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## 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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51 **Abstract**

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

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74 **Introduction**

75 The total number of rheumatoid arthritis (RA) patients in total hip arthroplasty (THA)  
76 databases ranges from 3% (61,568 THA patients) in a United States cohort to 6%  
77 (93,852 THA patients) in the Swedish National Registry [1,2]. A multidisciplinary  
78 approach is required for the management of these patients, with surgical procedures  
79 preferably undertaken by orthopaedic surgeons who are familiar with the specific  
80 problems of RA patients. While THA in patients with RA is known to greatly improve  
81 functional ability and thus self-support of the patient [3], controversy remains among  
82 orthopaedic surgeons concerning the optimal fixation of the implant [4-19].

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

87 Several studies have shown higher rates of loosening of cemented femoral components  
88 in patients with RA compared with cemented THA in patients with osteoarthritis (OA)  
89 [5,15]. The Finish arthroplasty register found that the risk of stem revision due to  
90 aseptic loosening for patients with RA under the age of 55 (2557 primary THA) was  
91 higher with cemented stems than with proximally porous coated uncemented stems [7].  
92 Femoral failure rates of 5.3% and 8% after an average follow-up of 7.4 to 4.3 years  
93 have been reported with cemented THA for patients with RA [16,17].

94 3 long-term follow-up series with a single uncemented contemporary femoral  
95 component in patients with RA have been published. The results have been promising  
96 with revision rates between 0% and 1% after a mean follow-up of 8 to 10 years  
97 [9,10,14].

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

103

#### 104 **Patients and Methods**

105 We performed 39 consecutive, unselected primary THA in patients with adult-onset RA  
106 using the CLS stem on 27 patients. All patients fulfilled the diagnostic criteria of the  
107 American College of Rheumatology. For the follow-up analysis after a mean time of  
108 12,2 years (minimum 10 years) there were 11 women (18 hips) and 6 men (9 hips) with  
109 an average age of 45,3 years (26 to 56) at time of surgery. 5 patients (5 hips) were lost  
110 to follow-up and 5 patients (7 hips) had died prior to follow-up investigation. Prior to  
111 surgery 5 patients (8 hips) had been taking oral corticosteroids only, 3 patients (6 hips)  
112 took oral steroids and at least one disease modifying rheumatic drug such as  
113 methotrexate, 9 patients (12 hips) had no medication at time of the index operation. No  
114 patient had received bone modulating drugs during the entire period of follow-up. There  
115 were 4 patients (4 hips) rated as Charnely A, 1 patient (2 hips) as Charnely B and 12  
116 patients (21 hips) as Charnely C [20].

117 The CLS femoral component is a collarless, three-dimensional tapered wedged made of  
118 titanium alloy (Ti<sub>6</sub>Al<sub>7</sub>Nb). Ribs in the proximal part of the prosthesis are designed to  
119 minimize rotational migration. The distal part is intentionally made small to avoid  
120 filling of the intramedullary canal in the diaphysis in order to encourage proximal load  
121 transfer to the femur. The surface was rough blasted and had no porous coating [21]. All  
122 procedures were performed in staged settings by three different senior surgeon in a

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

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

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

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

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

154 Radiographs were evaluated by an independent observer (LAM) who was unaware of  
155 the clinical outcome of the surgical procedure. Evaluation of the femoral and acetabular  
156 components was performed using published criteria [24]. Radiological “stability” of the  
157 femoral component was additionally assessed according to the criteria of Engh et al.  
158 [25]. Location of radiolucent lines, osteolysis and cortical hypertrophy were rated  
159 according to the Gruen criteria [26]. For evaluation of heterotopic ossification, the  
160 Brooker classification was used [27]. Stress shielding was classified as grade I when  
161 only resorption of the medial edge of the resection line appeared, grade II meant  
162 additional proximal medial bone resorption, while grade III findings extended more  
163 distally [28,29].

