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HIP

Less early subsidence of cemented Exeter short stems compared with cemented Exeter standard stems in Dorr type A femurs

A RADIOSTEREOMETRY STUDY WITH MINIMUM FIVE YEARS' FOLLOW-UP

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Aims

The Exeter short stem was designed for patients with Dorr type A femora and short-term results are promising. The aim of this study was to evaluate the minimum five-year stem migration pattern of Exeter short stems in comparison with Exeter standard stems.

Methods

In this case-control study, 25 patients (22 female) at mean age of 78 years (70 to 89) received cemented Exeter short stem (case group). Cases were selected based on Dorr type A femora and matched first by Dorr type A and then age to a control cohort of 21 patients (11 female) at mean age of 74 years (70 to 89) who received with cemented Exeter standard stems (control group). Preoperatively, all patients had primary hip osteoarthritis and no osteoporosis as confirmed by dual X-ray absorptiometry scanning. Patients were followed with radiostereometry for evaluation of stem migration (primary endpoint), evaluation of cement quality, and Oxford Hip Score. Measurements were taken preoperatively, and at three, 12, and 24 months and a minimum five-year follow-up.

Results

At three months, subsidence of the short stem -0.87 mm (95% confidence interval (CI) -1.07 to -0.67) was lower compared to the standard stem -1.59 mm (95% CI -1.82 to -1.36; $p < 0.001$). Both stems continued a similar pattern of subsidence until five-year follow-up. At five-year follow-up, the short stem had subsided mean -1.67 mm (95% CI -1.98 to -1.36) compared to mean -2.67 mm (95% CI -3.03 to -2.32) for the standard stem ($p < 0.001$). Subsidence was not influenced by preoperative bone quality (osteopenia vs normal) or cement mantle thickness.

Conclusion

The standard Exeter stem had more early subsidence compared with the short Exeter stem in patients with Dorr type A femora, but thereafter a similar migration pattern of subsidence until minimum five years follow-up. Both the standard and the short Exeter stems subside. The standard stem subsides more compared to the short stem in Dorr type A femurs. Subsidence of the Exeter stems was not affected by cement mantle thickness.

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Introduction

The cemented Exeter stem (Stryker, USA) has a long follow-up and low revision rates in total hip arthroplasty (THA) of older patients with osteoarthritis (OA).[1,2] However, in patients with a narrow femoral canal (Dorr

