Cementless total hip arthroplasty in patients with rheumatoid arthritis using a tapered designed titanium hip stem minimum: 10-year results

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1 **Cementless Total Hip Arthroplasty in Patients with Rheumatoid**
2 **Arthritis using a Tapered Designed Titanium Hip Stem**
3 Minimum 10-Year Results
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Abstract

The results of a cementless tapered designed femoral stem was studied at a minimum 10 year follow-up in a non-selected, consecutive group of 27 patients (39 hips) with rheumatoid arthritis. Clinical and radiological analyses were performed in 27 hips, 17 patients (mean age at surgery 45 years) after a mean of 12 years. Using the Harris Hip Score, 14 hips were rated as excellent; 9, good; 2, fair; and 2, poor. No stem had to be revised for aseptic loosening. Proximal stress shielding was observed in 26 hips (96%), heterotopic ossification was present in 11 hips (41%). 6 hips required revision of the acetabular component. With uncemented tapered femoral fixation excellent 12 year results are achieved in patients with rheumatoid arthritis.

Introduction

The total number of rheumatoid arthritis (RA) patients in total hip arthroplasty (THA) databases ranges from 3% (61,568 THA patients) in a United States cohort to 6% (93,852 THA patients) in the Swedish National Registry [1,2]. A multidisciplinary approach is required for the management of these patients, with surgical procedures preferably undertaken by orthopaedic surgeons who are familiar with the specific problems of RA patients. While THA in patients with RA is known to greatly improve functional ability and thus self-support of the patient [3], controversy remains among orthopaedic surgeons concerning the optimal fixation of the implant [4-19].

Cemented THA has traditionally been considered the gold standard for the treatment of patients with RA as poor bone stock caused by generalized disease activity, immobility and steroid therapy was thought to undermine primary stability and bony ingrowth of cementless implants [4,6].

Several studies have shown higher rates of loosening of cemented femoral components in patients with RA compared with cemented THA in patients with osteoarthritis (OA) [5,15]. The Finish arthroplasty register found that the risk of stem revision due to aseptic loosening for patients with RA under the age of 55 (2557 primary THA) was higher with cemented stems than with proximally porous coated uncemented stems [7]. Femoral failure rates of 5.3% and 8% after an average follow-up of 7.4 to 4.3 years have been reported with cemented THA for patients with RA [16,17].

3 long-term follow-up series with a single uncemented contemporary femoral component in patients with RA have been published. The results have been promising with revision rates between 0% and 1% after a mean follow-up of 8 to 10 years [9,10,14].

We have retrospectively assessed the long-term clinical and radiological results (mean time of follow-up: 12,2 years; minimum 10 years) of a non-selected, consecutive series for patients with RA who all underwent cementless THA with the femoral component cementless system (CLS, Sulzer Medica, CH; now: Zimmer, Warsaw, Indiana, USA), in combination with one of five different acetabular components.

Patients and Methods

We performed 39 consecutive, unselected primary THA in patients with adult-onset RA using the CLS stem on 27 patients. All patients fulfilled the diagnostic criteria of the American College of Rheumatology. For the follow-up analysis after a mean time of 12,2 years (minimum 10 years) there were 11 women (18 hips) and 6 men (9 hips) with an average age of 45,3 years (26 to 56) at time of surgery. 5 patients (5 hips) were lost to follow-up and 5 patients (7 hips) had died prior to follow-up investigation. Prior to surgery 5 patients (8 hips) had been taking oral corticosteroids only, 3 patients (6 hips) took oral steroids and at least one disease modifying rheumatic drug such as methotrexate, 9 patients (12 hips) had no medication at time of the index operation. No patient had received bone modulating drugs during the entire period of follow-up. There were 4 patients (4 hips) rated as Charnely A, 1 patient (2 hips) as Charnely B and 12 patients (21 hips) as Charnely C [20].

The CLS femoral component is a collarless, three-dimensional tapered wedged made of titanium alloy (Ti₆Al₇Nb). Ribs in the proximal part of the prosthesis are designed to minimize rotational migration. The distal part is intentionally made small to avoid filling of the intramedullary canal in the diaphysis in order to encourage proximal load transfer to the femur. The surface was rough blasted and had no porous coating [21]. All procedures were performed in staged settings by three different senior surgeon in a

closed air enclosure with laminar air flow. All patients were placed in supine position and operated on with a direct transgluteal lateral Bauer approach [22]. The largest stem that provided a stable press-fit was inserted after preparation of the femoral canal with chipped-tooth broaches.

