made of all 29 surviving patients (30 prostheses) who had not had a revision operation. No new revisions were found necessary and the cumulative duration of survival of the prosthesis remained 91%. The cumulative duration of survival of the femoral component was 98% after 18 years.

Two patients required a revision after 18–19 years, one because a femoral fracture with a loose prosthesis and one because a fracture of the stem of the prosthesis.

In 1997, 21 of the surviving 23 patients (24 hips), with a mean age of 84 (70–95) years still had their original adequately functioning prostheses. Since 1975, 11 of the original 146 prostheses were revised.

Conclusion: The long-term results of the cemented Stanmore total hip prosthesis are excellent. An adequately fixed femoral component remains firmly anchored. Problems arise relatively more frequently with regard to the durability of the anchoring of the acetabular component.

Total hip arthroplasty with impacted autologous chips in case of arthrosis in acetabular dysplasia and dislocation of the hip

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Introduction and definition of the problem: A vital bearing support round the cup of a total hip prosthesis is of essential importance. In case of acetabular dysplasia the anterior wall is frequently defective and the cranial segment is absent. Using impacted autologous bone chips, the acetabular wall was built up after reconstruction of the segmental defects with wire mesh. Earlier follow-up studies had shown that this technique of plastic bone repair results in good incorporation in existing bone, with a clinically and radiologically well-functioning neoarticulation. We expect that this group will reduce early failure and, in case of subsequent re-revision in this group of young patients, may lead to a simpler and biological re-revision.

Method: Presentation of mean 5-year results of 25 cemented total hip prostheses. The Harris hip score was determined pre- and postoperatively.

Cup migration was determined by means of a digital measuring technique developed by us. Bone integration was evaluated radiographically.

Results: Harris hip score: 41 preoperatively and 90 postoperatively.

Cup revision was carried out once because of loss of function of the sciatic nerve due to excessive distalization. Proximal migration of the cup from 0 to 4 mm was measured during the first 6 months after operation. Subsequently, com-

pletely unchanged positions were measured, with complete bone integration in all cases. Persistent lateral osteolysis was seen in only 3 cases.

Conclusion: The technique used appears encouraging. Initially there is minimal migration of the cup, subsequently there are no signs of migration or loosening.

Histological analysis of impacted bone grafting in revision operations of the hip

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Loss of bone at revision surgery of the hip can be treated with an impacted bone graft. This is transformed into vital bone. How and when this process takes place is not exactly known. We describe histological findings after hip revisions with impacted bone allografts.

Methods: During a period ranging from 2 weeks to 2.5 years after a hip revision operation with impacted donor bone, 17 biopsy samples (6x femur, 11x acetabulum) were taken at 12 different times from eight patients. Histological sections were examined for neovascularization and bone formation (woven bone).

Results and conclusion: At 5 weeks, neovascularization can be observed in the donor bone. From the patient's own bone, the bone grows into the graft. In the bone, resorption of donor bone occurs simultaneously with formation of new bone. After 4 months, transformation of the new bone into a lamellar structure can be seen. After 2 years, mostly lamellar bone is observed.

Histology demonstrates the formation of new bone tissue which with time develops a lamellar structure.

Reconstruction of the acetabulum with impacted bone chips and a cemented cup at revision of failed total hip arthroplasties—a 10–15 year follow-up

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In our Institute, acetabular defects at the revision of failed total hip arthroplasties (THA) are filled since 1979 with impacted bone chips. All patients with a follow-up of 10 years or longer were analysed.

Patients and method: 62 acetabuloplasties were carried out between 1979 and 1986 in 58 patients with revision of a THA. Data of two patients (two hips) were not available. Ten patients (10 hips) had died within 10 years after the operation; none had had a re-revision. 46 patients (50 hips)

were followed up after an average follow-up period of 11.8 (10–15) years. The indications for revision were aseptic loosening in 56 cases and septic loosening in four cases. The acetabular defects were classified according to D'Antonio (1989) as cavitary defects (37) and combined cavitary-segmental defects (23). A homologous femoral head was used in 35 cases, crista bone in nine cases and a combination of allo- and autografts in 16 cases. The number of re-revisions was determined, the Harris Hip Score (HHS) was applied and the radiographs of the acetabula were evaluated according to deLee and Charnley (1976).

Results: Five re-revisions had been performed: two septic loosening (3 and 6 years postoperatively) and three aseptic loosening after 6, 9 and 12 years, respectively. There were no preoperative HHSs, the HHS after a minimum of 10 years' follow-up was 85 (53–100). Radiographic failure was present in four patients.

Conclusion: Acetabular reconstruction using impacted bone chips at revisions of failed THAs appears to be a good technique with a proportion of re-revisions because of aseptic loosening of 6% after an average follow-up of 11.8 years.

Revision surgery of severely damaged femoral bones, with use of an impacted bone graft

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Patients and methods: This presentation deals with the results of a prospective study, started in 1992, of the use of impacted bone grafts at THP revision surgery with severely damaged femoral bones. Of the 32 hips operated on, 21 (66%) had a femoral defect of grade III or IV according to the Endo-Klinik classification.

Results: After an average follow-up of 42 (23–64) months, no re-revisions were necessary. The mean Harris Hip Score (HHS) was improved after the operation from 42 to 79 points (paired Student t-test: 95% confidence interval of $28.3 < \mu < 44.7$ and $p < 0.001$). The mean pain score of the HHS was improved after the operation from 18 to 40 points (paired Student t-test: 95% confidence interval of $17.9 < \mu < 70.0$ and $p < 0.001$).

76% of the Gruen zones could be evaluated radiologically, the other zones could not be evaluated because of over-projection of osteosynthesis material. In 37% of the zones that could be evaluated we saw restoration of cortex thickness, consolidation had occurred in 90% and incorporation of the bone graft in 85% of the zones.

Resorption of the graft was seen in 6% of the zones.

