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## Digital subtraction arthrography after total hip replacement

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The most common late complication after total hip replacement is aseptic loosening (2.6-8 percent of patients after a mean interval of 7½ years). Loosening of a prosthesis has to be demonstrated with the greatest possible certainty because the consequence is a revision operation: major surgery often performed at an advanced age.

The diagnosis "loosening" based on clinical and laboratory findings, scintigraphy and conventional radiography is not sufficiently conclusive for revision of the prosthesis. Moreover, these techniques cannot differentiate between mechanical and infectious loosening. In this respect digital subtraction arthrography provides valuable additional information.

In 24 patients with complaints of pain and clinically suspected loosening of the prosthesis, a digital subtraction arthrogram was obtained without difficulty via lateral puncture. No postinjection complications developed. The results of conventional diagnostic radiography and digital subtraction arthrography were compared with the findings at revision operation. The overall accuracy of the conventional radiographs was 58 percent (sensitivity 46 percent, specificity 100 percent), and that of digital subtraction arthrography was 93 percent (sensitivity 92 percent, specificity 100 percent).

Loosening of the prosthesis was demonstrated significantly better by digital subtraction arthrography. Infectious loosening was demonstrated in two patients by a positive culture of the aspirated synovial fluid. In addition, digital subtraction arthrography revealed the presence of fistulae, extracapsular bursae and fractures of cement, bone and prosthesis.

We conclude that digital subtraction arthrography is a valuable aid in the diagnosis of complications after total hip replacement. Loosening can be demonstrated with great certainty, and differentiation between mechanical and infectious loosening is possible. Valuable additional anatomical information can also be obtained.

## Results of Bombelli and Pauwels osteotomies in coxarthrosis

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Pauwels osteotomies were performed on 76 hips between 1967 and 1977. A follow-up study of this group (age 49 (25-73) years; follow-up 10 (6-14) years) revealed hip dysplasia in 57 cases. The Merle d'Aubigné protocol was used in the follow-up. Pain, mobility and walking pattern were classified. It was found that more than 50 percent of the patients in this group still showed a positive effect of the operation after 10 years.

The second group comprised 54 two-plane hip osteotomies according to Bombelli, performed between January 1980 and December 1982. The patients age was 50 (22-62) years. Hip dysplasia was diagnosed in 27 cases. The mean follow-up was 4 years. The criteria applied were the same as those in the Pauwels group.

The results in the Bombelli group 3 years after the operation were slightly better than those in the Pauwels group (although strictly speaking these groups should not be compared, each having its own range of indications). Pre- and postoperative mobility and walking pattern showed no distinct changes.

The conclusion is that intertrochanteric hip osteotomy may be contemplated in coxarthrosis even in patients over 60 years old; 10-year results can be

expected to be satisfactory (good in more than 50 percent).

### Three-dimensional visualization of the cartilage of the femoral head in preoperative planning for hip osteotomy in arthrosis and osteonecrosis

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The structure most essential to hip-joint function – the joint cartilage – is not visible on conventional radiographs. By exerting traction during radiography a vacuum arthrogram is obtained in which the configuration and thickness of the layer of cartilage are visible in the projection plane of the femoral head. By repeating this examination in cranio-caudal and caudo-cranial projections a three-dimensional image of the cartilage of the femoral head can be obtained. This simple, non-invasive technique can contribute to preoperative planning for hip osteotomy in arthrosis and osteonecrosis. Moreover, these techniques can be of value in determining indications whenever the efficacy of an intertrochanteric osteotomy seems doubtful.

### Results of intertrochanteric osteotomy in coxarthrosis

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During the period 1974–1981, 197 intertrochanteric osteotomies were performed on 164 patients with coxarthrosis in two hospitals in Amsterdam. Indications for the operation were age and expected improvement in mechanics of the affected joint. A retrospective study was performed of 51 men and 113 women (mean age 47 years) in whom the operation had been performed according to the AO technique. The aetiology of the coxarthrosis and the perioperative complications were in accordance with data from the literature.

The follow-up was based on the Harris Hip Score (HHS) and the Harris and Miegel Suitability Score (SC) and concerned a total of 169 operations on 141 patients, of whom 38 required total hip replacement after an average of 4 years and 3 months (1 year and 2 months to 9 years and 11 months), while three required arthrodesis after an average of 1 year and 7 months (1 year and 2 months to 3 years and 5 months). The age at operation in this group had been

54 (19–68) years. The pre- and postoperative HHS was 49 and 81 respectively, while the SC averaged 7 (3–10) years. The remaining 128 intertrochanteric osteotomies were still functional after an average of 7 years and 2 months (4 years and 6 months to 10 years and 10 months). The mean age in this group was 44 (13–73) years. The pre- and postoperative HHS was 61 and 70 respectively, the SC averaging 8 (1–12). In 69 percent of cases the postoperative HHS equalled or exceeded the preoperative HHS. In those cases the subjective results were reported as better than before the operation or unchanged in 80 percent. This was 67 percent in the patients whose postoperative HHS was less (31%) than the preoperative value.