Depending on availability and the surgeons preference one of four different cementless press-fit acetabular components were used. There were 7 Fitek cups with a metasul polyethylen (PE) liner (Zimmer, Warsaw, USA; before: Sulzer Medica, Wintherthur, Switzerland) 6 of which were fitted with screws; 9 hydroxylapatit-coated and 4 zirconium-coated Phönix cups (Brehm, Weisendorf, Germany) fitted with PE-liners (Brehm, Weisendorf, Germany) in 11 cases and alumina inlays in 2 cases (BioloX, CermaTec, Plochingen, Germany) ; 1 Plasmacup (PE-inlay) fixed with screws (Aesculap, Tuttlingen, Germany) and 1 Wagner cup (PE-inlay) (Zimmer, Warsaw, USA; before: Sulzer Medica, Wintherthur, Switzerland). 5 acetabular components were cemented: in 3 cases acetabular reconstruction was required and a Ganz reinforcement ring (Zimmer, Warsaw, USA; before: Sulzer Medica, Wintherthur, Switzerland) was implanted in addition to the cemented metasul PE-cup (Zimmer, Warsaw, USA; before: Sulzer Medica, Wintherthur, Switzerland) and in 2 cases cemented PE-cups (Brehm, Weisendorf, Germany) were used without acetabular reconstruction.

The femoral head size was 28 mm in 20 hips and 32 mm in 7 hips, there were 16 alumina ceramic (BioloX, CermaTec, Plochingen, Germany) and 11 CoCrMo-alloy (Metasul, Protek GmbH, Munich, Germany) heads. Due to the wide variety of acetabular implants used their performance was not the major target of this investigation.

All patients received prophylaxis for heterotopic ossification by oral administration of 3 doses of 50mg diclofenac for 2 weeks postoperatively. Routinely patients were given

perioperative antibiotics (single shot of 2g Cefazolin i.v.) and thromboembolism prophylaxis with subcutaneous heparin. Postoperatively, touch weight-bearing up to 15 kg was allowed for the first 6 weeks, then progressively increased loading to full weight-bearing within the next 2 weeks. At the final follow-up all patients were assessed clinically using the Harris hip score [23]. Preoperative pain, range of motion and function were reconstructed retrospectively by interview and patients charts.

Radiographs were evaluated by an independent observer (LAM) who was unaware of the clinical outcome of the surgical procedure. Evaluation of the femoral and acetabular components was performed using published criteria [24]. Radiological “stability” of the femoral component was additionally assessed according to the criteria of Engh et al. [25]. Location of radiolucent lines, osteolysis and cortical hypertrophy were rated according to the Gruen criteria [26]. For evaluation of heterotopic ossification, the Brooker classification was used [27]. Stress shielding was classified as grade I when only resorption of the medial edge of the resection line appeared, grade II meant additional proximal medial bone resorption, while grade III findings extended more distally [28,29].

Results

Of the 27 patients (39 hips) in this study, 5 patients (7 hips) had deceased at the time of the follow-up. Intermediate clinical and radiological follow up of 3 patients (5 hips) ranging from 5 to 8 years of the deceased patients showed radiological signs of stable ingrowth of all stems without impending failures. There were 2 patients (2 hips) who had died with their hips intact but no clinical or radiological data beyond the 1-year follow-up at which time the implant was functioning well. 5 patients (5 hips) were lost

to follow-up, only a 2 month postoperative clinical and radiological follow-up was available with a well functioning hip (fig.1).

Thus, clinical and radiological data were available of 17 patients (27 hips) after a mean of 12,2 years follow-up (minimum 10 years). There were 10 women (18 hips) and 7 men (9 hips) with an average age at surgery of 45,3 years (26 to 55). Of the 27 implants directly accounted for, no femoral component was revised and all stems had bony ingrowth. 5 cups (19%) had to be revised due to aseptic loosening, for one additional cup the liner had to be changed due to extensive wear (table 1).