Two patients postoperatively sustained a femoral fracture that was treated surgically with use of osteosynthesis material. Two other patients developed a fissure each which healed with conservative treatment. All fractures and fissures were just distally of the tip of the prosthesis. Four stems subsided more than 10 mm; in all four of these the cement was broken.

Conclusion: THP revision operation with use of impacted bone grafts gives good short-term results, even when the femoral bones are badly damaged.

The combination of impacted spongy bone grafting and a reinforcement ring at cup revisions—results after 10 years

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Aseptic loosening of cemented acetabular cups usually creates a major problem if a considerable amount of bone is lost. Biomechanical research has shown that in such a situation it is important to restore the normal center of rotation. In order to compensate the bone loss and to re-establish the center of rotation as well, we have since 1980 been using impacted spongy bone in combination with a reinforcement ring.

Methods: Between 1980 and 1988, 44 cup revisions were carried out in 42 patients because of aseptic loosening having occurred after a median of 8.1 years. The bone defects were refilled with grafts of spongy bone from the hospital's own bone bank; in addition, a Müller reinforcement ring was used 28 times, a Burg-Schneider ring 15 times and an Eichler ring once. The Merle d'Aubigné score and serial radiological control examinations were used for the clinical evaluation.

Results: The median follow-up was 10.1 (6.4–16.2) years. Two patients (2 hips) were not available for follow-up. There had been no early complications. In four patients, a second revision had been necessary after a median of 3.5 years, three times for a deep infection and once for aseptic loosening. The Merle d'Aubigné score increased from median 9.2 before operation to median of 14.6 at follow-up. Roentgenologically, three cases of definite loosening at follow-up. Excluding the three deep infections, the proportion of radiological failure according to the Harris classification after 10 years follow-up was 10% (4/39).

Conclusion: In cases of aseptic loosening of the acetabular cup associated with substantial loss of bone, spongy bone grafting in combination with a reinforcement ring gives highly acceptable long-term results.

Hip revision operations with bone impaction and migration of the femoral stem

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A widely used technique of hip revision is allograft bone impaction and cementing of a hip prosthesis. The purpose of this study was to determine if the migration of the revised femoral stem depends on the preoperative femoral defects.

Material and methods: The results of ten hip revisions carried out with this bone impaction technique and a cemented stem (Exeter, Howmedica) were studied clinically (Harris Hip Score) and radiologically.

Translation movements along a longitudinal, a transversal and a sagittal axis were determined by RSA (stereometry). The follow-up period was 18 months at least.

Results: The Harris Hip Score improved from a preoperative mean of 38 to a postoperative mean of 77 points. Femoral defects were twice of type II, four times of type III and four times of type IV (Endo-Klinik classification). Micro-movements of the femoral hip stem (translation along longitudinal axis) stabilized in five femora types II and III, the other five femoral stems showed ongoing migration.

18 months after the operation the migration (longitudinal axis) varied from 0 to 7.0 mm (mean 2.05 mm).

Conclusion: The degree of preoperative femoral destruction in revision surgery influences the migrations of femoral stems cemented in allograft bone.

Zweymüller total hip prosthesis in osteoarthritis and rheumatoid arthritis—results after 8 (5–11) years

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Introduction and definition of the problem: It is not clear if the long-term results of uncemented total hip prostheses are as good as those of cemented prostheses. We made a retrospective study of our results with the Zweymüller (Allopro, Baar, Switzerland) uncemented total hip prosthesis in osteoarthritis (OA) as well as in rheumatoid arthritis (RA).

Method: Between 1986 and 1992, 262 Zweymüller hip prostheses were implanted in 227 patients. Diagnoses: OA 150 patients (172 hips), RA 66 (79 hips) and other diagnoses 11. Mean age at operation was 62 (19–91) years. 188 Patients have been followed up, in the outpatient department and radiologically in 1997 after an average of 8 (5–11) years. Of the 32 deceased patients and the seven who could not be traced, the available data were collected.

Results: The Harris Hip Score rose significantly from 34 (SD 16) before operation to 82 (18) at follow-up.

16 hips were revised (13 OA and 3 RA): 8 screw cups (3 with loosening due to unknown causes, 2 PE attrition and 3 dislocations because of malposition), 3 PE inserts (PE attrition), 1 PE insert with stem (PE attrition) and 4 total hip prostheses (2 PE attrition, 1 late infection and 1 posttraumatic infection).

After 8 years, the cumulative survival according to Kaplan-Meier with revision as the endpoint was 90% for OA (SD 3%) and 92% for RA (6%). Survival of only the stem was 98% (1%) in the two groups combined.

Conclusion: The Zweymüller femoral component is a reliable implant. The conical screw cup gives slightly less good results. This is in part to be attributed to attrition of PE.

Results of 754 Zweymüller uncemented total hip prostheses

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Since 1987, five hospitals have been implanting the uncemented total hip prosthesis designed by K. Zweymüller (Allopro, Switzerland). The results of this prosthesis were established in a retrospective study.

Patients and methods: From January 1987 to December 1994, 820 Zweymüller total hip prostheses were implanted in 732 patients. The Harris Hip Scores of 754 prostheses (670 patients) were established by investigators who had not been involved in the treatment. On the radiographs, line formation, osteolysis, cortical reaction, bone apposition and heterotopic bone formation were counted per Gruen zone. The findings were analysed statistically using the Student t test.

Results: The mean Harris Hip Score amounted to 91 (40–100), the mean age to 64 (23–93) years and the mean follow-up period to 6.0 (2.4–10.3) years. We saw line formation in zones I and VII in 12% of the radiographs. Bone apposition in zone IV was seen in 53%. Six revisions of a primary Zweymüller hip prosthesis were performed because of aseptic loosening. Reoperations were carried out in 23 patients.

Conclusion: The results of the Zweymüller uncemented total hip prosthesis in the medium-long term are relatively good, especially in young patients.