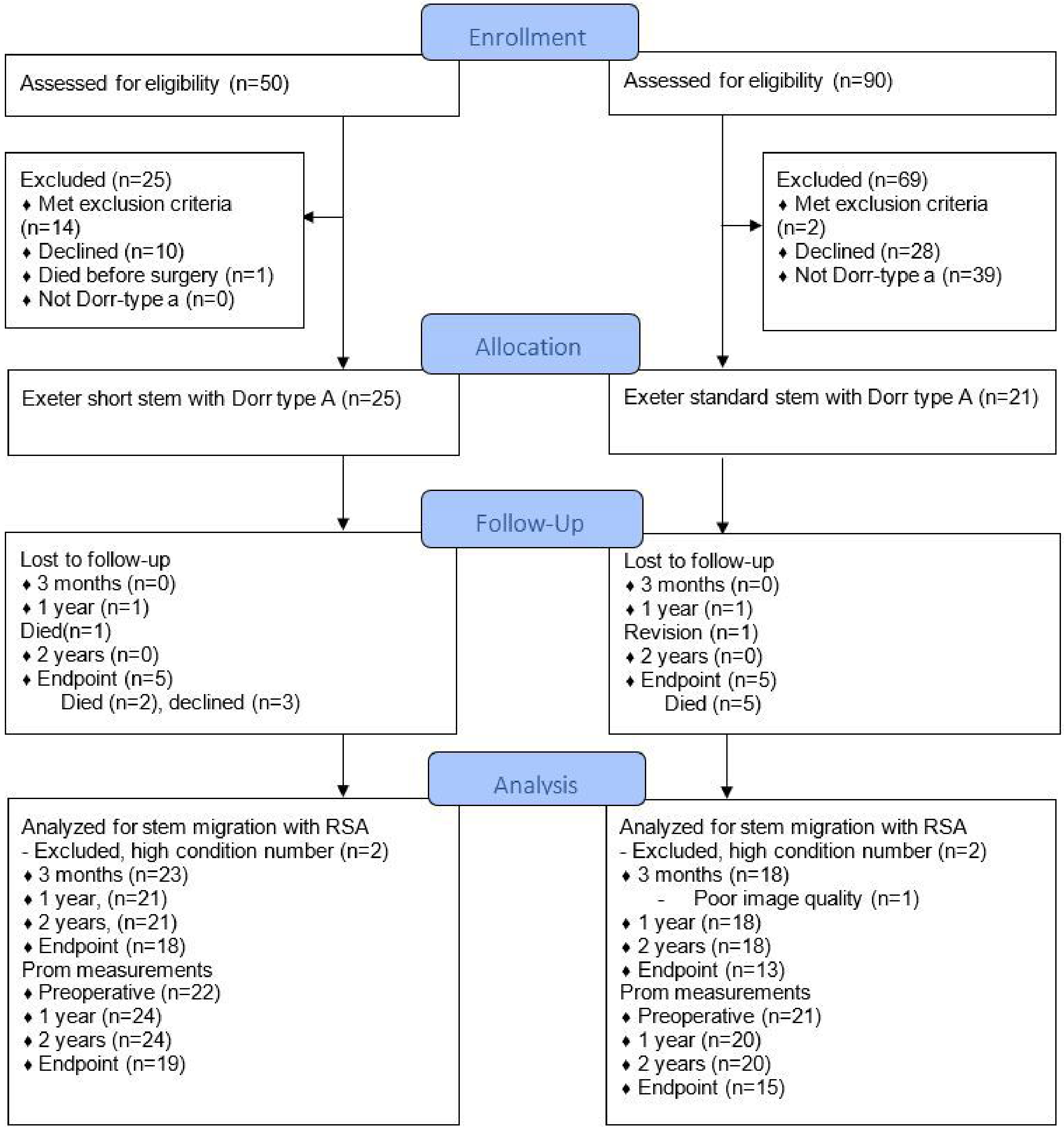

Fig. 1

Flowchart. RSA, radiostereometric analysis.

type A),[3] the Exeter stem design has been suggested to cause oversizing leading to an inadequate cement mantle thickness, increased risk of cement fracture, and ultimately increased risk of stem revision.[4] Consequently, the Exeter short stem design was developed to accommodate the anatomy of smaller femoral canals.

The Exeter stem design is 'force-closed', which is a polished and tapered stem intended to continuously subside in the bone cement mantle.[5,6] Continued stem subsidence and retroversion of the standard Exeter stem has been reported across the first decade after surgery, and studies indicate that it will likely continue throughout the lifespan of the implant.[7]

Radiostereometric analysis (RSA) is the gold standard method for measurement of implant migration.[8,9] The Exeter stem migration pattern in the short and longer term has been thoroughly investigated using RSA in patients with hip OA and hip fracture.[7,10] In contrast, only the short-term migration pattern of the Exeter short stem in Dorr type A femora has been reported, and studies comparing the two stem designs for patients with narrow femoral canals are lacking in the literature.[11]

Table I. Baseline demographic details of patients with short and standard stems.

Variable	Short stem	Standard stem	p-value
Total, n	25	21	
Mean age, yrs (95% CI)	78 (76 to 80)	74 (72 to 75)	0.003*
Sex, n			0.007†
Female	22	11	
Male	3	10	
Mean ASA grade (95% CI)	2.1 (1.9 to 2.4)‡	1.9 (1.7 to 2.1)	0.175*
Mean T-score (95% CI)	-1.4 (-1.8 to -1.0)	-0.5 (-1.1 to 0.1)	0.008*
Mean BMI, kg/m² (95% CI)	27 (25 to 28)	30 (28 to 32)	0.009*
Mean OHS (95% CI)	22 (18 to 26)‡	25 (22 to 28)	0.214*
Side, n			0.980†
Right	13	11	
Left	12	10	

*Independent-samples *t*-test.
†Chi-squared test.
‡Data missing for three patients.
ASA, American Society of Anesthesiologists; CI, confidence interval; OHS, Oxford Hip Score.

The purpose of this study was to compare the migration pattern until mid-term follow-up of cemented Exeter short stems (cases) with cemented Exeter standard stems (controls) in age matched patients with Dorr type A femora. We hypothesized that the Exeter short stem would subside and rotate less compared to the standard-length stem.