The conclusion is that intertrochanteric osteotomy is a fair-to-good alternative to total hip replacement or arthrodesis in “younger” patients with coxarthrosis.

### Early diagnosis of avascular necrosis of the femoral head

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Early diagnosis of avascular necrosis of the femoral head is important because the prognosis largely depends on early adequate therapy.

Despite the multitude of causal factors there is uniformity in symptoms, localization and prognosis. Focal circulatory disorders probably play a major role in the pathogenesis.

A bone scan is an indispensable aid in diagnosis: it reveals lesions 6–9 months before they are visible on radiographs. Given clinical suspicion and a positive bone scan, intra-osseous pressure is measured and phlebography performed. Disturbances in intra-osseous pressure, pressure tolerance tests and intra-osseous phlebogram were considered an indication for forage with a hollow 10 mm mill, with which a specimen for pathological examination is also obtained.

These intra-osseous studies have been performed in 30 cases since 1981; 20 forages have been performed. The follow-up on these cases is still too short to warrant conclusions. In a series with a follow-up of 8 years, Professor P. Ficat reports good clinical and radiographic results in 90 percent of the cases.

## Osteotomy for avascular necrosis of the femoral head

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The changes found in the femoral head following avascular necrosis often appear to be so severe that total hip replacement seems the only choice, particularly because the results of osteotomies have been disappointing. However, osteotomies for femoral head necroses used to be only varus or valgus. With other types of osteotomy considerably better results may be expected.

Success rates of up to 80 percent have been reported for flexion osteotomy as described by Merle d'Aubigné and even better results have been reported after the rotation osteotomy according to Sugioka.

Preoperative examination of the femoral head is important; cranio-caudal and caudo-cranial roentgenograms (according to Schneider) enable exact measurement of the size of the necrotic area and give a good impression of the quality of the femoral head.

Thirty flexion or rotation osteotomies, performed at the Slotervaart Hospital or at the St. Maarten Hospital in Ubbergen, were studied after 1-4 years. Despite severe destruction of the femoral head very good hip-joint function was achieved and no subsequent degeneration of the femoral head was found. So far, none of the patients thus treated has required total hip replacement.

## Excochleation and a pedicled anterolateral bone graft in the treatment of early forms of non-traumatic necrosis of the femoral head

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The process of idiopathic necrosis of the femoral head is confined to the anterolateral segment of the head and can be divided into four stages; stages I and II are characterized by an intact cartilage lining and good joint congruence. These cases are eligible for conservative or head-conserving surgical treatment.

A new technique is described: the osteonecrotic focus in the femoral head is excochleated to a level immediately beneath the intact cartilage via an opening in the ventral aspect of the femoral neck; a bone graft is then taken from the iliac crest but left pedicled to a 2 cm wide strip of the anterior edge of the gluteus medius and gluteus minimus muscles. The

efferent vessels toward this pedicle and the insertion on the greater trochanter are left intact. The pedicled bone graft is fixed firmly in the defect in the femoral head. Two young patients with three affected hip joints have been treated with this method and followed-up for a minimum of six years. During that time the necrosis stopped and new bone formation thus occurred preserving all three affected hip joints.

## Chiari's pelvic osteotomy

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Since 1969 we have performed Chiari's pelvic osteotomy in 47 patients aged 18 years and over; in seven patients the operation was performed bilaterally, giving a total of 54 hips thus treated. After the operation a one and a half plaster hip spica was applied for six weeks, followed by ambulation. In a few cases fixation of the osteotomy with an AO screw or Steinmann pin was required.

The patients ranged in age from 18 to 58 years; the follow-up ranged from 1.5 to 14.5 years.

The results of the operation, if performed for the right indication and without technical imperfections, were good to very good. In five cases a secondary arthrodesis was necessary because the osteotomy passed through the joint (4 cases) or because of an infection (1 case). Because of unchanged or increasing symptoms of coxarthrosis, total hip replacement was performed in two cases (7 years and 1 year after the osteotomy). Failures were due to: 1) faulty indication; 2) technical flaws; 3) infection.