The 10–15 year results of 252 Lübeck uncemented hip prostheses

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Introduction and definition of the problem: A retrospective study was carried out to determine the long-term results (10–15 years) of the uncemented Lübeck total hip prostheses implanted in the St Antoniushove Hospital of Leidschendam. This is a coarsely structured prosthesis with pores 1–2 mm in diameter and 6 mm deep. A primary mechanical fixation is transformed into a permanent fixation by ingrowing bone tissue. The study was concerned with the questions what the long-term results are, subjectively and clinically, what the radiographic findings are, if a reoperation had taken place and if so, on what indication (failure or complication) and if the patients were satisfied with their situation at the moment of follow-up.

Patients and methods: Between 1983 and 1988, 252 uncemented total hip prostheses were implanted in 233 pa-

tients, varying in age at the time of operation from 33 to 84 years. They were implanted by two surgeons by the postero-lateral approach with the patient lying on the side. At follow-up the clinical and subjective results were determined: the Harris Hip Score and the patient satisfaction score.

At the radiographic follow-up, attention was paid to bone condition, calcar resorption, major change of the position of the prosthesis (scored with the aid of a number of standard lines on the pelvis radiographs) and ectopic calcifications, which were classified according to the Brooker grading system. 17% of the patients were found to have died and 10% did not respond at all.

Results: In the deceased patients, two reoperations are known, one of them because of persistent pain without roentgenological change of the position of the prosthesis. In the control group, 15 reoperations were carried out, 3 because of aseptic loosening of the prosthesis (cup) and 5 because of a late infection. In one case, a possibly allergic reaction to the metal of the prosthesis was observed. A minimal change of the position of the prosthesis and an increase of the osteoporosis in general appear to cause no lowering of the score.

Conclusion: The 10–15 years' results of the uncemented Lübeck hip prosthesis can be classified as good, and invite to further use and postoperative checks; more sharply defined preoperative criteria may conceivably improve the results still further.

Histology of HA-coated hip prostheses

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A number of studies have shown that hydroxyapatite (HA) coatings lead to rapid and reliable bone apposition without a fibrous intermediate layer. However, histological observations of HA-coated hip prostheses have been described only sporadically. The question arises how long the osseo-integration remains intact and if there is any reaction of tissue to HA debris.

Methods: Histology and histomorphometry were carried out and the tissue reaction to third body debris was examined in five patients who died between 3.3 and 6.1 years after implantation of a HA-coated hip prosthesis. The hip prosthesis with the surrounding bone was fixed in 10% neutral buffered formalin after which the samples were imbedded en bloc in PMMA resin. Sections of all Gruen zones were made using the EXACT microsectioning system. Qualitative histology with paragon staining and quantitative histomorphometry with measurements of the residual HA coating.

Results: In the proximal Gruen zones of all prostheses complete microscopical osseo-integration had occurred with highly variable percentages of bone density, bone-prosthesis contact and residual coating. Bone and coating parameters of the acetabulum and the femur of the same patient showed more similarity than those of different patients. In one pa-

tient there was marked wear of polyethylene with a reaction of fibrous inflammatory tissue, but only in Gruen zones 1a and 7a. No reaction to titanium particles. The microscopical osseo-integration extended into Gruen zones 2 and 6 and often into Gruen zones 3 and 5, indicating stable distal fixation even in locations where no HA coating is present. This agreed with the roentgenological observation of slow shift of stress-induced bone formation along the stem in the distal direction. No signs of remodelling.

Conclusion: Between 3.3 and 6.1 years after THA, complete microscopical integration of the prosthetic components with matured trabecular bone distributed over and in direct contact with the prosthesis without growth of fibrous tissue at the bone-implant interface. Of the various particles (HA, titanium and PE), only PE induced a pronounced inflammatory reaction. Hardly any HA debris was observed.

The uncemented hip with Proplast interface—disappointing results

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Objective: A retrospective follow-up study of the long-term results of the Proplast prosthesis.

Material and methods: From 1983 to 1985 an uncemented hip prosthesis with Proplast coating (Vitek, Houston, USA) was implanted in Groningen University Hospital in 25 patients with a mean age of 48 (21–62) years. 23 patients were followed up after an average of 13 years. All were evaluated clinically using the Harris Hip Score, while migration, scalloping and pedestal sign were assessed radiologically.

Results: 15 of the 23 patients (65%) had required a revision of the prosthesis because of pain and inadequate fixation of the prosthesis after an average of 7.5 (2.5–12) years. Five of the eight prostheses still in situ showed clinical and radiological signs of failure of fixation of the prosthesis.

In 6 of the 15 revised patients there are signs that the scalloping continues even after the revision operation. This might be a late effect of the use of the Proplast coating.

Conclusion: In view of the large number of failing prostheses and the possible effects on the cortical bone even after revision surgery, it is clear that hip prostheses with this coating should no longer be used.

Hydroapatite, the solution for an uncemented acetabular component?

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The results of the uncemented screw cup reported in the literature are disappointing. In the Westeinde Hospital, also, experiences with this type of prosthesis were less good than

initially expected. However, the literature contains no results of a screw cup combined with hydroxyapatite. In order to establish the effect of a hydroxyapatite coating with use of a screw cup, a prospective study was organized in which 272 HA-coated mec rings (Ti-A14, Mecron, Berlin, Germany) were implanted between June 1990 and May 1993.

Patients and methods: The Mecron screw cup consists of a titanium alloy with a polyethylene lining. The prosthesis was coated with a 50 micron layer of hydroxyapatite, with a crystallinity of 64%, using the plasma spray method.

272 prostheses were implanted in 233 patients, 76 men and 167 women with a mean age of 61 years. 31 patients were not included in the study because of incomplete data. 201 patients (241 prostheses) were enrolled in the study. In 85 patients, the uncemented cup was combined with an uncemented stem. The stem was cemented in 158 patients.

The patients were seen for follow-up after 3, 6 and 12 months and subsequently once a year. The Harris Hip Score was recorded and standardized radiographs were made. The radiographs were examined for demarcation and migration.