The Harris Hip Score (HHS) was not taken preoperatively. Retrospective assessment of patient charts showed marked pain in all patients. Range of hip motion was limited to less than 110° in all cases, only 6 patients (35%) were able to walk without a cane or crutches. At follow-up the average HHS was 86. 14 hips were rated as excellent (52%); 9, good (33%); and 4, fair (14%). 25 hips (93%) had total relief from pain in the thigh, groin or buttocks. 2 hips (7%) presented with occasional pain of the buttocks and the thigh. A Trendelenburg limp was found in 1 hip (4%) caused by a postoperative partial paralysis of the sciatic nerve after acetabular revision surgery. 13 patients (76%) could walk over 500 meters, 4 patients (24%) walked outdoors under 500 meters. 11 patients (65%) needed no assistive devices for walking while 2 patients (12%) used a cane for outdoor walking only, 3 patients (18%) regularly used one cane.

No stem had to be revised for aseptic loosening and all stems presented complete bony ingrowth with no signs of definite or probable loosening. No postoperative subsidence was seen. 5 stems were undersized, 4 in slight varus and 2 in minimal valgus position. Proximal stress shielding was observed in all hips. Bone resorption in the proximal portion of the femur (Gruen zones 1 and 7), which was interpreted as grade II stress shielding, was present in 26 hips (96%), in one cases stress-shielding extended to Gruen

zones 2 and 6 (grade III). A non progressive 4x5x5mm osteolysis was seen in 1 patient (1 hip) located in Gruen zone 7, with 1-2mm wear of the cemented PE-cup. In another case of suspected press-fit cup loosening both stem and cup were intraoperatively found to be stable, a small proximal osteolysis in Gruen zone 7 was filled with autologous bone graft.

Radiolucencies of the stem without progression were found in 3 cases, all of which were located in the proximal Gruen zones I. Cortical hypertrophy was seen in 3 hips (11%) in Gruen zone 3 and 5. 12 hips 45% developed a radiographic appearance of bone apposition at the tip of the stem. Heterotopic ossification was present in 11 hips (41%): 8 hips (30%) grade I and 3 hips (11%) grade II.

With uncemented tapered femoral fixation excellent 12 year results are achieved in patients with rheumatoid arthritis (figure 2).

Acetabular component. For 22 acetabular components (81%) fixation was good without change in position. 5 cups (19%; 4 press-fit zirconium-coated Phoenix cups and one cemented PE-cup; Brehm, Weisendorf, Germany) had to be revised due to aseptic loosening, for one additional cup the liner had to be changed due to extensive wear (table. 1). Of the 22 non-revised acetabular components none showed signs of osteolysis and radiolucencies were seen in 1 hip (4%) in Zone II and III.

The amount of wear of the polyethylene liner or cup (n=20 of the 22 non-revised hips) was analyzed in increments of 1 mm maximum accuracy: < 1 mm (1 hip, 4%), 1-2 mm (7 hips, 26 %, 4 PE-liners, 3 metasul-PE-liners).

The 6 hips which required isolated revision of the cup had radiographically bone-ingrown femoral components that were stable on examination during the operation. The radiological follow-up showed that these stems remained radiologically bone-ingrown.

We observed no deep vein thrombosis, no luxation and no periprosthetic fracture in our cohort.

Discussion

In our non-selected, consecutive series of patients with RA who all underwent cementless THA the survival of the tapered designed stem has been excellent. No stem had to be revised and all showed signs of stable ingrowth after a mean follow-up of 12,2 years (minimum 10 years). Aseptic cup loosening was seen in four cases which had to be revised, additionally one liner had to be replaced due to extensive wear. Durable acetabular fixations remains to be the major problem compromising the longevity of cementless THA for patients with RA.

The greater incidence of acetabular and femoral loosening after cemented THA for patients with RA compared to those with OA [5,12,15,17,18,30] has been attributed to periacetabular and generalized osteoporosis related to disease activity, steroid therapy and immobility [6,31,32]. As for elderly patients with OA, the hypothesised poorer bone stock of patients with RA has been the main argument for cemented THA.

The increasing number of investigations with promising results for cementless THA for patients with RA [4,8-11,13] has recently been confirmed by a study of the Finnish Arthroplasty Register for the femoral component, while for the acetabulum cemented all-polyethylene cups were the implant of choice [7] (table 2).