Methods. A case cohort of 25 patients at mean age of 78 years (70 to 81) with Dorr type A femora was operated with the 125 mm Exeter short stem (Stryker, USA) between May 2015 and March 2017 at Aarhus University Hospital, Denmark, and the two-year stem migration results were previously published.[11]

A control cohort of 21 patients with 150 mm Exeter standard stem (Stryker, USA) were matched first by Dorr type A and then age to the case group from a randomized study on cup fixation.[12] The control group were a mean age of 74 years (70 to 81) and were operated between November 2014 and January 2018 at Gødstrup Regional Hospital, Denmark.[12] The studies were approved by the Central Danish Regional Committees on Biomechanical Research Ethics ((1-10-72-209-14)/(1-10-72-346-13)), and the randomized controlled trial (standard stem) was registered with ClinicalTrials.gov (NCT02404727).

Inclusion criteria were primary hip OA and Dorr type A femora on preoperative radiological assessment, age > 70 years, and no osteoporosis confirmed by dual X-ray absorptiometry (DXA) scanning. Exclusion criteria were vascular or neuromuscular disease in the operated leg, metabolic bone disease, major psychiatric disease, active cancer, severe systemic disease affecting the ability to walk, severe disease in the opposite leg or spine, current work-related injury case concerning the relevant hip, poor dental status, and alcohol or drug abuse. Patients only participated in the study with one hip.

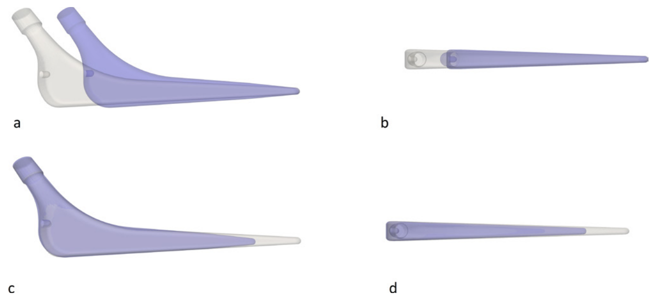

Fig. 2

3D models of the Exeter short stem (blue) and Exeter standard stem (grey) showns that a) and b) the short stem has a similar taper but distributed on a shorter stem (a, b), and proximal geometry similar to the standard stem (c, d).

All patients were examined postoperatively at three, 12, and 24 months and at a minimum five-year follow-up. The mean endpoint follow-up was 61 months (60 to 64) for the short stems and 74 months (69 to 83) for the standard stems.

Baseline patient demographics are presented in Table I and the patient flow is described in Figure 1. One patient received revision surgery due to deep infection after open reduction of intraprosthetic dislocation,[12] and was excluded from the analyses. No further revision surgery, hip dislocation, or signs of infection were registered at two years or the endpoint.

Prosthesis, surgery, and rehabilitation. All Exeter stems were collarless, polished, and double-tapered. The geometry and measures of the proximal part of the stem was similar for standard an short Exeter stems but the taper of the short stem was greater (Figure 2).

The standard stems were inserted with vacuum mixed Palacos *R* + G bone cement (Heraeus Medical, Germany) and combined with a chrome-cobalt 28 mm femoral head and a highly cross-linked vitamin E infused polyethylene liner (E1; Zimmer Biomet, USA) in an Avantage Reload cemented or cementless dual-mobility acetabular component (Zimmer Biomet). The short stems were fixed with vacuum mixed Refobacin Bone Cement R (Zimmer Biomet) and combined with either a chrome-cobalt (Lfit; Stryker, Poland) or a ceramic (Biolox Delta; CeramTec, Germany) 28 mm femoral head and a sequentially annealed highly cross-linked liner (x3; Stryker, Poland) in a cementless Anatomical Dual Mobility acetabular component (ADM; Stryker, Poland).

All procedures were performed by experienced hip surgeons using the posterolateral surgical approach. All patients had six to eight 1 mm tantalum beads inserted in the periprosthetic femoral bone (lesser and greater trochanter) for RSA analysis. All patients received 1,500 mg Cefuroxime (B. Braun, Germany) during and three times within 24 hours of surgery as prophylactic antibiotics. Thromboprophylactic treatment (daily: Xarelto 10 mg × 1 or Eliquis 2.5 mg × 2) was routinely

