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Original research

How do cemented short Exeter stems perform compared with standard-length Exeter stems? The experience of the New Zealand National Joint Registry

Michael C. Wyatt, FRACS [a, b, *], Vaughan Poutawera, FRACS [c], David C. Kieser, PhD, FRACS [d], Chris M.A. Frampton, PhD [d], Gary J. Hooper, MD, FRACS [d]

[a] Department of Trauma and Orthopaedic Surgery, Midcentral District Health Board, Palmerston North Hospital, Palmerston North, Manawatu, New Zealand
[b] Department of Tranlational Health Sciences, Massey University, Palmerston North, Manawatu, New Zealand
[c] Department of Trauma and Orthopaedics, Tauranga Hospital, Tauranga, New Zealand
[d] Department of Orthopaedic Surgery and Musculoskeletal Medicine, University of Otago Christchurch, Christchurch, New Zealand

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A B S T R A C T

Background: The standard Exeter (Stryker) cemented stem is 150 mm long with standard offsets ranging from 37.5 mm to 56 mm. Exeter short stems of 125 mm are also available in the offsets of 37.5 mm, 44 mm, and 50 mm. In addition, smaller (125 mm or shorter) Exeter cemented stems with offsets of 35.5 mm or less are available. The aim of this study was to examine the New Zealand Joint Registry (NZJR) comparing medium-term survival rates and functional outcomes of standard-length stems with Exeter short stems of various offsets in patients undergoing primary total hip replacement.
Methods: Using the NZJR, we compared the results of 3 separate groups of patients with Exeter stems. Patients with standard 150 mm length Exeter stems (Standard) were compared with patients with Exeter 125 mm stems with regular 37.5 mm, 44 mm, and 50 mm offsets (Short 37+) and Exeter 125 mm stems with offsets of 35.5 mm and below (Short 37−). Demographic data, preoperative diagnosis, patient-reported outcome measures, and reasons for revision were compared between groups. Kaplan-Meier survival analysis and Cox multivariate regression analysis were used to examine implant survival and the influence of stem group on revision rates adjusting for gender, age, diagnosis, and surgical approach.
Results: There were 43,427 Exeter cemented stems in the NZJR between January 1, 1999 and 31, May 2018; 41,629 Standard, 657 Short 37+, and 1501 Short 37−. In all 3 groups, the posterior surgical approach was preferred (Standard, 76.1%; Short 37+, 94.6%; Short 37−, 76.6%; $P < .001$). In the Short 37− group, 94.1% were female, while in the other 2 groups, there was an equal gender ratio ($P < .001$). The Short 37- group was also significantly younger than the other 2 groups with 41.6% younger than 65 years compared with Short 37+ (37.2%) and Standard groups (36.9%) ($P < .01$). There was no difference in American Society of Anesthesiologists grade between groups. Body mass index (BMI) was significantly higher in both the Short 37− and Short 37 + groups compared with the Standard group (Standard BMI, 28.71; SD 5.72; Short 37+ BMI, 29.69; SD, 6.67; Short 37− BMI, 29.09; SD 7.07; $P < .001$). The all-cause revision rate for standard stems was 0.55/100 component years (cy) (95% CI: 0.52 to 0.58). The Short 37− group had a higher rate of revision compared with the Standard group (hazard ratio 1.6; 95% CI: 1.3 to 1.98; $P < .001$), while the Short 37+ group had a hazard ratio of 0.84 (95% CI: 0.38 to 1.88; $P = .674$) compared with the Standard group. Cox regression analysis controlling for age, gender, diagnosis of OA, and surgical approach did not affect these findings. However, no clinically meaningful difference between Oxford hip scores was observed.
Conclusions: There was a significant difference in revision rates for aseptic loosening with standard-length Exeter stems having a lower revision rate than short Exeter stems with offsets 35.5 mm or less. The Short 37+ groups, despite comprising relatively small numbers, performed similarly to the Standard stem group.