Three long-term follow-up series with a single uncemented contemporary femoral component in patients with RA have been published: Lyback et al. [4] reported an excellent 100% 10-year survival rate (with aseptic loosening as an endpoint) for a group of 55 patients (77 hips) with juvenile chronic arthritis (mean age at operation 28 years)

who had received the proximally circumferentially porous-coated Bi-metric stem. For another proximally circumferentially porous-coated uncemented stem (Biomet Taperloc) Keisu et al [10] reported no revision and no signs of radiological loosening after a mean follow-up of 8 years in group of 39 patients (50 hips) with adult-onset RA (mean age at operation 55 years). Jana et al [9] reported of 55 patients (71 hips) with adult-onset RA (mean age at operation 55.1 years) after a mean follow-up of 11.2 years with 1 stem revised and an additional 4 stems showing radiological signs of loosening (porous-coated Anatomic Medullary Locking stem).

It is well published, that for patients with OA of the hip joint, tapered designed uncemented stems achieve excellent clinical and radiological results at 10 years postoperatively [33-35]. Specifically with the CLS stem used in the present patient cohort, we have observed similar excellent results for 94 patients (107 hips) with OA (mean age at operation 51 years) after a mean follow-up of 10.3 years, no stem had to be revised and radiological stable ingrowth was observed in 95% of the radiographically analysed cases [35].

Our single femoral implant, single surgeon series is the first with a mean 12,2 year (minium 10 years) follow-up for tapered designed uncemented stems in patients with RA and only the second publication thus far with an above mean 10-year-results for uncemented stems of patients with adult-onset RA. We recognize that our study is limited by the relatively small patient cohort and the retrospective nature of our investigation. Furthermore our series is nonrandomised, thus no direct comparisons with a cemented group is possible. Nevertheless, we managed to account for all but 5 of the patients still alive of this series. Even though no match of the presented RA group was possible with an osteoarthritic control group, the number of stem revisions and stable

radiological ingrowth with the same implant show equally excellent results for both groups in our hospital [35].

All published short- and longterm data with a single contemporary uncemented femoral component for patients with juvenile and adult-onset RA confirm the encouraging results of our series [4,8-11,13] underlined by the report of the Finnish Arthroplasty Register [7] who analysed 2,557 THA for RA in younger patients and found favourable results for uncemented femoral implants.

The chronic course of RA with multiple affected joints of the lower limbs affected, makes the clinical evaluation of a specific surgical procedure difficult to interpret. While excellent clinical results after THA were reported by Keisu et al. [10] with a relatively high HHS of 93 (follow-up mean: 8 years; mean age at operation: 55 years) and 32% of their patients classified according to Charnley as grade C, Jana et al. [9] found the Merle D'Aubigné and Postel walking score (follow-up mean: 10 years; mean age at operation: 55.1 years) to improve in only 61% of their patients, 20% had lower scores. Even though 12 patients (21 hips, 78%) of our patients were rated as Charnley C we found satisfying clinical results with an average HHS of 86 at follow-up. All patients reported clinical improvement with reduced pain and increased walking distance.

Keisu et al. [10] noted postoperative mild thigh pain in only 2,2% of his RA patients after cementless THA with the titanium alloy, circumferential plasma spray coated, Taperloc femoral stem. Accordingly, we observed 2 patients who presented with occasional thigh pain. With the same implant in the same clinic and a comparable mean follow-up time thigh pain was observed only for patients with OA in cases of radiologically loose, but not yet revised acetabular components. Whether the low incidence of thigh pain compared to other cementless implants [36,37] is due to the

tapered geometry that is believed to distribute stress over a larger area remains speculative [10, 38].

No case of superficial or deep wound infection was seen in our series. While for all patients who had taken oral corticosteroids preoperatively the dose was increased perioperatively and administered intravenously to avoid an Addison-crisis, other immunosuppressing drugs such as MTX were paused 2 weeks prior to surgery until definite wound healing (2 weeks postoperatively) was reached. No clear consensus exists on whether methotrexate (MTX) should be continued or whether this therapy should be discontinued for a few weeks in patients with rheumatoid arthritis (RA) undergoing surgery. Pieringer et al. [39] analysed the current literature according to which continued MTX therapy appears to be safe perioperatively and seems also to be associated with a reduced risk of flares, even though none of examined papers addressed the issue of safety in connection with comorbidities. Our series is too small to make any conclusion on the observed rate of infection and the influence of discontinuing MTX therapy perioperatively.