Ultimately, the results were compared with the uncoated group of which the results have been published earlier.

Results: 32 early complications were observed, varying from dislocation (2) to a bladder infection. In five cases, a superficial infection necessitated antibiotic treatment. In one of these patients, the prosthesis had ultimately to be removed because of a deep infection. In this patient, a new prosthesis was implanted one year later with good results.

demarcation

	12 months		24 months		36 months		48 months		60 months	
	C%	N%	C%	N%	C%	N%	C%	N%	C%	N%
0	99.5	33	98.8	29	100	26	98.2	22	95	12
1	0	31	0	15	0	9	0	8	0	11
2	0.5	25	1.2	32	0	26	0	21	0	18
3	0	10	0	19	0	29	1.8	35	5	53

C = coated

N = not coated

The results of the coated group are better than those of the uncoated group during the first few years. After 3 and 6 months, neither demarcation nor migration were observed. One year after operation there was still no demarcation in 99% of the coated group as against only 33% in the uncoated group. After 5 years, three patients (5%) of the coated group showed third-degree demarcation, as against 53% in the uncoated group. The proportion of failure of HA-coated acetabular components mentioned in the Orthopaedic Knowledge Update 1996 amounted to an average of 10% after 5 years.

The mean Harris Hip Score (HHS) increased from 53 before operation to 93 one year after operation. Four years after operation, the mean HHS was 96.

Conclusion: HA improves the early postoperative results of a screw cup. This group of patients will be subjected further to intensive follow-up for determination of the long-term results.

5–12 years' follow-up after cruciate ligament sparing, uncemented total knee arthroplasty using a mobile bearing KNIW system in a young population

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Between 1984 and 1992 in the Slotervaart Hospital 326 primary knee arthroplasties were carried out with a mobile bearing knee system (LCS, DePuy-Van Straten, Nieuwegein), with preservation of both cruciate ligaments (BCL) in 115 knees and of the posterior cruciate ligament (PCL) in 196 knees. Fifteen times preservation of the cruciate ligaments was impossible (RP). Mean age was 57 (19–70) years. Diagnosis: rheumatoid arthritis (RA) 235, osteoarthritis (OA) 85, other diagnoses 6.

The follow-up extended to the end of 1996. Fifty-nine patients (18%) had died, in 12 patients, the prosthesis was in situ but visits to the outpatient were no longer possible, and four patients were lost to follow-up.

The mean Knee Society Score increased from 38 before to 90 after operation.

Six infections occurred, three of them revised successfully and three leading to arthrodesis.

The patellar prostheses, femoral components and tibial components with central anchoring (PCL and RP) showed no aseptic loosening. The BCL tibial component with short fixation 13 times showed aseptic loosening due to osteoporosis and obesity in RA and after a head of tibia osteotomy (HTO) in OA. Dislocation of the meniscal bearing occurred 8 times (2.5%) in every case due to ligament instability. Fracture of the meniscal component occurred twice, after trauma.

It may be concluded that a knee arthroplasty aiming at preservation of the cruciate ligaments in a young population leads to good results. When mobile meniscus components are used, ligament instability must not be accepted. Total knee arthroplasty after HTO requires central fixation of the tibial component.

800 AGC knee prostheses—analysis of the necessity of reoperation after 5–10 years' follow-up

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Between 1985 and 1991, 800 AGC knee prostheses were implanted in 669 patients (656 women, 144 men, mean age 70 years) in five Dutch hospitals. The retrospective study comprised a clinical and roentgenological evaluation combined with a questionnaire. This study was concerned with analysing the survival and the need to reoperate after implantation of the total knee prosthesis, which is discussed in some detail.

Patients and methods: A reoperation after implantation of the knee prosthesis was performed 86 times. The question if there exists a demonstrable avoidable cause of need for reoperation was studied by examining all available radiographs and reading the available operation reports and medical files.

Results: 86 reoperations out of 800 knee prostheses is 10.8%, comprising:

- 14 primary infections
- 20 extra-articular or periarticular soft tissue problems, 3 of them with a demonstrable avoidable cause (instability twice and rupture of the patellar tendon once)
- 3 fractures
- 9 revisions of the tibial plateau, 6 of them due to among other things, varus/valgus position, instability and wear of polyethylene
- 2 revisions of the femoral component without demonstrable cause (both uncemented, however)
- 38 revisions of the patellar prosthesis, 13 of them without demonstrable cause, 7 due to incorrect placement of the patellar prosthesis and 18 with an abnormal valgus or flexion position of the femoral component.

Conclusion: 34 of the 86 reoperations had a demonstrable avoidable cause. Since this study was started at the introduction of the AGC knee prosthesis, it is to be expected that, due to better instrumentarium and more experience of the surgeons, the percentage of reoperations will decrease in future.

Fifteen years' survivorship of the SKI total knee prosthesis

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Introduction and definition of the problem: The department of Orthopedics of Groningen University Hospital carried out a retrospective survivorship analysis in a successive series of 345 primary SKI total knee prostheses (Waldemar Link GmbH, Hamburg).

The follow-up ranged from 5 to 15 years with a mean at-risk period of 94 months.

The tibial component of this prosthesis is modular and has a PE insert with screw fixation, changeable by rotation.

The study was concerned with clinical function, survivorship, percentage of revisions and prosthesis-related complications, as well as with the question whether the modular tibial component meets its requirements.

Method: Between 1982 and 1992, 345 primary SKI prostheses were implanted in 262 patients (69 men and 193 women). The indications were: RA in 59%, AD in 34% and PTA in 4%.

Four patients (5 knees) were lost to follow-up.

The remaining surviving patients (n=205 knees) were examined in the outpatient and roentgenological departments and scored according to the Clinical Dual Rating System (CDRS) criteria of the Knee Society.

Regarding the survivorship analysis, an enquiry was conducted among the GPs of all deceased patients.

The data were analysed using MRDM software (IMSOR Leiden).