## Results after triple osteotomy of the pelvis according to Tönnis

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Between 1980 and April 1985 a triple osteotomy according to Tönnis was performed on 22 hips of 15 patients ranging in age from 15 to 45 years, all with symptoms of acetabular dysplasia. In all cases the preoperative symptoms disappeared and adequate hip mobility was ensured. The follow-up averaged 31 months.

The Tönnis technique calls for detachment of the acetabulum from its three pillars using a pelvic approach. It differs from other techniques in that the ischium is left intact so that no sitting problems develop. Good cover of the femoral head is achieved, es-

pecially in axial, posterior and anterior directions. This operation can only be performed if mobility in the hip-joint is still adequate.

In adults with untreated congenital hip dysplasia, triple osteotomy according to Tönnis ensures good cover of the femoral head. In all our patients the symptoms disappeared after this operation.

### Long-term results of the shelf operation in 56 patients with early coxarthrosis

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During the period 1945–1959, 128 patients with hip dysplasia and/or dislocation or subluxation of the hip with arthrosis were treated by unilateral or bilateral shelf operations if the mobility of the hip was still reasonable. H. S. M. Raat reported on 116 of these patients in his thesis (1961). It seemed of importance to study the long-term results, arbitrarily choosing a minimum follow-up of 16 years. Of the 116 patients originally treated 56 were available for this study. The remaining 72 failed to report for a follow-up within 16 years of the operation.

The patients included in the study were 55 females and 1 male. The series included 74 shelf operations, combined with a corrective intertrochanteric osteotomy in 3 cases. In 14 cases total hip replacement had subsequently been performed; the minimum interval between shelf operation and total hip replacement was 17 years, the maximum follow-up 35 years. Arthrodesis was performed in 5 cases.

The follow-up revealed good long-term subjective improvement in combination with clinically improved function and radiographically demonstrable widening of the intra-articular space. The findings show that, given the correct indication, the shelf operation ensures good long-term results in patients with painful early coxarthrosis.

### Autologous chip graft in the treatment of acetabular dysplasia after total hip replacement

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After total hip replacement for dysplastic coxarthrosis the osseous cover of the cup is usually insufficient. In some cases a large anterolateral exostosis develops, but usually a bone graft is required to ensure containment. Such an autologous graft shelf operation was performed in 45 cases.

The location of the graft is determined through the unroofed part of the fitting instrument. The acetabular rim is freshened and the bone pegs are fixed with traction screws, while ground-up cancellous bone is interposed. Medialization is also effected if the cavity is extremely shallow. In patients with painful high dislocation the original cavity is exposed by a trochanteric osteotomy or proximal femoral re-lease. Medialization combined with an extensive graft is usually sufficient but in some cases an Eichler ring may be needed for stabilization. Only rarely is the dysplasia so extreme that an additional pelvic osteotomy is required.

Follow-ups were performed 3 months after the operation and thereafter once a year. Three patients have died. The mean follow-up is now about 8 years.

All grafts were consolidated after 3 months. The hip score was comparable with that after routine total hip replacement. Periarticular calcifications were not more frequent than otherwise. No cup has so far shown signs of loosening. The follow-up will be continued but at this time it already seems clear that in dysplastic coxarthrosis an autologous bone graft combined with adequate cementing gives excellent fixation and guarantees a long life-span. Should the cup show loosening, an exchange is easy because the bone stock is larger.

### Total hip replacement according to Charnley-Müller. Follow-up over 15 years

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Between 1967 and 1972, 512 total hip replacements (Charnley-Müller) were performed on 457 patients. Follow-ups on this series were performed in 1972, 1977, 1981 and 1985, the results being evaluated on the basis of the Merle d'Aubigné protocol. The number of patients available for follow-up was 454 in 1972, 375 in 1977, 294 in 1981 and 138 in 1985. The follow-up was 15 (13–18) years.

Excellent and very good results were recorded in 92 percent of cases in 1972, in 76 percent in 1977, in 60 percent in 1981 and in 50 percent in 1985.

At completion of the study in the autumn of 1985, 84 patients (61 percent) with a total of 88 prostheses were walking with the original prosthesis, while 54 patients (39 percent) had undergone a revision operation.

Of the original 88 prostheses, 56 (64 percent) had been implanted in primary and 32 (36 percent) in secondary total hip replacements.

The ratio between primary and secondary hip replacements was 1.49 in the total series (in 1972),

1.75 in the group of still functioning original prostheses, and 0.80 in the group of already revised prostheses.

No significant influence of sex and age on the final result was demonstrable.