Radiographic evidence of bone ingrowth of the stem in our series (100 %) is equal to the radiographic results of Keisu et al. [10] (100% radiographic evidence of bone ingrowth). Despite reported an increased polyethylene wear rate Keisu et al. [10] observed no case of proximal or distal femoral osteolysis. They believed that the circumferential plasma spray coating in combination with the 100% rate of proximal bone ingrowth of the Taperloc titanium alloy femoral stem protected the femoral canal from PE-debris and thus osteolysis [10].

Despite polyethylene particulate debris, osteolysis and radiolucencies were never of clinical or radiological significance for the femoral component in our investigation. Schramm et al [35] reported wear of the polyethylene liners of < 1 mm (56%), 1-2 mm

(29%), > 2 mm (5%), for patients with osteoarthritis of the hip joint (mean time of follow-up 10.3 years, mean age at operation 51 years) who had received the same prosthesis in the same clinic with an identical polyethylen liner. Even though our cohort was slightly younger and our mean follow-up an average 2 years longer, we observed less PE-wear (< 1 mm (1 hip, 4%), 1-2 mm (7 hips, 26 %, 4 PE-liners, 3 metasul-PE-liners) which be contribute to the lower physical demand of RA patients.

Even though acetabular components were not the major target of this investigation due to the wide variety of acetabular implants used, their performace was considered good. The 4 revised press-fit cups were all zirconium coated and prone for aseptic loosening caused by debonding of the zirconium from the cup. None of the non-zirconium coated press-fit cups had to be revised or showed radiological signs of loosening at follow-up.

The results of cementless THA for young patients with rheumatoid arthritis are very promising and comparable to patients with OA. Durable femoral and acetabular fixation was achieved. Slight undersizing, varus and valgus positioning of the stem did not undermine good clinical results after a mean 12,2 year follow-up

Legends

Figure 1 Kaplan Meier curve indicating the lost to follow-up and a worst case (lost to follow-up and deceased patients) scenario.

Figure 2 45 year old male, 14 year follow-up. CLS-stem with Fitek press-fit cup. Stress-shielding in Gruen zones I and VII.

References

- 1 Mahomed NN, Barrett JA, Katz JN (2003) Rates and outcomes of primary and revision total hip replacement in the United States Medicare Population. *J Bone Joint Surg Am* 85:27
- 2 Malchau H, Herberts P, Ahnfelt L (1993) Prognosis of total hip replacement in Sweden: follow-up of 92675 operations performed 1978-1990. *Acta Orthop Scand* 64:497
- 3 Nelissen RGHH (2003) The impact of total joint replacement in rheumatoid arthritis. *Prac Res Clin Rheum* 17(5):831
- 4 Akesson K, Onsten I, Obrant KJ (1994) Periarticular bone in rheumatoid arthritis versus arthrosis. Histomorphometry in 103 hip biopsies. *Acta Orthop Scand* 65(2):135
- 5 Chmell MJ, Scott RD, Thomas WH, et al. (1997) Total hip arthroplasty with cement for juvenile rheumatoid arthritis. Results at a minimum of ten years in patients less than thirty years old. *J Bone Joint Surg Am* 79(1):44
- 6 Dequeker J, Maenaut K, Verwilghen J, et al. (1995) Osteoporosis in rheumatoid arthritis. *Clin Exp Rheumatol* 13(Suppl 12):21
- 7 Eskelinen A, Paavolainen P, Helenius I, et al. (2006) Total hip arthroplasty for rheumatoid arthritis in younger patients: 2,557 replacements in the Finnish Arthroplasty Register followed for 0-24 years. *Acta Orthop* 77(6):853
- 8 Garcia C, Fernandez J, Tonino A (1998) Rheumatoid arthritis and hydroxyapatite-coated hip prostheses: Five-year results. International ABG Study Group. *J Arthroplasty* (13)6:660