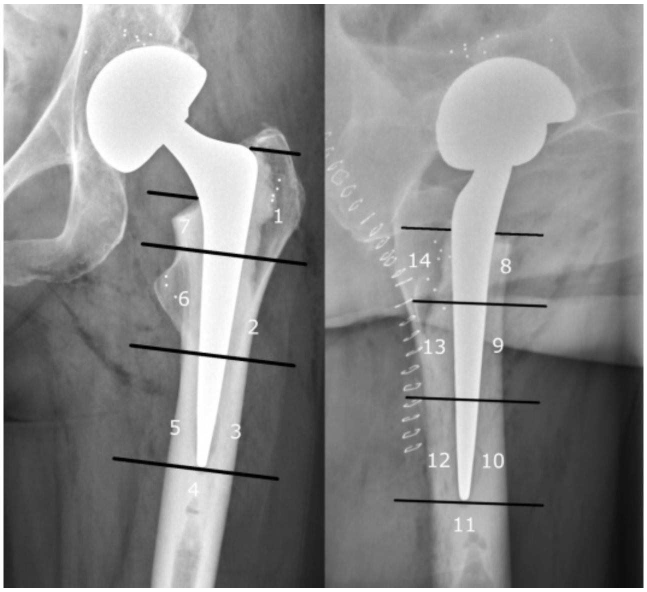

Fig. 3

Anterior/posterior and cross-table lateral radiographs of a right hip with Exeter short stem. Modified Grüen zones were used in the radiographic evaluation. The periprosthetic bone was evenly divided from tip to shoulder. Proximal zones ended with the cement mantle. The zones were numbered from lateral to medial and from anterior to posterior.

administered postoperatively until discharge. Postoperatively, patients were encouraged to walk with full weight-bearing supported by walking aids as needed.

RSA. All RSA images were obtained using a standard RSA set-up previously described.[11,12] RSA recordings were analyzed by one experienced analysist (PBJ) using the elementary geometrical shape method in Model-Based RSA 4.2 (RSAcore, Netherlands). The stem translations and rotations were measured relative to the femoral bone markers in the coordinate system of the calibration box.[8] In six cases, a mean marker configuration model was used.[13] Four patients were excluded from the analysis due to poor bone-marker representation. The maximum accepted condition number and mean rigid body error was 151 and 0.35, respectively. The mean condition number was 80 (95% confidence interval (CI) 73 to 88).

Radiological evaluation. Radiological evaluation was performed twice for all patients by two experienced surgeons (DV, SSJ) and the mean value of the measurements was used. Preoperative anteroposterior (AP) radiographs were used to measure the cortical index as described by Gruen et al[14] and categorize femora as described by Dorr et al.[3] Adequate cement thickness was defined as a minimum of 2 mm.[15] Cement mantle thickness (mm) and valgus/varus stem alignment were evaluated on radiographs taken postoperatively.[16] Radiolucent line (RLL) thickness (mm) and osteolytic areas (mm × mm) were evaluated in 14 modified Gruen zones on AP and lateral radiographs taken postoperatively and compared to radiographs at the endpoint (Figure 3).

Table II. Precision of radiostereometric analysis measurements based on 42 double examinations.

Measurement	Mean difference (SD; 95% CI)
Translation, mm	
X	-0.01 (0.18; -0.07 to 0.05)
Y	-0.03 (0.12; -0.07 to 0.00)
Z	0.07 (0.38; -0.05 to 0.19)
Rotation, °	
X	-0.07 (0.32; -0.17 to 0.03)
Y	-0.16 (1.24; -0.54 to 0.23)
Z	-0.01 (0.17; -0.06 to 0.04)

CI, confidence interval; SD, standard deviation.

Cement fracture was evaluated on the last follow-up radiograph. RLLs of more than 1 mm and development of osteolytic areas of more than 3 × 3 mm was registered on the final radiograph.[17,18] The measurements were adjusted for magnification using the known size of the femoral head or known cup diameter.

DXA. All patients were preoperatively assessed for osteoporosis using a DXA scan of the lumbar spine scan (L1-L4) and both hips. The lowest T-score value was used to categorize osteopenia (T-score < -1.0) and normal bone density (T ≥ -1.0).[19] DXA scans were performed on identical two fan-beam Lunar iDXA scanners (GE, USA) in both institutions and analyzed with Encore software (v. 13; USA) using the USA National Health and Nutrition Examination Survey as reference population.[19]

Patient-reported outcome measures. Patient-perceived outcome was scored from 0 (worst) to 48 points (best) using Oxford hip score (OHS).[20–22] The minimal important change in OHS was assumed at 10 points.[23] Pain was measured on a visual analogue scale from 0 to 100 (no pain to worst pain), at rest and active. Scores were obtained preoperatively, at 12 and 24 months and at endpoint follow-ups. Patients and medical records in were inquired about revisions, dislocations, and signs of infections during follow-up.