Results and conclusions:

Pain abatement	preoperative/follow-up
Subjective according to the VAS (max. 10 points)	7.6/1.8
Objective according to the CDRS (max. 50 points)	12.2/39.8
Overall knee function CDRS (max. 100 points)	51/109
	(0–160) / (20–195)

Revision of a primary prosthesis was carried out 34 times: in five cases this meant an arthrodesis.

The complication of isolated loosening of the screw was seen 11 times; all these were cured secondarily. The largest number of revisions involved the 7 mm PE tibial component (27 times).

With a mean duration of implantation of 117 months, the SKI prosthesis gives a significant abatement of pain and improvement of knee function.

Survival analysis with as its end point revision of one or more components of the prosthesis (with the exclusion of securing) shows that after 10 and after 15 years the probabilities are 91.2% and 82.0% that the primary prosthesis is in situ (95% confidence interval: 88–95% and 75–90%, respectively).

Hydroxyapatite reduces tibial plateau migration in knee prostheses

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Calcium phosphate coatings (e.g. hydroxyapatite, HA) are used frequently to improve the fixation of uncemented prostheses. Good medium-term results have been reported for the hip prosthesis, but cement is still the standard fixation technique.

Short-term migratory movements have a predictive value regarding loosening in the long run.

Material and methods: A prospective randomized trial in 30 patients was carried out to determine the influence of type of prosthesis fixation (i.e. cemented, uncemented without coating and uncemented with hydroxyapatite coating) on migration of the tibial component of knee prostheses (cruciate ligament-sparing type, Interax, Howmedica). Clinical and radiological scoring (Knee Society) and RSA (radiostereometry) measurements were carried out at six follow-up times during two years. Analysis of micromovements was done by means of ANOVA tests.

Results: The three groups did not differ as regards clinical score and radiolucency round the prosthesis.

Conclusion: The use of uncemented, non-HA coated Interax knee prostheses should be discontinued.

Patellofemoral arthroplasty—a study of 108 prostheses with a mean follow-up of 8 years

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A retrospective evaluation was made of 108 successive patellofemoral arthroplasties (PFA) in 92 patients in the period 1977 to 1995. Knees were scored according to the system of the American Knee Society (max. 200 points) and radiological assessment was done.

Mean age at operation was 50.7 (23–80) years. Mean follow-up (FU) amounted to 95 (24–238) months. The male:female ratio was 1:14. In the course of the follow-up period, nine patients were excluded from the study.

Results: Four complete and two partial PF revisions, two patellectomies and six TKAs (6%) were performed. One case of loosening of the patellar component was seen.

Patient satisfaction was matched against the Knee Score (KSC). This resulted in 82% good to excellent results.

Conclusion: We conclude that PFA is a good option for radiologically documented unicompartmental patellofemoral arthrosis.

Revisions of total knee prostheses with large bone homografts in aseptic and septic loosening

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Between 1987 and 1997, 118 knee revisions were carried out. In 76 cases (63 of aseptic and 13 of septic loosening) there was considerable loss of bone on the tibial and/or femoral side. The technique and the experiences with reconstruction in this group of patients will be discussed.

For the reconstruction of the bone defects (contained and uncontained) use was made of bone chips, ground bone and, in some cases, larger bone fragments from our own bone bank (femoral heads, 1 to 5 per case).

A long tuberosity osteotomy was necessary in 65% of the cases to achieve a good view and access.

Primary stability is essential for a good result.

A very complete modular prosthesis system is required, with the possibilities of lengthened stems, a posterior stabilized prosthesis and a (semi)constraint prosthesis.

On the femoral side, at least one intact condyle is required to obtain primary stability: on the tibial side, at least 65% cortical support on all sides is necessary. The lengthened stems in femur and tibia are inserted pressfit in firmly impacted ground bone. Bone cement is used only at the distal femoral part and beneath the tibial plateau. In ten cases (13%), wound healing was retarded without further problems; in one case, reoperation was carried out because of a reinfection; in one patient, an exarticulation had to be performed because of wound necrosis. In all other cases there

was primary wound healing with fine fusion of the bone grafts. The Knee Score of the first 32 cases (4.3 years follow-up) increased from 36 to 84.

Conclusion: In experienced hands revision of a knee prosthesis is nearly always possible when use is made of bone homografts, even when there are very extensive defects. Arthrodesis has only to be considered in major soft tissue problems, an insufficient extensor mechanism or very virulent infection.

Arthrodesis of the knee with the Ilizarov ring fixation system after removal of an infected knee prosthesis

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Introduction and definition of the question: Infection of a total knee arthroplasty (TKA) has an incidence between 0.5 and 16%. If the TKA cannot be preserved or revised, arthrodesis (AD) is the best alternative. AD for infected TKA results in 29–94% in consolidation, according to a literature review. The success of the AD depends on the bone loss, on the shape of the bone surfaces and on the fixation stability. In case of major bone loss, bone fixation is a major problem. An intramedullary locking pin is a good option, but it cannot be used in active infection nor does it offer the possibility of continuous compression. We opted for the Ilizarov ring fixation system, because transfixation pins inserted crosswise fix bone very well, but particularly also because of the good stability and possibility of axial compression.

Methods: Ten women and 11 men (with an average age of 75 (55–90) years) were treated. Reimplantation was impossible in all patients because of persistent infection and/or major bone loss. There were eight primary and three secondary ADs. After removal of the prosthesis and debridement, the Ilizarov frame was applied in one stage in five patients, while in the other six patients the TKA had been removed previously. During the early phase, the AD surface was compressed again at every visit to the outpatient clinic (2–3 weeks' interval) by tightening the fixation system a few millimeters, until the space between the bone surfaces in the X-rays began to fade. After the operation, antibiotics were administered for at least 6 weeks.

Results and conclusion: All ADs (100%) consolidated after an average of 47 (26–78) weeks. There were 17 complications in all, four delayed unions (>1 year), one femoral fracture, two fixation problems, five pin track infections, five patient-related complications such as pneumonia and urinary tract infections.