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* Corresponding author. Department of Trauma and Orthopaedic Surgery, Palmerston North Hospital, New Zealand. Tel.: +64 279202530.
E-mail address: michaelcharleswyatt@icloud.com

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Introduction

Total hip replacement (THR) for osteoarthritis is one of the most successful and cost-effective operations in modern medicine [1]. THR is now performed in increasingly younger patients, but this trend places growing demands on implant longevity. In New Zealand, the Exeter (Stryker) stem is the most commonly used cemented femoral component and has been for the last 20 years.

The Exeter stem was first introduced in 1970, and despite small modifications, the essential collarless, polished, dual tapered design has endured. This design transforms compressive load into circular hoop stresses which are subsequently transferred into the surrounding low modulus cement mantle and surrounding bone [2]. The standard Exeter stem is 150 mm in length and is available in 37.5 mm, 44 mm, 50 mm, and 56 mm offsets. To address smaller femoral canals such as those of the Asian population, for patients with juvenile arthritis or hip dysplasia, the 35.5 mm offset 125 mm long "CDH stem" was introduced in 2001. Further stems with smaller offsets of 33 mm (115 mm long) and 30 mm offset (95 mm long) were subsequently introduced (Fig. 1). Despite concerns about insufficient mechanical strength and premature stem breakage in short stems [3], a recent study from the Australian Orthopedic Association National Joint Registry showed that at 7 years, there was no significant difference in survival rates between standard-length Exeter stems and short stems of offsets of 35.5 mm or less [4]. This Australian study, however, did not include data on how the Exeter 125 mm of offsets 37.5 mm, 44 mm, and 50 mm (introduced in 2011) compared in terms of function or survivorship. Small changes in implant designs can lead to dramatic clinical failures [3,5]; therefore, the performance of smaller Exeter stems of various offsets must be proven to be at least the equivalent of the established standard-length stems.

The purpose of our study was therefore to examine the New Zealand Joint Registry (NZJR) to investigate the long-term survivorship of Exeter short stems (≤125 mm) of offsets 37.7 mm, 44 mm, and 50 mm (Short 37 + group) with Exeter short stems (≤125 mm) of offsets ≤35.5 mm (Short 37− group) compared with standard-length Exeter stems (Standard group). In particular, we sought to compare rates of femoral aseptic loosening. Our hypothesis was that Exeter short stems would compare favorably with standard-length stems.

Figure 1. Short and standard length Exeter cemented stems. Left to right: 95 mm length with 30 mm offset, 115 mm length with 33 mm offset, 125 mm length with 35.5 mm offset, 150 mm length with 37.5 mm offset.

Material and methods

Data source

The NZJR was established in 1998 and has a >96% data capture rate of all joint replacement surgeries. Prospective entry of data into the NZJR is a mandatory requirement of all members of the New Zealand Orthopedic Association with all data secured in Christchurch, New Zealand. One of the authors (C.F.) accessed the database to acquire data specifically for this study. Deidentified data of all patients undergoing primary THR from NZJR inception to May 31, 2018 was available for analysis. We performed and reported this study in accordance with STROBE and RECORD guidelines [6].

Ethical approval

No formal institutional review board approval was required as this was a review of the NZJR which already has institutional review board approval for publication of results stored in its registry.

Patient demographics and diagnosis

We collected the following patient demographics: age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA), and preoperative diagnosis. These factors were then compared between the 3 groups.

Operative cohort

We identified all Exeter stems used and divided these into 3 groups: Standard 150 mm length Exeter stems (Standard), Short 125 mm stems with offsets 37.5 mm or greater (Short 37+), and Short ≤125 mm stems with offsets ≤35.5 mm (Short 37−). The surgical approach used in each of the 3 groups was also examined.