164

## 165 **Results**

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

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

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

180 The Harris Hip Score (HHS) was not taken preoperatively. Retrospective assessment of  
181 patient charts showed marked pain in all patients. Range of hip motion was limited to  
182 less than 110° in all cases, only 6 patients (35%) were able to walk without a cane or  
183 crutches. At follow-up the average HHS was 86. 14 hips were rated as excellent (52%);  
184 9, good (33%); and 4, fair (14%). 25 hips (93%) had total relief from pain in the thigh,  
185 groin or buttocks. 2 hips (7%) presented with occasional pain of the buttocks and the  
186 and the thigh. A Trendelenburg limp was found in 1 hip (4%) caused by a postoperative  
187 partial paralysis of the sciatic nerve after acetabular revision surgery. 13 patients (76%)  
188 could walk over 500 meters, 4 patients (24%) walked outdoors under 500 meters. 11  
189 patients (65%) needed no assistive devices for walking while 2 patients (12%) used a  
190 cane for outdoor walking only, 3 patients (18%) regularly used one cane.

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

197 zones 2 and 6 (grade III). A non progressive 4x5x5mm osteolysis was seen in 1 patient  
198 (1 hip) located in Gruen zone 7, with 1-2mm wear of the cemented PE-cup. In another  
199 case of suspected press-fit cup loosening both stem and cup were intraoperatively found  
200 to be stable, a small proximal osteolysis in Gruen zone 7 was filled with autologous  
201 bone graft.

202 Radiolucencies of the stem without progression were found in 3 cases, all of which were  
203 located in the proximal Gruen zones I. Cortical hypertrophy was seen in 3 hips (11%) in  
204 Gruen zone 3 and 5. 12 hips 45% developed a radiographic appearance of bone  
205 apposition at the tip of the stem. Heterotopic ossification was present in 11 hips (41%):  
206 8 hips (30%) grade I and 3 hips (11%) grade II.

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

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

215 The amount of wear of the polyethylene liner or cup (n=20 of the 22 non-revised hips)  
216 was analyzed in increments of 1 mm maximum accuracy: < 1 mm (1 hip, 4%), 1-2 mm  
217 (7 hips, 26 %, 4 PE-liners, 3 metasul-PE-liners).

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

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

223

## 224 **Discussion**

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

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

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

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

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

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

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

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

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

276 The chronic course of RA with multiple affected joints of the lower limbs affected,  
277 makes the clinical evaluation of a specific surgical procedure difficult to interpret.

278 While excellent clinical results after THA were reported by Keisu et al. [10] with a  
279 relatively high HHS of 93 (follow-up mean: 8 years; mean age at operation: 55 years)  
280 and 32% of their patients classified according to Charnley as grade C, Jana et al. [9]  
281 found the Merle D'Aubigné and Postel walking score (follow-up mean: 10 years; mean  
282 age at operation: 55.1 years) to improve in only 61% of their patients, 20% had lower  
283 scores. Even though 12 patients (21 hips, 78%) of our patients were rated as Charnely C  
284 we found satisfying clinical results with an average HHS of 86 at follow-up. All patients  
285 reported clinical improvement with reduced pain and increased walking distance.

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

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

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

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

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

318 (29%), > 2 mm (5%), for patients with osteoarthritis of the hip joint (mean time of  
319 follow-up 10.3 years, mean age at operation 51 years) who had received the same  
320 prosthesis in the same clinic with an identical polyethylen liner. Even though our cohort  
321 was slightly younger and our mean follow-up an average 2 years longer, we observed  
322 less PE-wear (< 1 mm (1 hip, 4%), 1-2 mm (7 hips, 26 %, 4 PE-liners, 3 metasul-PE-  
323 liners) which be contribute to the lower physical demand of RA patients.