### Stanmore total hip replacement. A follow-up over 9–10 years

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Between 1975 and 1977, 195 total hip replacements were performed. The series included 135 patients with 146 hips not previously operated on: 110 women and 25 men with a mean age of 70.2 years (40–93 years). Annual check-ups were made. A follow-up examination was made in 1985. The course in all cases was known. Of the 52 patients (54 prostheses) who had died, two had undergone a reoperation because of infection and recurrent dislocation respectively. In the surviving 83 patients (92 prostheses), 5 prostheses (5.4 percent) had been exchanged because of loosening (4) and fracture of the femoral component (1). The remaining 78 patients (87 prostheses) were interviewed and/or examined.

78 prostheses were functioning without causing pain or restricting daily activities; 9 caused some pain or slight restriction in daily activities. None of the prostheses functioned poorly. A radiographic examination was performed in 74 cases (83 prostheses). Four patients (4 prostheses) were in too poor a general condition to report for this examination, but they had no complaints concerning the hip. The position of 81 hips proved not to have changed since the operation. The position of the femoral component had changed in two cases. A changed position of the cup or signs of polyethylene wear were not observed.

After a follow-up of at least nine years, reoperation for loosening had been found necessary for 5 of the 92 hips while 87 of the 92 hips "survived".

### Weber's rotation prosthesis: a follow-up study over 5–11 years

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An important principle of the Weber total hip prosthesis is the loose head, which is placed on a cylindrical neck so that rotation as well as axial motion is

possible. Torsion on the stem and wear of the cup are thus reduced.

A follow-up was performed on 95 hip replacements in 76 patients, who fulfilled the following criteria:

- 1) a diagnosis of primary coxarthrosis or coxarthrosis with dysplasia;
- 2) no previous intra-articular operations;
- 3) operation performed by a staff orthopaedist.

The follow-up period was 7 (5–11) years. The mean age was 71 years.

#### Results:

The mean preoperative Harris Hip Score was 48.3, while that at the follow-up examination was 79.1

Loosening of the stem was seen in 21 and loosening of the cup in 6 cases; 13 of these prostheses were (partly) exchanged because of complaints. Late infection was involved in 2 cases and trauma in 1 case; the other cases should be regarded as mechanical loosening. Of the 95 patients, 83 were satisfied or highly satisfied with the result.

The conclusion is that a Weber prosthesis can be implanted in a relatively simple way with good results, even in re-operations. The number of stem loosening is expected to diminish in the future due to the use of a cement stopper.

### Preliminary experience with the fixed femoral cup arthroplasty

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The use of conventional types of cup prostheses for the hip has been marred by an unacceptably high complication rate.

A new type of prosthesis was tried: The total articular replacement arthroplasty or TARA, designed by C. O. Townley.

This series consisted of 35 total hip replacements for rheumatoid arthritis; 14 patients showed necrosis of the femoral head resulting from corticosteroid medication. The patient age was 52 (27–58) years. The follow-up ranged from 6 months to 3.5 years.

The clinical results with this prosthesis, were measured with the aid of the criteria formulated by Merle d'Aubigné and by the recording of complications.

The principal improvement was in the pain criterion: the mean preoperative score of 1.3 was improved to 4.9 at follow-up.

The functional score averaged 2.8 before and 4.9 after the operation, and the walking distance scores were 2.5 and 4.6 respectively.

There were no loosening or infections, but tran-

sient paresis of the femoral nerve was observed in 2 cases, and ectopic ossification in 5.

This type of prosthesis seems especially suitable for relatively young patients with aseptic osteonecrosis of the femoral head.

### A follow-up study over 3–5 years on the first one-hundred total hip replacements using the Lord prosthesis

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One-hundred Lord prostheses were implanted between 1980 and 1982. The mean follow-up was 46 months. Postoperative bone ingrowth was observed after an average of 6½ months. Periarticular calcifications (including very small calcium particles) were seen in 26 percent of cases, trochanteric fissures in 13 percent and femoral fissures in 10 percent. Initial inexperience explains these large percentages. Consolidation of trochanteric fissures required 2½ months and of femoral fissures 4½ months. Dislocations were observed in 3 cases. Technical problems in fixation of the prosthesis occurred in 4 cases (unplanned cup protrusion in 2, unstable fixation in 2 cases).

Cancellous bone grafts were occasionally required. Proximal osteolysis at the level of the stem occurred in 40 percent (severe in 7 percent and mild in 33 percent); in these cases, the bone round the tip of the prosthesis was of good quality. Osteolysis caused no symptoms. No bone loss round the acetabular component was observed. In no case was loosening of the prosthesis seen. The subjective results were good, although pain in the thigh was sometimes reported in the early postoperative phase.