There were 43,427 Exeter cemented stems reported in the NZJR between January 1, 1999 and 31, May 2018. There were 1501 Exeter short stems with offsets ≤35.5 mm (Short 37−), 657 Exeter short stems with standard, that is, 37.5 mm, 44 mm, and 50 mm offsets (Short 37+), and 41,269 standard-length stems with Universal and V40 stems combined (Standard).

In all groups, the posterior approach was preferred (Short 37− group, 76.6%; Short 37+ group, 94.7%; Standard group, 76.1%; $P <$ .001). The distribution of femoral offsets used in our study is shown in Table 1.

Outcome measures

(1) Revision rates: We examined the all-cause revision rates between study groups with revision recorded as the rate/100 component years (cy) with 95% confidence intervals. We define observed component years as the number of registered primary procedures multiplied by the number of years each component has been in place. The revision rate/100 cy is equivalent to the yearly revision rate expressed as a percentage and is derived by dividing the number of prostheses revised by the total observed component years multiplied by 100. This estimate allows the comparison of revision rates when examining implant data with varying follow-up times but does assume consistent revision rates over time. A "revision" included resection arthroplasty and amputation but not soft tissue procedures. The all-cause revision rate provides the most conservative estimate of prosthesis survivorship. In addition, we examined the reasons for revision

Table 1
Distribution of femoral component offsets between groups of Exeter cemented stems.

	Offset							Total
	30	33	35.5	37.5	44	50	56	
Short/standard stem								
Short 37−								
Count	12	13	1476	0	0	0	0	1501
%	0.8%	0.9%	98.3%	0.0%	0.0%	0.0%	0.0%	100.0%
Short 37+								
Count	0	0	0	245	326	86	0	657
%	0.0%	0.0%	0.0%	37.3%	49.6%	13.1%	0.0%	100.0%
Standard								
Count	0	0	0	9061	27,094	5010	95	41,260
%	0.0%	0.0%	0.0%	22.0%	65.7%	12.1%	0.2%	100.0%
Total								
Count	12	13	1476	9306	27,420	5096	95	43,418
%	0.0%	0.0%	3.4%	21.4%	63.2%	11.7%	0.2%	100.0%

Table 2
Comparison of diagnoses for patients undergoing primary THR for each of the 3 groups of Exeter stems.

Diagnosis											
	Osteoarthritis	Rheumatoid arthritis	Other Inflammatory	Acute fracture NOF	After dysplasia	Old fracture NOF	After dislocation	Avascular necrosis	Tumor	Other	Total
Short/standard stem											
Short 37−											
Count	1191	36	20	70	103	21	6	51	25	49	1501
%	79.3%	2.4%	1.3%	4.7%	6.9%	1.4%	0.4%	3.4%	1.7%	3.3%	100.0%
Short 37+											
Count	616	2	2	13	10	3	0	17	1	8	657
%	93.8%	0.3%	0.3%	2.0%	1.5%	0.5%	0.0%	2.6%	0.2%	1.2%	100.0%
Standard											
Count	36,144	567	224	2061	364	566	76	1178	252	872	41,926
%	87.6%	1.4%	0.5%	5.0%	0.9%	1.4%	0.2%	2.9%	0.6%	2.1%	100.0%
Total											
Count	37,951	605	246	2144	477	590	82	1246	278	929	43,427
%	87.4%	1.4%	0.6%	4.9%	1.1%	1.4%	0.2%	2.9%	0.6%	2.1%	100.0%

NOF, Neck of femur.