- 373 9 Jana AK, Engh CA Jr, Lewandowski PJ, et al. (2001) Total hip arthroplasty
374 using porous-coated femoral components in patients with rheumatoid arthritis. J
375 Bone Joint Surg Br 83(5):686
376
- 377 10 Keisu KS, Orozco F, McCallum JD et al. (2001) Cementless femoral fixation in
378 the rheumatoid patient undergoing total hip arthroplasty: minimum 5-year
379 results. J Arthroplasty 16(4):415
380
- 381 11 Lachiewicz PF (1994) Porous-coated total hip arthroplasty in rheumatoid
382 arthritis. J Arthroplasty 9(1):9
383
- 384 12 Lachiewicz PF, McCaskill B, Inglis A, et al. (1986) Total hip arthroplasty in
385 juvenile rheumatoid arthritis. Two to eleven-year results. J Bone Joint Surg Am
386 68(4):502
387
- 388 13 Loehr JF, Munzinger U, Tibesku C: Uncemented total hip arthroplasty in
389 patients with rheumatoid arthritis. Clin Orthop Relat Res 366:31, 1999
390
- 391 14 Lybäck CC, Lybäck CO, Kyrö A, et al. (2004) Survival of Bi-Metric femoral
392 stems in 77 total hip arthroplasties for juvenile chronic arthritis. Int Orthop
393 28(6):357
394
- 395 15 Poss R, Maloney JP, Ewald FC, et al. (1984) Six- to 11-year results of total hip
396 arthroplasty in rheumatoid arthritis. Clin Orthop Relat Res 182:109
397
- 398 16 Ranawat CS, Dorr LD, Inglis AE (1980) Total hip arthroplasty in protrusio
399 acetabuli of rheumatoid arthritis. J Bone Joint Surg Am 62(7):1059
400
- 401 17 Severt R, Wood R, Cracchiolo A 3rd, et al. (1991) Long-term follow-up of
402 cemented total hip arthroplasty in rheumatoid arthritis. Clin Orthop Relat Res
403 265:137
404
- 405 18 Unger AS, Inglis AE, Ranawat CS, et al. (1987) Total hip arthroplasty in
406 rheumatoid arthritis. A long-term follow-up study. J Arthroplasty 2(3):191

407 19 Thomason HC, Lachiewicz PF (2001) The influence of technique on fixation of
408 primary total hip arthroplasty in patients with rheumatoid arthritis. J
409 Arthroplasty 16(5):628
410

411 20 Charnley J (1972) The long-term results of low-friction arthroplasty of the hip
412 performed as a primary intervention. J Bone joint Surg Br 54:61
413

414 21 Spotorno L, Romagnoli S, Ivaldo N, et al. (1993) The CLS system. Theoretical
415 concept and results. Acta Orthop Belg 59(Suppl 1):144
416

417 22 Bauer R, Kerschbaumer F, Poisel S, et al. (1979) The transgluteal approach to
418 the hip joint. Arch Orthop Trauma Surg 1-2:47
419

420 23 Harris WH (1969) Traumatic arthritis of the hip after dislocation and acetabular
421 fractures: treatment by mold arthroplasty. An end-result study using a new
422 method of result evaluation. J Bone Joint Surg Am 51(4):737-55
423

424 24 Johnston RC, Fitzgerald RH, Jr., Harris WH, Poss R, Muller ME, Sledge CB
425 (1990) Clinical and radiographic evaluation of total hip replacement. A standard
426 system of terminology for reporting results. J Bone Joint Surg Am 72(2):161-8
427

428 25 Engh CA, Bobyn JD, Glassman AH (1987) Porous-coated hip replacement. The
429 factors governing bone ingrowth, stress shielding, and clinical results. J Bone
430 Joint Surg Br 69(1):45-55
431

432 26 Gruen TA, McNiece GM, Amstutz HC (1979) Modes of failure of cemented
433 stem-type femoral components: a radiographic analysis of loosening. Clin
434 Orthop 141:17
435

436 27 Brooker AE, Bowermann JW, Robinson RA, et al. (1973) Ectopic ossification
437 following total hip replacement. Incidence and a method of classification. J Bone
438 Joint Surg Am 55:1629
439

440 28 Engh CA, McGovern TF, Bobyn JD, et al. (1992) A quantitative evaluation of
441 periprosthetic bone-remodeling after cementless total hip arthroplasty. J Bone
442 Joint Surg Am 74(7):1009
443

444 29 McLaughlin JR, Lee KR (1997) Total hip arthroplasty with an uncemented
445 femoral component. Excellent results at ten-year follow-up. J Bone Joint Surg Br
446 79(6):900
447

448 30 Sarmiento A, Ebramzadeh E, Gogan WJ, et al. (1990) Total hip arthroplasty
449 with cement. A long-term radiographic analysis in patients who are older than
450 fifty and younger than fifty years. J Bone Joint Surg Am 72(10):1470
451