The results in this series compare well with those in the series of cemented prostheses. In our opinion the advantage of better bone quality justifies preference for an uncemented prosthesis.

### Results 1–3 years after primary implantation of the Zweymüller hip prosthesis

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Prospective data are available on 143 of 151 Zweymüller hip prostheses implanted at two hospitals,

with a follow-up of 1.5 (1–3) years. The patients in question are 101 non-rheumatic patients (11 with bilateral hip replacement) with a mean age of 62 years and 25 rheumatic patients (6 with bilateral hip replacement) with a mean age of 56 years. Results were evaluated with the aid of a modified Harris Hip Score. In non-rheumatic patients the mean preoperative HHS was 38.0 and the mean postoperative HHS was 89.3. The respective scores in the rheumatic patients were 21.4 and 81.6. 98 patients were very satisfied, 31 largely satisfied, 9 partly satisfied and 5 dissatisfied.

Radiographic examination revealed periarticular ossifications in 12 cases, a changed position in 2 cases (varus position in 1 and longitudinal sagging in 1). Radiolucency in the bone along the entire shaft was seen in 7 cases, and atrophy round the cup was seen in 6 cases.

Complications were: femoral nerve dysfunction in 5 cases (permanent in 1) and avulsion of the trochanter in 9 cases. One patient required re-operation because of a loosened cup.

An uncemented Zweymüller prosthesis, thus gave good results in most cases. The complications were partly due to technical errors as a result of insufficient experience with this new prosthesis.

### Preliminary experience with Lübeck's uncemented total hip prosthesis

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Between 1983 and 1985, 57 uncemented total hip prostheses of the Lübeck type were implanted in 53 patients. The follow-up ranged from 6 to 30 months. The Lübeck prosthesis was chosen because of its ingrowth-stimulating material and the surface structure (cancellous bone/metal) of stem and outer cup. Favourable initial results caused an extension of the range of indications to older patients and revisions.

The operation was performed under antibiotic protection via a posterolateral approach. Postoperative management: no weight-bearing for up to 8 weeks, including 4 weeks in bed (with regular radiographic check-ups).

The age at operation was 57 (33–82) years. Indications were: coxarthrosis in 47 cases, rheumatoid arthritis in 5 cases, revision of loosened cemented prostheses in 5 cases. There were no (immediate) postoperative complications in the form of infection or dislocation.

Follow-up results: pain was hardly ever reported after the second week, and virtually no ectopic os-

sifications were observed. Functional results: negative Trendelenburg sign in all cases. Hip function virtually unrestricted in all cases but four. Walking distance (leaving other factors undiscussed) unrestricted by hip function.

The conclusion is that the short-term results can be regarded as satisfactory, justifying continued use of the Lübeck prosthesis and extension of the range of indications.

### Cup arthroplasty in the treatment of aseptic osteonecrosis of the femoral head

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In Leiden, uncemented cups have long been used in the treatment of aseptic osteonecrosis of the femoral head. During the period 1973–1982 cup arthroplasty was performed in 33 cases of aseptic osteonecrosis of the femoral head, using a Thomine cup for 32 hips and a double cup according to Gérard for 13 hips. Causes of osteonecrosis were: prednisone medication after kidney transplantation (24 hips), prednisone medication for other reasons (4 hips), "idiopathic necrosis" (9 hips) and situation following hip-joint fracture (8 hips).

All patients were examined clinically and radiographically both before and after the operation, assessing the clinical condition with the aid of the Merle d'Aubigné protocol. The minimal interval between operation and follow-up was 3 years. Results in terms of pain, walking distance and mobility were good in two-thirds of cases. Varus tilting was observed with Thomine cups in particular and depended on the size of the weight-bearing part of the cup.

Eight hips required reoperation: in 3 cases the cup was removed and total hip replacement performed; arthrodesis was performed in 1 case; in 2 cases the hooks used for fixation of the trochanter osteotomy were removed, and in 2 cases a capsulectomy was performed to improve hip mobility.

Cup arthroplasty using an uncemented cup is a conservative procedure with fair results and should be contemplated for the treatment of young patients with aseptic osteonecrosis of the femoral head.

### Gerard's double cup prosthesis. A clinical follow-up and biomechanical analysis

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Between 1978 and 1982, 109 uncemented double cup prostheses according to Gerard were implanted in 99 patients. The indications were extended beyond the limit set by the designer. The age of the patients was 52 (16–71) years, and the follow-up 3–6 years.