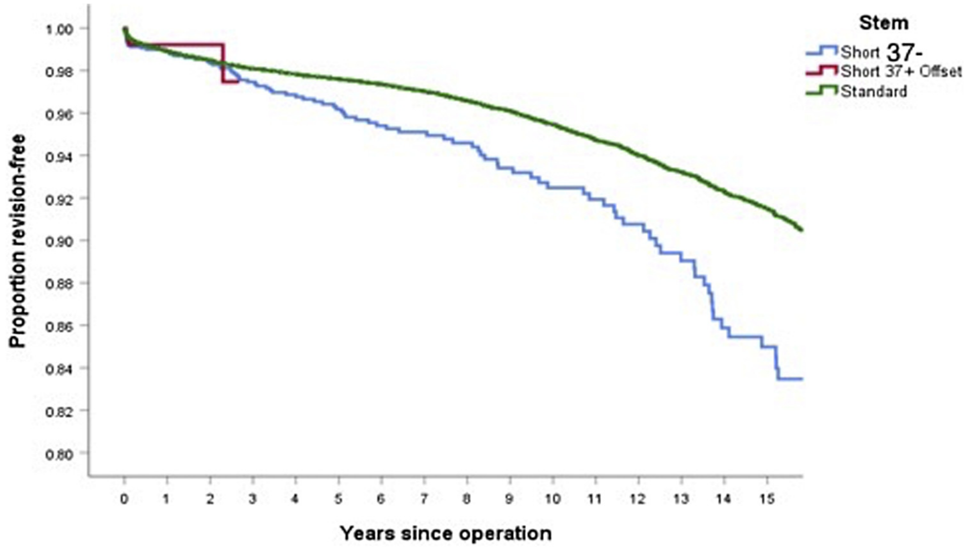

Figure 2. Kaplan-Meier survivorship curve of all-cause revision free survival rates compared between Exeter cemented stem groups.

and compared them within each group; in particular, we examined revisions for stem-related reasons such as fracture and aseptic loosening.

(2) Functional outcome scores: We examined the patient-reported outcome measures (PROMs) collected from patients at 6 months and at 5 years after arthroplasty (Oxford 12 scores). This validated score consists of 12 domains which address pain, function, and activities of daily living. Within each domain, a score of 0 is the worst, while 4 is the best. The overall best possible score is 48 and the worst is 0. These questionnaires were mailed to and completed by the patients without assistance or supervision. In the first 4 years of the NZJR, all patients were invited to complete these questionnaires and did so with a compliance rate of 70%. Because this time, 28% of patients have been selected randomly, and PROMs, distributed to this group to ensure at least a 20% return rate.

Statistical analysis

All-cause revision rates were expressed as rate/100 cy with 95% confidence intervals. Hazard ratios with 95% confidence intervals were examined and Kaplan-Meier survival analysis performed. Subsequently, Cox multivariate regression analysis was used to examine the influence of stem group on all-cause revision rates and revisions due to stem-related failures such as aseptic loosening and fracture adjusting for gender, age, and approach and diagnosis of OA. The Oxford 12 scores were compared between study groups using ANOVA. A P value of <.05 was deemed to be statistically significant.

Results

There were 43,427 Exeter cemented stems reported in the NZJR between January 1, 1999 and May 31, 2018. There were 1501 Exeter short stems with offsets ≤35.5 mm (Short 37−), 657 Exeter short stems with standard, that is, 37.5 mm, 44 mm, and 50 mm offsets (Short 37+), and 41,269 standard-length stems with Universal and V40 stems combined (Standard).

Patient demographics and diagnosis

The Short 37− group was significantly younger than the other 2 groups with 41.6% younger than 65 years (mean: 65.71, SD: 12.97) compared with 37.2% in the Short 37 + group (mean: 66.95, SD: 10.96) and 26.9% in the Standard group (mean: 69.97, SD: 10.14) (P < .001). There was also a significantly higher proportion of female patients in the Short 37− group (1412, 94.1% female; 89, 5.9% male; P < .0001), while the gender distribution was split equally in both the Standard and Short 37+

Table 3
Comparison of reasons for revision between groups.