Statistical analysis. Distribution of variables was evaluated using qq-plots. The effect of stem length, T-score, stem varus-alignment with femur, and cement mantle (< 2 mm) was tested using univariate repeated measurement analysis (mixed model), with the interaction of time and fixation as fixed effect. Migration measures were presented using mean and 95% confidence intervals (CIs). The effect of stem length on improvements in OHS and pain was tested using independent-samples *t*-test. Sex and side were tested using chi-squared test. Precision of RSA measurements was calculated from double examinations expecting zero migration between the two recordings,[8] and reported as mean difference (bias), standard deviation (SD), and 95% CIs. Statistics were calculated using Stata v. /BE 17.0 (StataCorp, USA) and the statistical significance was set at $p < 0.05$.

Table III. Translations and rotations for mixed model of short and standard Exeter stems. Endpoint was a minimum 60 months.

Movement	Short stem	Standard stem	p-value*
Mean translation, mm (95% CI)			
x (+medial/-lateral)			
3 months	-0.09 (-0.18 to -0.01)	0.03 (-0.07 to 0.13)	0.067
12 months	-0.12 (-0.25 to 0.01)	0.01 (-0.14 to 0.15)	0.189
24 months	-0.14 (-0.27 to -0.02)	0.01 (-0.13 to 0.15)	0.119
Endpoint	-0.05 (-0.16 to 0.06)	-0.00 (-0.12 to 0.12)	0.541
y (+proximal/-distal; subsidence)			
3 months	-0.87 (-1.07 to -0.67)	-1.59 (-1.82 to -1.36)	< 0.001
12 months	-1.26 (-1.51 to -1.01)	-2.09 (-2.38 to -1.81)	< 0.001
24 months	-1.45 (-1.73 to -1.17)	-2.31 (-2.63 to -1.99)	< 0.001
Endpoint	-1.67 (-1.98 to -1.36)	-2.67 (-3.03 to -2.32)	< 0.001
z (+anterior/-posterior)			
3 months	-0.05 (-0.20 to 0.10)	-0.04 (-0.21 to 0.13)	0.929
12 months	-0.12 (-0.34 to 0.09)	-0.16 (-0.40 to 0.08)	0.810
24 months	-0.12 (-0.31 to 0.08)	-0.18 (-0.39 to 0.04)	0.688
Endpoint	-0.14 (-0.31 to 0.02)	-0.10 (-0.29 to 0.09)	0.729
Total translation			
3 months	0.96 (0.74 to 1.18)	1.62 (1.38 to 1.87)	< 0.001
12 months	1.35 (1.09 to 1.62)	2.20 (1.91 to 2.50)	< 0.001
24 months	1.51 (1.23 to 1.79)	2.42 (2.10 to 2.73)	< 0.001
Endpoint	1.72 (1.40 to 2.04)	2.70 (2.33 to 3.06)	< 0.001
Mean rotation, ° (95% CI)			
x (+anterior/-posterior tilt)			
3 months	-0.17 (-0.48 to 0.15)	-0.04 (-0.41 to 0.32)	0.618
12 months	-0.19 (-0.54 to 0.15)	-0.11 (-0.49 to 0.27)	0.757
24 months	-0.15 (-0.51 to 0.21)	-0.09 (-0.49 to 0.31)	0.834
Endpoint	-0.20 (-0.56 to 0.17)	-0.35 (-0.77 to 0.06)	0.585
y (+retroversion/-anteversion)			
3 months	0.33 (-0.17 to 0.83)	0.30 (-0.28 to 0.87)	0.933
12 months	0.68 (0.16 to 1.21)	1.07 (0.49 to 1.65)	0.341
24 months	0.79 (0.28 to 1.30)	1.30 (0.74 to 1.87)	0.196
Endpoint	1.44 (0.85 to 2.02)	1.77 (1.10 to 2.44)	0.470
z (+valgus/- varus)			
3 months	0.06 (-0.06 to 0.18)	-0.12 (-0.25 to 0.01)	0.070
12 months	0.06 (-0.08 to 0.19)	-0.09 (-0.24 to 0.06)	0.179
24 months	0.04 (-0.12 to 0.19)	-0.11 (-0.29 to 0.07)	0.257
Endpoint	0.05 (-0.11 to 0.21)	-0.21 (-0.39 to 0.03)	0.057
Total rotation			
3 months	1.16 (0.80 to 1.52)	1.31 (0.90 to 1.72)	0.582
12 months	1.34 (0.94 to 1.75)	1.61 (1.16 to 2.06)	0.391
24 months	1.20 (0.72 to 1.68)	1.74 (1.22 to 2.27)	0.142
Endpoint	1.73 (1.22 to 2.25)	2.08 (1.49 to 2.67)	0.389
Maximum total point motion			
3 months	1.40 (0.99 to 1.80)	2.22 (1.77 to 2.68)	0.008
12 months	1.81 (1.41 to 2.21)	2.84 (2.40 to 3.29)	0.001
24 months	1.93 (1.53 to 2.32)	3.01 (2.56 to 3.46)	0.001
Endpoint	2.21 (1.76 to 2.66)	3.45 (2.94 to 3.96)	0.001

*Linear mixed model.
CI, confidence interval.