Pre- and postoperative evaluation was based on the Merle d'Aubigné/Postel scores. The preoperative score was moderate in 82 percent and poor in 18 percent. The postoperative score was excellent or good in 52 percent, moderate in 43 percent and poor in 5 percent of cases.

The postoperative evaluation included cineradiography, with special reference to the mobility of the acetabular cup in the frontal plane; a statistically significant correlation was found between good mobility of the acetabular cup and a good clinical score.

Biomechanical analysis with the aid of the finite elements demonstrated that the tensions developing in the milled femoral head beneath a cup fixed to the femur without cement, exceed those in a normal femoral head.

Revision was required in 21 cases (19 percent): total hip replacement in 20 cases and arthrodesis in 1 case. These operations posed no technical problems. Failure of the cup prosthesis was partly explained by faulty indications in 5 cases: insufficient bone mass resulting in resorption of the femoral head, and protrusion of the acetabulum resulting in jamming of the acetabular cup.

Histological examination of the femoral heads frequently revealed an extensive zone of avascular necrosis, particularly in the anterolateral part of the head remnant.

Despite our results the Gerard double cup prosthesis still has a prominent place in our department, particularly for younger patients, in view of the bone-saving aspect of the operation and the fact that revision to a total hip replacement poses no serious technical problems.

## The ceramic total hip prosthesis (type Mittelmeier)

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The uncemented ceramic hip prosthesis has been designed for young patients with hip-joint diseases no longer responding to conservative measures and not expected to benefit from operations such as an osteotomy. The well-known long-term disadvantages of bone cement (PMMA) can be avoided with this prosthesis. A retrospective study of short-term results was performed.

During the period 1980–1985, 41 ceramic total hip prostheses were implanted in 37 carefully selected patients with primary coxarthrosis or osteonecrosis of the femoral head. All these patients (from four different hospitals) were personally examined by the authors.

The age at operation was 48 (23–58) years and the follow-up period was 3.5 (1.2–6) years.

The results according to the IOWA hip score were good in 25, moderate in 6 and poor in 6 hips. The poor hips (since revised) showed loosening of one or both components at reoperation.

These poor short-term results compare very unfavourably with the results obtained during the same period with 1206 cemented total hip prostheses implanted by the same surgeons. In this series only 8 hips required revision due to loosening. The ceramic total hip prosthesis has failed to fulfil our expectations.

## The value of radiological examination prior to revision of total hip replacement

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In 31 patients the preoperative radiographic findings were compared with operative findings and cultures. Activities in chronological order were: survey radiograph technetium and gallium scan, arthrography (using a digital subtraction technique if necessary) and culture. During the operation a loosened cup component was found in 28 and a loosened head/neck component in 27 cases. A loosened cup was erroneously diagnosed on the basis of radiographic features in 1 of the 31 cases. In 9 cases a fixed cup was erroneously diagnosed, and in 9 other cases the femoral component was mistakenly regarded as fixed. With the technetium scan a loose cup was erroneously di-

agnosed in 1 case and loose cups were mistaken to be fixed in 5 cases. There was one false-positive and one false-negative radiographic diagnosis regarding the femoral component. The arthrogram gave a false-positive cup result in 2 cases, and one aspirate was mistaken to be negative. The gallium scan showed 3 false-positive cups and 2 false-positive head/neck components. Peroperative infection with positive cultures occurred in 3 cases; in all these cases the joint aspirate was already positive at arthrography. The gallium scan was positive in 5 cases: pus without positive culture in 2 cases, histological diagnosis before infection in 1 case, pseudarthrosis of a femoral fracture in 1 and subsequent wound infection in 1 case.

The conclusion is that preoperative diagnostic radiology can be confined to a survey radiograph and arthrogram with joint puncture and culture. Technetium and gallium scans seem to provide no additional information.

## Results of revisions of total hip replacements

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Results of hip arthroplasty revisions performed in Leiden between 1969 and 1985 were studied. The series of 104 revisions included 4 patients whose data were incomplete or absent. The interval between primary operation and revision was 67 (4–180) months; in 10 re-revisions the interval was 51 (8–104) months. The age at revision was 68 (26–85) years. Twenty revisions were not included in the study: 9 because of death (8 patients, only 1 of whom died shortly postoperatively), 5 because of revision elsewhere and 5 Girdlestone operations (6 revisions) performed for infection.