Reason for revision	Loosening acetabular component	Loosening femoral component	Dislocation	Pain	Deep infection	Fracture of the femur
Short/standard stem						
Short 37−						
Count	39	18	17	11	8	5
%	42.4%	19.6%	18.5%	12.0%	8.7%	5.4%
Short 37+						
Count	0	0	0	1	5	0
%	0.0%	0.0%	0.0%	16.7%	83.3%	0.0%
Standard						
Count	408	110	458	135	250	202
%	26.6%	7.2%	29.9%	8.8%	16.3%	13.2%
Total						
Count	447	128	475	147	263	207
%	27.4%	7.9%	29.2%	9.0%	16.1%	12.7%

Table 4
Reasons for revision of short stem components considering acetabular implant fixation.

	Cement_Acetabulum				Total	
	No		Yes			
	N	%	N	%	N	%
Short 37−						
Loosening acetabulum	9	16.4%	30	81.1%	39	42.4%
Loosening femur	15	27.3%	3	8.1%	18	19.6%
Dislocation	15	27.3%	2	5.4%	17	18.5%
Pain	9	16.4%	2	5.4%	11	12.0%
Deep infection	7	12.7%	1	2.7%	8	8.7%
Fracture of the femur	2	3.6%	3	8.1%	5	5.4%
	55		37		92	92
Short 37+	0	0.0%			0	0.0%
Loosening acetabulum	0	0.0%			0	0.0%
Loosening femur	0	0.0%			0	0.0%
Dislocation	1	16.7%			1	16.7%
Pain	5	83.3%			5	83.3%
Deep infection	0	0.0%			0	0.0%
Fracture of the femur	0	0.0%			0	0.0%
	6		0		6	6

groups. Osteoarthritis was the primary diagnosis in 87.6% in the Standard group, 93.8% in the 37 + group, and 79.3% in the Short 37− group. The proportion of patients undergoing THR for dysplasia was higher in the Short 37− group (6.9%), while it was only 1.5% and 1.1% in the Short 37+ and Standard groups, respectively. The distribution across the other diagnoses was similar between the 3 groups (Table 2). There was no significant difference in ASA class between groups; however, BMI was significantly higher in both the Short 37− and Short 37 + groups compared with the Standard group (Short 37− group mean BMI: 29.09, SD: 7.07; Short 37 + group mean BMI: 29.69, SD: 6.67; Standard group mean BMI: 28.71, SD: 5.72; $P < .001$).

All-cause revision rates and reasons for revision

Operative cohort

The overall all-cause revision rate for all Exeter stems at a mean follow-up of 6.7 years (28/9980.9 cy) in the NZJR was 0.56/100 cy (95% CI: 0.53 to 0.59). The mean follow-up for unrevised THR was Short 37−: 6.68 years, Short 37+: 1.15 years, Standard: 6.83 years. The all-cause revision rate for standard stems at a mean follow-up of 6.8 years was 0.55/100 cy (95% CI: 0.52 to 0.58). At a mean follow-up of 6.7 years, the Short 37− group had a higher rate of revision compared with the Standard group (0.92/100 cy; 95% CI: 0.74 to 1.13; hazard ratio: 1.6; 95% CI: 1.3 to 1.98; $P < .001$). The Short 37+ group at a mean of 1.1 years had an all-cause revision rate of 0.8/100 cy (95% CI: 0.25 to 1.65; hazards ratio 0.84 compared with the Standard group; 95% CI: 0.376 to 1.88; $P = .674$). These results are displayed in Figure 2.

The comparison between the 3 groups for reasons for revision is shown in Table 3. There was a higher proportion of revisions for deep infection in the Short 37+ group, and this is not attributed to the characteristics of the stem (5 deep infection, 83.3% of revisions in the 37 + group), while in the Standard group, the most common cause for revision was instability (458 cases, 29.9%), and in the Short 37− group, it was acetabular loosening (39 cases, 42.4%). Aseptic loosening of the femoral component was not seen in the Short 37+ group, yet it was in 7.2% of the Standard group and 19.6% of the Short 37- group (Table 3). 42.4% of Short 37− stems were revised for acetabular component loosening, and 81% of these cases had cemented acetabular components (Table 4). In Cox multivariate regression analysis of all-cause revision rates adjusting for gender, age, and surgical approach, the differences remained statistically significant between Short 37− and Standard groups (Table 5; hazard ratio: 1.55; 95% CI: 1.23 to 1.95; $P < .001$).