Compared with the literature, the AD result in this group of patients is remarkably good, particularly in view of the frequently major bone loss. This good result is attributed to the stability of the fixation system and continuous compression of the bone surfaces.

The Caffinière prosthesis for CMC-1 arthrosis—results, loosening and indications

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A total of 78 Caffinière prostheses were implanted between 1981 and 1996; of these, 61 were available for follow-up study of the results and causes of loosening, to establish the indications.

Method: The clinical result was determined using a 40-points scoring system for pain, function, strength and mobility. Satisfaction was scored on a visual analog scale. Radiographs were examined for degree of arthrosis, postoperative position of the prosthesis and lengthening; follow-up radiographs for loosening. Sex, age at operation, adduction deformity and lengthening were analysed as possible loosening factors.

Results and conclusions: The mean follow-up was 8.3 (1.2-16.0) years. Eleven thumbs had been revised, five times with arthrodesis or resection.

The mean total score amounted to 32.0 for the primary prostheses, 31.2 for revision prostheses and 24.0 for arthrodeses/ resections. Good results (30 points or higher) were achieved in 67%. Eighty-five per cent of all patients were satisfied (seven or higher).

No significant differences were found for degree of arthrosis, adduction deformity or loose or firmly anchored prostheses.

In 27 hands (44%), aseptic loosening of 24 cups and 15 stems occurred, significantly more often in men and in women who had been younger at the time of operation.

We conclude that the proportion of loosening was large, but that the clinical result scores were fair to good. The prosthesis is indicated only for women over 60 years of age.

Treatment of severe rheumatoid arthritis of the wrist using the Guepar total wrist prosthesis

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Material: We examined 44 patients with rheumatoid arthritis in whom 58 Guepar total wrist prostheses had been implanted. The prostheses were implanted between 1991 and 1997, with a mean follow-up of 45 (6-82) months. In five patients, a revision of a Swan prosthesis was performed with the aid of a Guepar wrist prosthesis using bone allografting.

Results: Before operation, all patients had much pain and loss of strength in the affected wrist. The mean mobility was 43°. Eighty per cent of the patients after the operation were satisfied with the abatement of the pain and with the function.

Complications: A superficial infection occurred postoperatively in two patients.

In two patients, it was necessary to perform a rotation osteotomy of MC II and MC III (?). Revision of the prosthesis was done four times: one septic loosening, two aseptic loosening and one dislocation of the prosthesis.

In one case, an arthrodesis of the wrist was created secondarily, after an aseptic loosening. Two patients after operation complained of pain at the distal ulna.

A release was carried out in two patients because of a malposition developed postoperatively.

Conclusion: The results of the Guepar prosthesis in patients with severe rheumatoid arthritis of the wrist are satisfactory. The postoperative function is acceptable and adequate for everyday use, mostly due to the elimination of the pain. The Guepar wrist prosthesis may be regarded as a good alternative to arthrodesis, particularly if both wrists are affected.

The results of the operation can be improved by use of titanium screws and by a technical solution for the unstable distal ulna.

Results of the cemented Kudo elbow prosthesis

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The main indications for a total elbow replacement are crippling reduction of function and severe pain due to destructive lesions in rheumatoid arthritis. The short-term results of the Kudo elbow prosthesis were assessed.

Method: 22 patients with 24 cemented Kudo elbow prostheses were examined. The mean age was 51.6 years. The median follow-up was 2.9 (0.7-4.7) years. The Hospital for Special Surgery (HSS) Score was determined before operations and at follow-up.

Results: The radiographic classification according to Larsen at preoperative examination was grade III in one patient, grade IV in ten and grade V in 13 patients. The HSS score was 47.

Early postoperative complications were a fracture of the medial epicondyle in one, dislocation of the prosthesis in one, ulnar nerve dysfunction with incomplete recovery in two, partial loss of function of the radial nerve in one and a superficial wound infection in one patient. One patient died after a myocardial infarction.

Four prostheses (17%) were revised because of infection, a broken stem of the humeral component of the prosthesis, recurrent dislocations and aseptic loosening, respectively.

Radiographs at follow-up revealed signs of aseptic loosening in two other patients.

The HSS Score at follow-up amounted to 78 points.

Conclusion: 79% of the patients were highly satisfied with the results of the operation, in spite of the large number of complications.

New views on the shoulder prosthesis

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The results of a replacement arthroplasty of the shoulder are determined not only by the placement and design of the prosthesis but also by the additional surgery such as release of the contractures, repair of the ruptured cuff and genigen correction of the glenoid cavity. The question which prompted the study was whether on the basis of new biomechanical insights into the shoulder a new shoulder prosthesis could be designed with accurate restoration of the preoperative mechanical situation. Also, a new surgical approach of the shoulder joint was elaborated by means of cadaver studies, with a view to adequate performance of the additional surgery.

Method: A new design for the prosthesis was formulated and it was subsequently tested in cadaver studies. Also, in the anatomical laboratory, a new approach was elaborated in a cadaver study.

Results: A newly designed prosthesis has by now been implanted in a group of 25 patients.

The posterosuperior approach that had been developed was used in 90 shoulders.

The Kudo total elbow prosthesis, complications at one to five years' follow-up of uncemented implantation

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Patients and method: An uncemented Kudo total elbow prosthesis (non-constrained surface replacement prosthesis, Biomet Swindon, UK) was implanted between 1991 and 1996 in 51 patients (38 women and 13 men). Diagnoses: rheumatoid arthritis 48, post-traumatic arthrosis 3. The mean follow-up amounted to 3.5 years. Three patients were lost to follow-up. All operations were performed by the same surgeon, via the posterior approach. The ulnar nerve was not visualized.

Results: Pain score, mobility score and ADL score all improved significantly after various periods of follow-up.