The remaining 80 revisions in 72 patients were evaluated by pre- and postoperative Merle d'Aubigné scoring. Of the 72 patients, 65 were seen at the out-patient clinic while 7 were approached via the family doctor and/or by telephone. The follow-up was 56 (12–143) months. The pain score improved from 1.7 to 4.7. Walking distance improved from 1.9 to 3.0. Function scores hardly improved (from 4.7 to 4.9). The total score improved from 8.3 before to 12.6 after revision.

The conclusion is that revision operations mainly reduce pain; a striking finding was that the functional score after revision was not lower than that before.

## Girdlestone arthroplasty after total hip replacement

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When a complicated total hip replacement seems to require revision, a Girdlestone operation is sometimes the obvious solution, but this is often an unsatisfactory situation both for the patient and for the orthopaedic surgeon. In order to simplify the choice between implantation of a new prosthesis and acceptance of a Girdlestone hip, a clinical follow-up study was performed on 20 patients with a Girdlestone hip. The age was 64 (26–79) years and the mean duration of the Girdlestone situation was 4 years. The indication for removal of the hip prosthesis had been infection in 70 percent and aseptic loosening in 30 percent of the cases. The reason for not implanting a new prosthesis was poor general condition in 30 percent, technical problems in 30 percent and the risk of recurrent infection in 20 percent of cases. In none of the patients was infection still present. The walking distance was more than 500 metres in 60 percent, and 10 percent of the patients were in a wheelchair. Sixty percent were satisfied or very satisfied, and 40 percent were moderately or highly dissatisfied. Fifty percent of these patients hoped to be eligible for another total hip replacement.

Evaluation of the data obtained shows that pain was the principal complaint in the dissatisfied group. In the group of dissatisfied patients (40 percent) aseptic loosening was quite common.

The conclusion is that a Girdlestone situation after infection of a total hip replacement was a satisfactory situation in 60 percent of the cases.

## Cost/profit analysis of total hip replacements

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In connection with budgeting in health care it is useful for medical care providers to have some understanding of economic phenomena. Only too often does economizing in one sector lead to a disproportionate increase in expenditure in another sector.

Figures are presented to demonstrate that implantation of a total hip prosthesis is a cost-saving operation for the community: about f 70,000 is saved over the first 5 years after the operation.

Economy is a matter of scarcity. When using

scarce means for a particular purpose, the community must refrain from using these means for another purpose. This is the cost.

The cost of using a means constitutes the profit or gain by using it for the possible alternative. The alternative to a total hip replacement is conservative treatment of the patient.

The patient population of 1978 received questionnaires, to which 39 patients responded. Items considered were provisions required before and after the operation in 1978, and those which would have been required if the operation had not been performed. This was done with regard to accommodation, care, district nursing care and physiotherapy.

With regard to pre- and postoperative well-being the Karnofsky Activity Scale was used. Although we are convinced that well-being is an economic item, it is difficult to determine its price in our community, and consequently this calculation was omitted. Our figures would have been even more favourable if this calculation could have been included.

## Tumours in the region of the hip; resection and reconstruction with a prosthesis

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Between 1978 and 1985, 14 patients with a malignant bone tumour in the region of the hip were treated by resection and reconstruction with the aid of a prosthesis. A distinction was made between 5 primary and 9 metastatic tumours. The diagnosis and staging of the primary tumours was: osteosarcoma in 2 cases and chondrosarcoma in 3, all in stage IIB according to the Enneking system. The metastatic lesions were diagnosed as mammary carcinoma in 3 cases, multiple myeloma in 2, bronchial carcinoma in 2, prostatic carcinoma in 1 and unidentified carcinoma in 1 case.

The two patients with an osteosarcoma were given pre- and postoperative chemotherapy (Rosen protocol). The metastatic tumours were usually treated by radiotherapy before operation. The mean age at operation was 44 years (primary tumours) and 60 years (metastases). The tumour was localized in the proximal femur in 13 cases and in ileum and ischium in 1 case.

At the time of the follow-up study 7 patients were alive after 24–82 months. Six patients with an osseous metastasis and 1 with a chondrosarcoma had died (survival 3–24 months). In none of the 14 patients did the prosthesis cause problems. According

to the Enneking Evaluation Score the results in the survivors were good in all patients with a metastasis; the results in patients with a primary malignancy ranged from moderate to good.

The findings confirm the international trend in favour of implanting a prosthesis in patients of this category.

## Arthrodesis of the hip

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Between 1974 and 1984 arthrodesis of the hip was performed in 32 patients: 19 men and 13 women with a mean age of 37 years. There were 20 instances of post-traumatic destruction of the hip and 15 cases related to septic arthritis.