Survival curves for aseptic loosening are displayed in Figure 3. When the regression analysis focused on aseptic femoral loosening as the cause for revision surgery (Table 5), this was higher in the Short 37− group compared with the Standard group (hazards ratio: 2.72; 95% CI: 2.04 to 3.633; $P < .001$), and this remained significant even after adjusting for age, gender, diagnosis, and approach (hazards ratio: 2.429; 95% CI: 1.76 to 3.35; $P < .001$). The Kaplan-Meier survival curve comparing revision for aseptic femoral loosening in Short 37− and Standard groups is shown in Figure 4. Although there is limited follow-up for the Short 37+ group, there is currently no suggestion of a significant difference between Short 37+ and Standard groups in both unadjusted (hazards ratio: 0.66; 95% CI: 0.27 to 1.59; $P = .353$) and adjusted (hazards ratio: 1.122; 95% CI 0.41 to 3.07; $P = .82$) comparisons.

Functional outcome scores

The Oxford scores were higher in the Standard group compared with the Short 37− group at both 6 months and 5 years. The differences in Oxford Hip Scores between groups at 6 months were statistically significant (Standard: 40.29, SD 7.61; Short 37+: 39.11, SD: 7.83; Short 37-: 39.28, SD: 8.14; $P = .018$) and maintained at 5 years for Standard vs Short 37− stems (Standard: 42.21, SD: 7.06; Short 37−: 40.2, SD: 8.29; $P = .003$). The Oxford score was also significantly higher in the Standard group compared with the Short

Table 5
Cox multivariate regression analysis.

Variables in the equation	B	SE	Wald	df	Sig.	HR	95.0% CI for HR	
							Lower	Upper
Short 37−/standard stem			12.230	2	0.002			
Standard stem v Short 37−	0.396	0.116	11.651	1	0.001	1.485	1.183	1.864
Standard stem v short 37+	−0.321	0.449	0.508	1	0.476	0.726	0.301	1.751
Sex	−0.228	0.053	18.582	1	0.000	0.796	0.718	0.883
agegrps			59.840	3	0.000			
agegrps(1)	−0.264	0.084	10.011	1	0.002	0.768	0.652	0.904
agegrps(2)	−0.499	0.081	38.035	1	0.000	0.607	0.518	0.711
agegrps(3)	−0.609	0.088	47.870	1	0.000	0.544	0.458	0.646
approac			8.473	3	0.037			
approac(1)	−0.053	0.126	0.179	1	0.672	0.948	0.741	1.214
approac(2)	−0.229	0.135	2.859	1	0.091	0.795	0.610	1.037
approac(3)	0.290	0.464	0.391	1	0.532	1.336	0.538	3.316
OA	−0.475	0.069	47.974	1	0.000	0.622	0.544	0.711