Postoperative complications:

- ulna-humeral dislocation (1)
- superficial wound infection (3)
- revisions (7): loosening ulnar component (5), all with the (standard) short stem of the ulnar uncemented component, fracture of the humeral component at the stem-barrel junction (2)
- postoperative ulnar nerve neuropathy (10).

After this relatively large proportion of ulnar loosening was established, use was made since early 1996 of a longer ulnar stem with uncemented implantation.

Conclusion: Use of the uncemented KUDO total elbow prosthesis gives results similar to those reported in the literature, during the limited follow-up. Possibly, visualization of the ulnar nerve may lead to fewer postoperative neuropathies.

The incidence of loosening of the ulnar component requires improvement. This may possibly be achieved by cementing the (standard) short ulnar component or use a longer stem with uncemented implantation.

Radiolucency and aseptic loosening of the Souter-Strathclyde total elbow prosthesis

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In case of major cartilaginous damage of the elbow joint, a replacement joint may be implanted. Aseptic loosening of the elbow prosthesis is reported relatively often (3–30%).

The present study was concerned with a number of prosthesis-related, patient-related and surgeon-related factors of aseptic loosening of the Souter-Strathclyde total elbow prosthesis.

Method: The results were evaluated of all elbow prostheses primarily implanted in 115 RA patients (120 elbows) between 1992 and 1996.

All standard radiographs were examined systematically for positioning of the prosthesis, quality of cementing, presence of lytic lesions and heterotopic ossification. The presence of radiolucent lines was graded using the Souter score list (1990).

Results and conclusion: After follow-up periods of 2 to 14 years, aseptic loosening was observed in 16 elbows. Nine patients had needed a revision operation within 5 years, five prostheses had to be revised after 5 to 10 years, and two after a period of more than 10 years postoperatively.

Immediately after the operation, some degree of radiolucency was observed at 57% of the humeral components and at 47% of the ulnar components. After one year, these proportions were 64% and 78%, respectively. No statistically significant differences in radiolucency were found in connection with handedness, sex, age and duration of standing of the RA. Loosening was more often observed of type small components than of type medium or large components.

The elbow prosthesis in rheumatoid arthritis

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The elbow joint, also, can be affected so severely by rheumatoid arthritis that arthroplasty of the elbow in the sense of a prosthesis is the only remaining useful treatment; it may

lead to reliable abatement of pain and improvement of function.

Method: From 1985, an elbow prosthesis of the Souter type was implanted bloodlessly 40 times in 32 patients via a posterior approach.

Results: Six complications were seen: twice a fracture of the distal humerus, once a fracture of the olecranon, twice ulnar nerve damage and once, recurrent dislocation of the prosthesis. No infections were seen. All complications could be cured or healed. After an average follow-up of 6 years, the mean increase of flexion/extension was 25° and that of rotation 42°. The pain score also showed significant improvement. Radiological loosening (continuous radiolucent margin of more than 2 mm and/or migration) of the humeral component was seen seven times (4 men and 3 women, 17.5%). There was no loosening of ulnar components. Two patients wanted revision which was performed with a HA coated humeral component. Both patients displayed good apposition of bone to the prosthesis without signs of recurrence of loosening after 2 and 3 years, respectively.

Conclusion: The Souter elbow prosthesis is highly satisfactory in patients with rheumatoid arthritis in that it gives substantial abatement of pain and fair improvement of function. Implantation of a HA coated primary humeral component if indicated is to be recommended.

Isoelastic hemiarthroplasty of the shoulder. Results in 66 patients with 5–11 years' follow-up

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Hemiarthroplasty of the shoulder has proved to be a good solution in pain and loss of function due to various causes.

The purpose of this study was to compare the results of the uncemented isoelastic hemiarthroplasty with those reported in the literature.

Patients and methods: 66 hemiprostheses of the isoelastic type were implanted in our hospital in 64 patients during the period October 1985 to March 1993. The data of three of these patients (4 prostheses) were lost.

The indications for operations were: rheumatoid arthritis (32), primary arthrosis (16), posttraumatic arthrosis (12) and other indications (2). The male:female ratio was 17:45 and the mean age 63 (35–85) years.

A retrospective study was made of the data and the patients were invited for follow-up examination. The shoulders were evaluated by means of the Constant-Murley Score and the Dutch Simple Shoulder Test. In addition, mobility ranges were recorded in degrees.

Results: The mean follow-up was 5.5 (3–10) years. Complications occurred in 10% of the patients. As was to be expected, the pain was clearly diminished after the operation (Vahvanen 1989). In addition, the strength, ROM and ADL improved. All ranges of movement except the exorotation showed significant improvement.

No postoperative differences could be demonstrated between the function in the RA patients on the one hand and those with osteoarthritis and other indications on the other.

Loosening occurred in one patient and dislocation of the prostheses twice.

Discussion: Use of an uncemented isoelastic hemiarthroplasty gives good long-term results. In our study, no significant differences between the various indication groups could be demonstrated.

Results of a prospective study comparing the newly developed resorbable cement stop with the Thackray polyethylene cement stop

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A retrospective study in our clinic proved that with the Thackray® polyethylene cement stop (PE) (DePuy Leeds, UK), in use in our clinic for many years, a large proportion of complications occurred (45%). For instance, at 15% of the revision operations a femoral window had to be made to enable us to remove the cement stop, while in 25% of the patients we found loose wings of the PE stop in the cement beneath and round the stem of the prosthesis. This prompted us to develop a new resorbable cement stop, made of a flexible co-polymer of polyethylene glycol terephthalate and polybutylene terephthalate (Polyactive 70/30). The biological and cement-retaining properties of this so-called Shuttle Stop (CAM implants, Leiden, the Netherlands) were tested extensively in vitro and in a feasibility study in humans and were highly favorable. This study describes the results of a prospective comparative study between the Shuttle Stop and the Thackray stop.