Results

Stem migration. Precision of RSA measurements is presented in Table II. The migration pattern showed statistically significantly and clinically relevant more early subsidence of the standard stem with continuous and similar subsidence in both groups after three months (Table III; Figure 4). At endpoint, the short stem subsided mean -1.67 mm (95% CI -1.98 to -1.36), which was less compared to mean -2.67 mm (95% CI -3.03 to -2.32) for the standard stem ($p < 0.001$, mixed model). Subsidence was

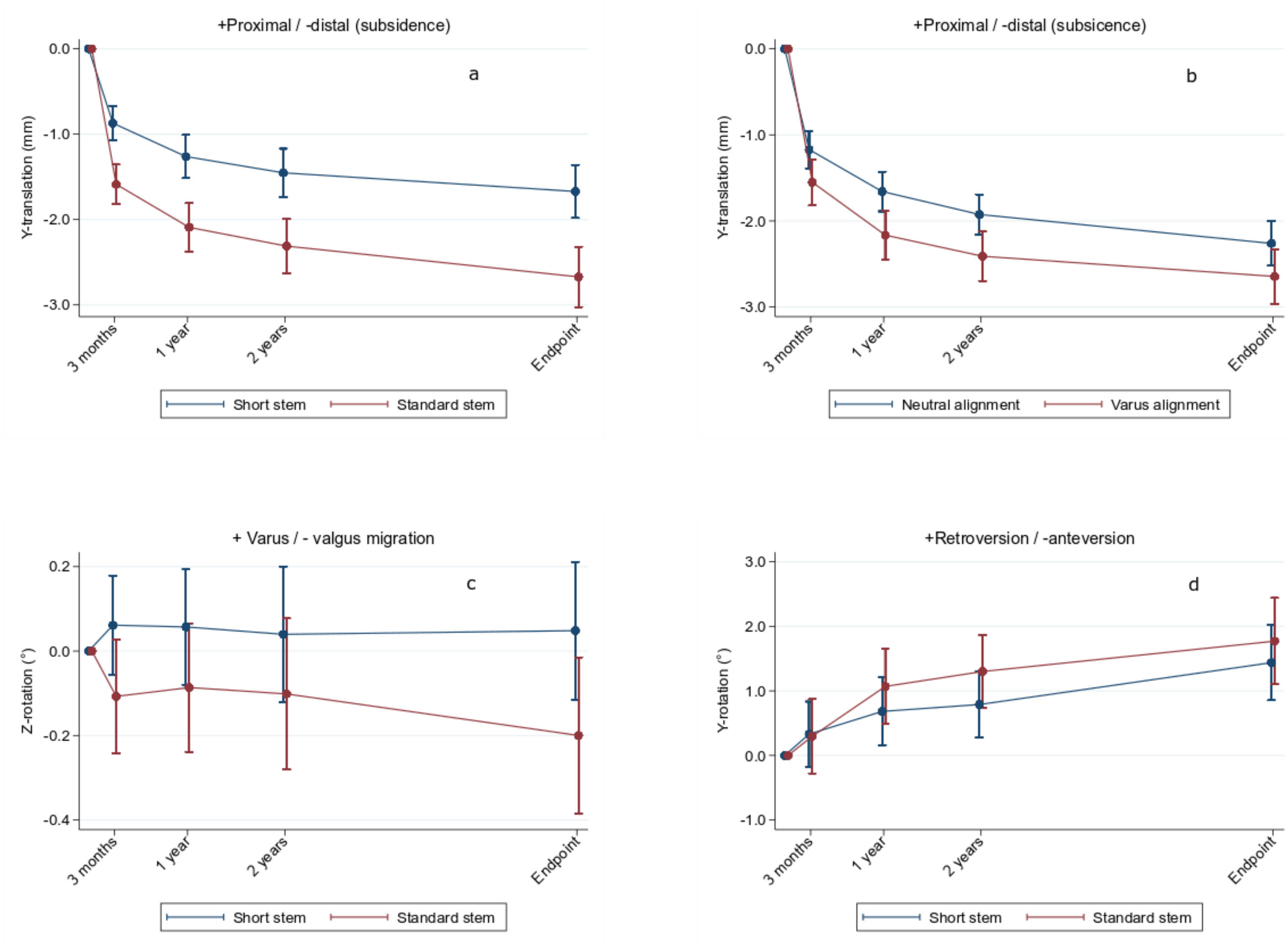

Fig. 4

Graphic results from mixed model analysis showing a) and b) stem subsidence (-), c) valgus(+)/varus(-) stem rotation, and d) stem retroversion(+)/anteversion(-).