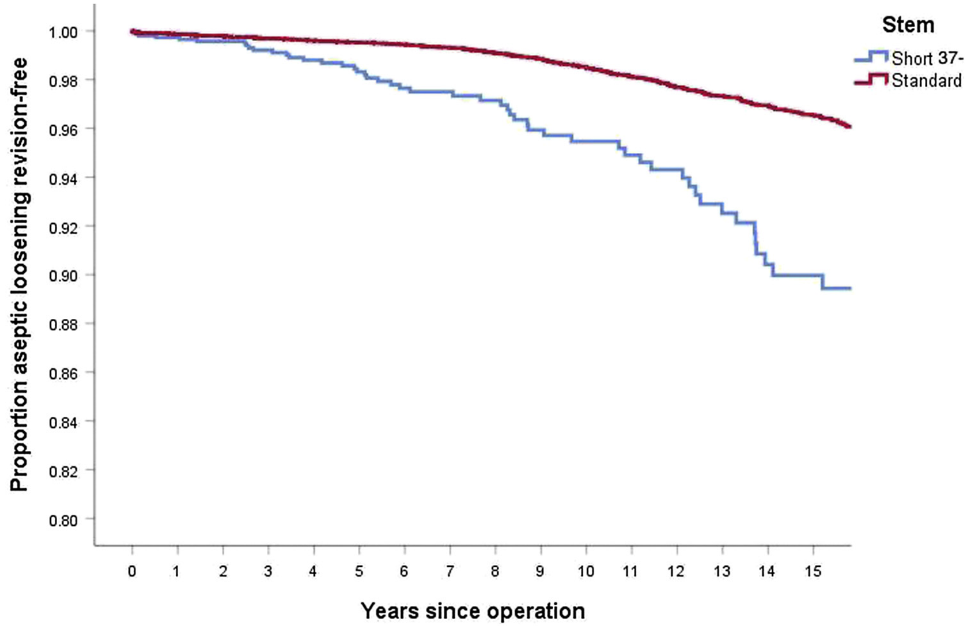

Figure 3. Kaplan-Meier survivorship curve of revisions for aseptic (both components) loosening compared between Exeter Standard and Short 37- cemented stem groups.

37+ group at 6 months. There were insufficient data for statistical analysis of the Short 37+ group at 5 years. The magnitude of the differences between groups was small and perhaps unlikely to represent clinically relevant differences in function (Table 6).

Discussion

The results of this study show that the use of the Exeter cemented stem for primary THR in New Zealand provides excellent function and survivorship at mean 6.7 years of follow-up. According to the most recent NZJR report, overall primary THRs have an all-cause revision rate of 0.72/100 cy (95% CI: 0.71 to 0.74); therefore, the Exeter stem overall with a revision rate of 0.56/100 cy (95% CI: 0.53 to 0.59) is a positive outlier for survivorship [7]. Our results also show that patients who received a Short 37− stem were significantly younger and more likely female than those who received a standard-length Exeter stem. The Short 37− group, perhaps predictably, also had a higher prevalence of hip dysplasia. We cannot comment on patient ethnicity from our study or the precise nature of the femoral geometry. In our study, the posterior approach was preferred, but on regression analysis, the approach did not affect revision rates. The Short 37− group was more likely to undergo revision compared with the Standard group. The Short 37+ group, however, once the deep infection revision was excluded had similar revision rates to the Standard group. We feel that the higher rate of deep infection cannot be attributed to stem design or