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

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

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334

### 335 **Legends**

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

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

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484 Table 1. Reoperation summary of all analysed hips

After operation (years)	Components revised	Revision diagnosis
485 4.1	Zirconium coated Phoenix cup	aseptic loosening
486 7.10	Zirconium coated Phoenix cup	aseptic loosening
487 10.1	Inlay (Aesculap plasmacup)	extensive inlay wear
488 8.8	Zirconium coated Phoenix cup	aseptic loosening
489 9.3	cemented PE cup	aseptic loosening
490 12.0	Zirconium coated Phoenix cup	aseptic loosening

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

Author	No. of THA/ no.of	Mean age at operation patients	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 (%)
502 Lachiewicz (1994) <sup>a</sup> jRA	35/25	41	4.5	none	HHS 91	none	none	none	1 (3%)
503 Garcia (1998) <sup>b</sup> aRA	33/32	51	5	none	HHS 81	none	none	none	none
504 Loehr (1999) <sup>c</sup> aRA	21/15	53	3.3	none	n.a.	none	5 (24%)	none	none
505 Keisu (2001) <sup>d</sup> aRA	50/39	55	8	19%	HHS 93	none	none	7 (14%)	7 (14%)
506 Jana (2001) <sup>e</sup> aRA	71/55	55	11.4	13%	n.a.	1 (2%)	5 (7%)	14 (20%)	21 (30%)
507 Lybaeck (2004) <sup>d</sup> jRA	77/55	28	10	9%	n.a.	2 (3%)	n.a.	27 (39%)	n.a.
508 Schramm (2000) <sup>c</sup> OA	89/80	51	10.3	7%	84%	none	4 (5%)	3 (4%)	7 (9%)
509 <b>Present study<sup>c</sup>; aRA</b>	<b>39/27</b>	<b>45</b>	<b>12.2</b>	<b>13%</b>	<b>HHS 86</b>	<b>none</b>	<b>none</b>	<b>6 (22%)</b>	<b>6 (22%)</b>

510 <sup>a</sup>Harris-Galante porous (Zimmer)

511 <sup>b</sup>AGB hip prosthesis (Howmedica)

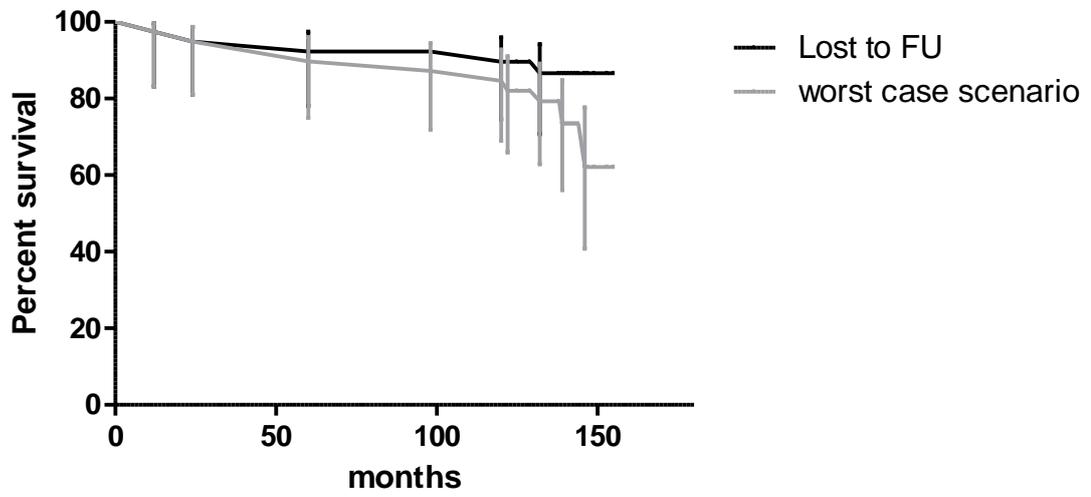
512 <sup>c</sup>CLS-stem (Zimmer)

513 <sup>d</sup>Taperloc femoral stem (Biomet)

514 <sup>e</sup>Anatomic Medullary Locking stem (DePuy, Johnson & Johnson)

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**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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