larger in patients with varus alignment until two years' follow-up (p = 0.011, mixed model) but was not influenced by preoperative bone quality (osteopenia vs normal) or cement mantle thickness.

Both stems had retroversion (five-year mean 1.44° (95% CI 0.85 to 2.02) and 1.77° (95% CI 1.10 to 2.44)) with a continued migration pattern towards endpoint follow-up (Figure 3). The short stem migrated slightly in valgus (five-year mean 0.05° (95% CI -0.11 to 0.21)), whereas the standard stem migrated slightly in varus (five-year mean 0.20° (95% CI 0.01 to 0.38)) (Figure 3; Table III).

Radiological evaluation. All femora were classified as Dorr type A. The postoperative stem alignment was mean 2.4° (SD 1.9°) varus for the short stems and mean 2.8° (SD 1.9°) varus for the standard stems. The cement mantle was thicker in zone one of short stems compared to standard stems (p = 0.004, independent-samples *t*-test). In zone six and seven, the cement mantle was thinner for short stems compared to standard stems, (p = 0.041, independent-samples *t*-test). Inadequate cement mantle (< 2 mm thickness) was registered in at least one zone in 21 patients with short stem and in 15 patients with standard stem. There were no RLLs for the short stem but one patient with standard stem had RLLs between cement and bone in three zones (one, seven, and eight). No cement fractures or osteolytic areas were found in the two cohorts (Table IV).

Patient-reported outcomes. OHS increased 18 points (95% CI 12 to 23) to 39 points (95% CI 34 to 44) in the short stem group and 19 points (95% CI 13 to 25) to 44 (CI 95% 41 to 48) in the standard stem group (p = 0.752, independent-samples *t*-test). Likewise, pain was significantly improved (p < 0.001, independent-samples *t*-test). At final follow-up, VAS pain at rest and during activity was 4 (95% CI 0 to 8) and 10 (95% CI 3 to 17) respectively, with no significant difference between groups (p = 0.305, independent-samples *t*-test).

Table IV. Radiological evaluation. Cement mantle thickness and stem alignment were measured on the postoperative radiographs and radiolucent lines measured on the latest available radiographs. No cement fractures or osteolytic areas were found in the two cohorts.

	Short stem (n = 25)			Standard stem (n = 21)			
Variable	**Mean cement mantle, mm (SD)**	**< 2 mm, n**	**RLL, n**	**Mean cement mantle, mm (SD)**	**< 2 mm, n**	**RLL, n**	**p-value***
Gruen zone							
Zone 1	3.2 (1.4)	6	0	2.1 (1.2)	9	1	0.004
Zone 2	4.0 (1.2)	1	0	4.5 (1.6)	1	0	0.238
Zone 3	3.5 (1.2)	1	0	2.8 (0.8)	5	0	0.053
Zone 4	11.9 (2.6)	0	0	13.8 (3.3)	0	0	0.037
Zone 5	2.6 (0.7)	4	0	3.0 (0.9)	1	0	0.097
Zone 6	2.1 (1.0)	15	0	2.8 (1.1)	8	0	0.041
Zone 7	3.2 (1.0)	2	0	5.1 (1.8)	1	1	< 0.001
Zone 8	2.9 (1.1)	4	0	3.1 (1.3)	3	1	0.532
Zone 9	2.5 (1.1)	9	0	2.0 (1.1)	11	0	0.205
Zone 10	4.1 (1.3)	1	0	4.0 (1.1)	0	0	0.781
Zone 11	14.8 (3.8)	0	0	16.2 (3.7)	0	0	0.194
Zone 12	4.5 (1.4)	0	0	4.6 (1.7)	1	0	0.721
Zone 13	6.3 (2.1)	0	0	7.1 (2.1)	0	0	0.214
Zone 14	3.3 (1.2)	2	0	3.6 (2.3)	1	0	0.630
Cortical index	56.8 (6.8)			62.7 (5.2)			
	Mean (SD)	Valgus (> 3°), n	Varus (< -3°), n	Mean (SD)	Valgus (> 3°), n	Varus (< -3°), n	
Stem alignment, °	-2.4 (1.9)	1	11	-2.8 (1.9)	0	9	

*Independent-samples *t*-test.
RLL, radiolucent lines; SD, standard deviation.