Material and method: From 1 August 1994 to 1 January 1996, 104 patients were enrolled in this study after informed consent. The patients had severe osteoarthritis of the hip joint, a hip fracture or an indication for a revision operation, and received a cemented hip prosthesis. The cement used was the medium/high viscosity gentamicin Palacos cement (Genta-Palacos®, Merck, Darmstadt, Germany) which was introduced at maximal pressure with a cement squirt. Depth of placement of the stop was noted, as were all other relevant details concerning the hip implantation. Postoperatively, the localization of the cement stop was measured in the radiograph in order to detect shift if any, and the radiograph was examined for leakage of cement past the stop. All patients were assessed with the Hospital for Special Surgery Hip Score one year after the operation.

Results: The measurements proved that there were no differences between the two cement stops with regard to frequency and degree of shift of the stop caused by the introduction of the cement under pressure. Shift occurred in 25% of the stops and was always less than 2 cm. A significant difference was found in the frequency and degree of leakag-

es along the cement stops in favor of the Shuttle stop. Moderate to severe cement leakage occurred with 53.5% of the Thackray cement stops and with 13% of the Shuttle stops. Even after longer follow-up (up to 4 years), no local changes of the position of the cement stops were seen, nor could any difference in hip score between the two groups be demonstrated. Consequently, we conclude that the bioresorbable Shuttle stop gives reliable occlusion of the femoral canal, while complications during the removal at revision surgery can be avoided.

Digital measurements of migration of THA on pelvic radiographs—a problem in practice

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Measurement of migration of hip prostheses on successive radiographs is impaired by numerous factors:

- measurement; inter- and intraobserver variation,
- technique; sensitivity to rotation, magnification factor,
- alteration of pelvic anatomy; acetabuloplasties.

Method: An acetabular cup was implanted and migrated in a human cadaver pelvis. AP radiographs were made from different angles. Various known measuring methods were compared using RSA. A new (Radboud) method for vertical migration was developed. From lines situated far from the acetabulum a composite line was calculated. Vertical migration of the cup was measured in relation to this line. Horizontal migration was calculated with the aid of the 'adjusted' Kohler line. All measurements were reduced to migration within an orthogonal axis system and consequently were comparable with RSA.

Results: The borderline between pseudomigration and real migration varies between 0.4 and 4.2 mm. With the aid of the Radboud method it is possible, within 10° of rotation in four directions, to demonstrate migration as soon as it is larger than 2.9 mm in the vertical and 1.2 mm in the horizontal direction. Accordingly, unlike other methods, this method can be used even in daily practice with this degree of accuracy.

Conclusion: Currently, accurate measurement of migration of hip prostheses on successive radiographs is not feasible in everyday practice, because the methods yield much pseudomigration since the markers are not consistent. The Radboud method is a reasonable alternative.

Influence of two different approaches on the gait after total hip arthroplasty

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The occurrence of a Trendelenburg symptom and Duchenne gait after a direct-lateral or a posterolateral approach were investigated in a prospective study.

Material and method: 21 hip prostheses were implanted by a direct-lateral approach and 18 hip prostheses via a posterolateral approach. All operations were performed by the same surgeon.

After an average of 19 (4–32) months, an independent investigator examined the patients for a Trendelenburg symptom, Duchenne gait and postoperative dislocation. In addition, the patient was asked for his opinion on the gait. Statistical analysis was done using the Fischer Exact Test.

Results: In 11 of the 21 patients subjected to the direct-lateral approach (52%), a Trendelenburg symptom was present as against two of the 18 (11%) patients for whom the posterolateral approach was used. This difference is highly significant ($p < 0.01$).

An evident Duchenne gait was seen in ten patients (48%) of the direct-lateral approach group and in two (11%) patients of the posterolateral approach group ($p < 0.05$).

After a direct-lateral approach, 15 patients (76%) considered that they walked with a limp, as against six patients (33%) after a posterolateral approach ($p < 0.05$).

Dislocation of the prosthesis occurred in one patient of both groups.

Conclusion: The direct-lateral approach to the hip joint leads to a significantly worse gait than the posterolateral approach.

Translation and validation of the 12-item questionnaire on the perceptions of patients about total hip replacement

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The University Hospitals of Maastricht and Utrecht and the Rijnland Hospital started in 1996 with the translation and validation of the English patient outcome 12-item questionnaire (University of Oxford and the Nuffield Orthopaedic Centre, Oxford, UK). This questionnaire was devised specifically for patients subjected to a total hip operation. Since in the literature other factors can be found that might influence the wellbeing of the hip patient, six further questions were added to the Dutch version. We called the Dutch translation the Oxford Heup Score (Oxford Hip Score).

Method: The method comprises the translation procedure and the testing of the translation for reliability, validity and sensitivity. The questionnaire was completed by 150 hip patients before operation and 7 weeks and 3, 6 and 12 months postoperatively. Reliability was tested by means of the test-retest method, the internal consistency by means of Cronbach's alpha, the concept validity by determining the correlation between the Oxford Hip Score and the RAND-36 and

the sensitivity by comparing the preoperative with the postoperative Oxford Hip Scores.

Results: The interim analysis shows that the Oxford Hip Score is a reliable, valid and sensitive instrument to measure the state of health as experienced by the hip patient him/herself. The addition to the value of the added questions is still being studied.

Digital subtraction arthrography in the preoperative evaluation for total hip prosthesis

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The objective of this clinical study was to determine the diagnostic value of blank radiographs, digital subtraction arthrography and bone scintigraphy in patients with an infected or loose hip prosthesis.

Material and methods: The digital subtraction arthrograms, scintigrams and blank radiographs of 70 successive patients subjected to a revision of a hip arthroplasty were examined individually and blindly for presence or absence of loosening of the femoral or acetabular component.

The findings at operation served as the gold standard.

Results: Digital subtraction arthrography was the best ($p < 0.001$) predictor of loosening of the femoral or acetabular component.

Conclusion: Digital subtraction arthrography gave the best results in predicting loosening of acetabular or femoral components of hip prostheses.