452 31 Dequeker J, Geusens P (1990) Osteoporosis and arthritis. Ann Rheum Dis
453 49(5):276
454

455 32 Sambrook PN (2000) The skeleton in rheumatoid arthritis: common mechanisms
456 for bone erosion and osteoporosis? J Rheumatol 27(11):2541
457

458 33 Froimson MI, Garino J, Machenau A, et al. (2007) Minimum 10-year Results
459 of a Tapered, Titanium, Hydroxyapatite-Coated Hip Stem: An Independent
460 Review. 22(1):1
461

462 34 Reikerås O, Gunderson RB (2003) Excellent results of HA coating on a grit-
463 blasted stem: 245 patients followed for 8-12 years. Acta Orthop Scand 74(2):140
464 .

465 35 Schramm M, Keck F, Hohmann D, et al. (2000) Total hip arthroplasty using an
466 uncemented femoral component with taper design: outcome at 10-year follow-
467 up. Arch Orthop Trauma Surg 120(7-8):407
468

469 36 Engh CA, Massin P (1989) Cementless total hip arthroplasty using the anatomic
470 medullary locking stem. Results using a survivorship analysis. Clin Orthop Relat
471 Res 249:141
472

- 37 de Nies F, Fidler MW (1996) The Harris-Galante cementless femoral component: poor results in 57 hips followed for 3 years. Acta Orthop Scand 67(2):122
- 38 Hozack W, Gardiner R, Hearn S, et al. (1994) Taperloc femoral component. A 2-6-year study of the first 100 consecutive cases. J Arthroplasty 9(5):489
- 39 Pieringer H, Stuby U, Biesenbach G (2008) The place of methotrexate perioperatively in elective orthopedic surgeries in patients with rheumatoid arthritis. Clin Rheumatol. 27(10):1217

Table 1. Reoperation summary of all analysed hips

After operation (years)	Components revised	Revision diagnosis
4.1	Zirconium coated Phoenix cup	aseptic loosening
7.10	Zirconium coated Phoenix cup	aseptic loosening
10.1	Inlay (Aesculap plasmacup)	extensive inlay wear
8.8	Zirconium coated Phoenix cup	aseptic loosening
9.3	cemented PE cup	aseptic loosening
12.0	Zirconium coated Phoenix cup	aseptic loosening

Table 2. Results in Comparison to the literature of single femoral component series (aRA: adult-onset rheumatoid arthritis; jRA: juvenile rheumatoid arthritis; OA: Osteoarthritis; n.a.: not available)

Author	No. of THA/ no.of	Mean age at operation	Mean follow-up (years)	Lost to follow-up (years)	Excellent and good clinical or HHS	Rate of stem revision (%)	Rate of loosened stems: radiol.+ revised (%)	Rate of acetab. revision (%)	Rate of loosened cups: radiol.+ revised (%)
Lachiewicz (1994) ^a jRA	35/25	41	4.5	none	HHS 91	none	none	none	1 (3%)
Garcia (1998) ^b aRA	33/32	51	5	none	HHS 81	none	none	none	none
Loehr (1999) ^c aRA	21/15	53	3.3	none	n.a.	none	5 (24%)	none	none
Keisu (2001) ^d aRA	50/39	55	8	19%	HHS 93	none	none	7 (14%)	7 (14%)
Jana (2001) ^e aRA	71/55	55	11.4	13%	n.a.	1 (2%)	5 (7%)	14 (20%)	21 (30%)
Lybaeck (2004) ^d jRA	77/55	28	10	9%	n.a.	2 (3%)	n.a.	27 (39%)	n.a.
Schramm (2000) ^c OA	89/80	51	10.3	7%	84%	none	4 (5%)	3 (4%)	7 (9%)
Present study ^c ; aRA	39/27	45	12.2	13%	HHS 86	none	none	6 (22%)	6 (22%)

^aHarris-Galante porous (Zimmer)

^bAGB hip prosthesis (Howmedica)

^cCLS-stem (Zimmer)

^dTaperloc femoral stem (Biomet)

^eAnatomic Medullary Locking stem (DePuy, Johnson & Johnson)

Figure 1 Kaplan Meier curve indicating the lost to follow-up and a worst case (lost to follow-up and deceased patients) scenario.

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569 **Figure 2** 45 year old male, 14 year follow-up. CLS-stem with Fitek press-fit cup.

570 Stress-shielding in Gruen zones I and VII.

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