Discussion

The key finding was more early subsidence in Exeter standard stems compared with the short stem in patients with primary hip OA and Dorr type A femora. After three months, both stems had a migration pattern of continued and similar subsidence and retroversion. From a postoperative mean varus alignment, the short stem rotated slightly in valgus whereas the standard stem rotated slightly in varus. The cement mantle was thicker in the proximal lateral femoral Gruen zone one, and thinner in proximal medial femoral zones, for the short stem compared to the standard stem.

Subsidence of the Exeter short stem has not previously been reported for longer follow-ups, but five-year subsidence for Exeter standard stems has been reported to 1.9 mm and 1.8 mm,[7,24] which is comparable to the mean 1.7 mm in short stems but somewhat less than the mean 2.7 mm found for standard stems in this study. In other cemented tapered stems, excess subsidence has been shown to be associated with increased risk of revision,[25,26] but the Exeter standard stem is designed for continued distal migration.[6] Although this subsidence continues without excess implant failure,[7] the increased laxity of the joint may increase the risk of edge loading and subsequent wear of the liner.[27,28] Therefore, limited subsidence of the short stem may be preferable.

Studies indicate that retroversion may increase the risk of failure for cemented tapered polished stems.[29–31] We found no difference in retroversion for the short and standard stems, but the low retroversion of the short stem herald good survivability.[32]

Postoperative stem alignment in varus has been associated with periprosthetic fractures, excess subsidence, and increased cement stress (Gruen zones 3 and 7) at long-term follow-up.[33] The majority of the stems in both groups were inserted in varus alignment (> 3°) or neutral alignment but we found no statistically significant difference in subsidence based on stem alignment. There was very limited rotation of the short stem in varus direction, which may supportive of a good long-term survival of the short stem design.

Oversizing of the stem leaves only space for a very thin cement mantle, which has been suggested to lead to cement fractures in Dorr type A femora operated with standard length Exeter stem.[4] We found no cement fractures in either group, although more than half of the patients had cement mantles thinner than 2 mm. Furthermore, the difference in stem subsidence between the two groups could not be explained by cement mantle thickness, which is in line with a long-term study of the Exeter standard stem.[10]

In general, changes in the stem shape affects the load transmission to the cement mantle, stem migration and potential stem survival.[34] We believe that the funnel-like shape of the short stem resists subsidence and complies with the anatomy of the proximal femur seen in Dorr type A femora and is the likely reason that Exeter short stems subsides less than the Exeter standard stems. The subsidence of the short stem was similar to that of the triple tapered short C-stem reported by Sundberg et al,[24] though not specifically in Dorr type A femora.

We used a control group with cemented Exeter standard stem as comparison with the case group that received Exeter short stem. There were many similarities and a few differences for the settings in which the two stems were inserted. The surgeons were all very familiar with insertion of both stem types and only three surgeons operated the patients in two locations. The same guide system and technique were used for both stem types. The RSA, radiograph, and DXA systems used to evaluate the two patient cohorts were of the same brand in the two institutions where patients were treated. One very experienced technician analyzed all DXA scans and RSA images and two surgeons evaluated the radiological outcome. In terms of differences, the final follow-up time of Exeter short stem (five years) was shorter than for the Exeter standard stem (six years). Unsurprisingly, this leads to more migration for the standard stem at final endpoint as the Exeter stem design promotes continued migration. Nonetheless, the group differences presented early, at three months, with more subsidence and varus rotation in Exeter standard stems. Therefore, the one-year time difference in final follow-up does not explain the difference in implant migration alone.

Short stems were cemented with Refobacin bone cement R and standard stems were cemented with Palacos *R* + G cement. However, Refobacin bone cement R and Palacos *R* + G shows similar shrinkage and similar stem migration measured with RSA in collarless, highly polished and tapered stem.[35,36] Further, any differences in cement viscosity have no effect on migrations of the Exeter stem.[37]

In conclusion, the standard Exeter stem had more early subsidence compared with the short Exeter stem in patients with Dorr type A femora, but thereafter a similar migration pattern of subsidence until a minimum five-year follow-up.

Take home message

- The standard Exeter stem had more early subsidence compared with the short Exeter stem in patients with Dorr type A femora.

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