Minimal osteosynthesis combined with subtrochanteric osteotomy was performed in 9 cases. Postoperative management comprised supracondylar traction followed by immobilization in a pelvis-leg cast. Postoperative wound infection developed in 2 cases and union of the subtrochanteric osteotomy was delayed in 3; in all these cases consolidation was achieved with a plate osteosynthesis. After a mean follow-up period of 6.5 years, 7 of the 9 patients were satisfied with the result. There was complete consolidation in 7 and painless fibrous ankylosis in 2; all showed about 40° flexion restriction of the ipsilateral knee.

In 23 cases the arthrodesis was fixed with the aid of a cobra plate. Postoperative management was functional in 19 cases and a pelvis-leg cast was applied in 4. Complications: wound infection in 2 cases, ileus in 1 case, paresis of the femoral nerve in 1 and of the peroneal nerve in 1 case. Two patients required reoperation for non-union. Two needed corrective intertrochanteric osteotomy with adjustment of the cobra plate and 4 needed contralateral intertrochanteric shortening. After a mean follow-up period of 6.5 years, 14 out of 20 patients were satisfied with the result obtained. Fibrous ankylosis existed in 2 and consolidation in 18 cases. Usually asymptomatic instability of the ipsilateral knee existed in 21 of the 29 patients. Fifty percent of the patients ultimately resumed their work.

## Radiotherapy to prevent periarticular ossification

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Extensive periarticular ossification (PAO) may be a gravely disabling factor in patients with hip prostheses. In view of the high recurrence risk resection of PAO should be combined with preventive measures. A prospective study of the effect of radiotherapy in this respect was performed in a clinical setting. Patients were irradiated from the 5th postoperative day with a total dose of 20 YG (2000 rad) in 10 series (frequency 4 times per week).

Two groups of patients were treated. In group I (3 men and 4 women) only the PAO was resected, whereas in group II (6 men and 3 women) a revision of the hip prosthesis for aseptic loosening was done as well. The age in both groups was 69 (61–76) years. Patients were clinically and radiographically examined both before and after the operation.

The follow-up period was 23 (9–36) months. Changes in function, walking pattern and pain were registered in group I, while in group II only the function was used as clinical parameter. Both groups showed striking improvement in the parameters mentioned. The radiographically determined recurrence was found to be small in group I and moderate in group II. This difference is probably explained by the fact that patients in group II underwent a more extensive operation with trochanteric osteotomy. Complications were not observed.

The carcinogenic effect of irradiation at the dosage mentioned is reported as nil in the literature. For higher dosages a latent period of 10–20 years has been reported.

## Periarticular heterotopic ossification following head injury. Resection under protection with etidronic acid

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Periarticular ossification occurs in a large percentage of cases following head injury or in association with some other serious neurological condition (acute febrile polyneuritis). This usually reduces the mobility of the affected joint. Osseous ankylosis of the joint not infrequently results.

Forty-six patients with periarticular heterotopic ossification have been treated in accordance with a fixed protocol since 1972. Six weeks before the operation treatment with 20 mg EHDP (later on etidronic acid) per kg body weight per day was started. After resection of the periarticular bone this medication was continued for three months after the operation.

In the majority of the patients ossifications around both hip-joints were resected. Resections around

knee and shoulder-joint were an exception. Recovery of mobility was good even after years of osseous ankylosis of the hip-joint.

### The use of an orthosis in the treatment of dislocation of total hip replacements in the immediate postoperative phase

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Dislocation of a total hip replacement in the immediate postoperative phase is an inconvenient complication for doctor and patient. Dislocation rates of 2–3 percent have been reported in larger series. Treatment after reduction used to consist of bed rest with the legs in abduction, for 3–6 weeks.

In 1983 Laurens D. Dorr described an orthosis allowing quicker ambulation of the patient. Between 1983 and 1985 six dislocations (in a series of about

200 total hip replacements) were thus treated. The six patients all suffered dislocation of the hip (dorsal in 1 and ventral in 1) after a week's bed rest.

Five patients were immediately provided with an orthosis. One patient refused this and at her request was discharged immediately after reduction. She suffered two redislocations within three months of the operation, whereupon an orthosis was applied.

The hip was always reduced immediately after dislocation and the instrument maker needed a week to manufacture the orthosis; the patient was then ambulated, wearing the orthosis for the next three months.

No redislocation occurred in any of the patients thus treated. After a mean follow-up period of 16 months no restriction of movement was observed.

The conclusion is that the Dorr orthosis is a welcome asset in the treatment of dislocation of total hip replacements in the immediate postoperative phase, provided that the position of prosthesis or cup has not significantly changed.