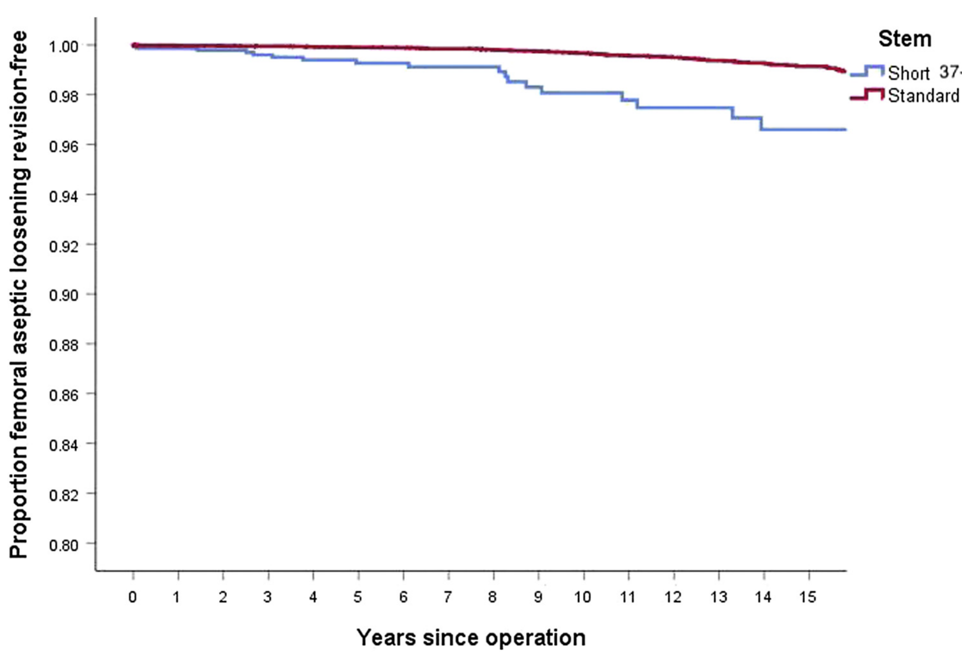

Figure 4. Kaplan-Meier survivorship curve of revisions for aseptic femoral loosening compared between Exeter Standard and Short 37- cemented stem groups.

Table 6
Oxford functional scores compared between groups at both 6 mo and at 5 y.

	Short 37−	Short 37+	Standard	Total	
Oxford score 6 mo					
Mean	39.28	39.11	40.29	40.25	$P = .018$
Std. deviation	8.14	7.83	7.61	7.63	
Minimum	5	15	0	0	
Maximum	48	48	48	48	
N	378	72	9957	10,407	
Oxford score 5 y					
Mean	40.20		42.27	42.21	$P = .003$
Std. deviation	8.39		7.01	7.06	
Minimum	14		5	5	
Maximum	48		48	48	
N	106	0	3614	3720	

ASA in this study. When we examined stem-related failures, the Short 37− group had a higher likelihood of revision for aseptic femoral loosening compared with the Standard group (19.6% vs 7.2%, respectively). Multivariate analysis adjusting for age, gender, and approach suggests that the stem morphology was a key factor in these observed revision rates. There was no difference between the 3 groups when examining revisions for stem fracture. This is noteworthy of not as one might anticipate that the Short 37+ group might have an increased varus moment that could potentiate aseptic loosening or stem fracture. While Oxford scores were superior in the Standard group, the high ceiling effect of this outcome measure may limit the clinical significance of the observed differences between groups.

In the Australian National Joint Registry study at 7 years [4], there was no significant difference in survivorship rates between the Short 37− and Standard groups (3.4% revised; 95% CI: 2.4 to 4.8% vs 3.5%; 95% CI: 3.3 to 3.8%, respectively). This contrasts the findings of our study where the Standard group had superior survivorship compared with the Short 37− group. The Australian study did not examine the Short 37+ stems [4]. Our study's findings suggest that the Short 37+ stems behave more like Standard stems. Furthermore, the findings of our study are in agreement with those of a recent study that showed that lower offset femoral components had a higher risk of revision [8]. Therefore, offset may be more critical than stem length with the cemented Exeter as rotational stability is provided by the proximal body [9]. In this study cohort, we have combined Universal and V40 standard-length Exeter stems. The Exeter Universal stem was introduced in 1988 and proved highly successful with the first 325 stems demonstrating 100% survivorship of the femoral component with aseptic femoral loosening as the endpoint [10]. Because there are no published differences of altered survivorship with a change from the Universal to the V40 Exeter stem, we feel that this combination is justified for the purpose of this study [11].

This study is a retrospective analysis of prospectively, systematically, and consecutively collected registry data with >96% capture rate. The revision rate of the Exeter stem is low; therefore, large data sets are needed to provide adequate statistical power for an intelligible comparison. Over 40,000 Exeter stems were available for the analysis provided in our study, which we feel substantiates this as an important and pertinent study. The relatively low number of stems and duration of follow-up in the Short 37+ group is a study limitation. In adjusted comparisons, however, there was no discernible difference between the Short 37+ and Standard groups. This study is representative of a wide spectrum of orthopedic surgeons with varied clinical experience covering an entire nation. The inclusion of 43,427 Exeter cemented stems is the largest comparative series of Exeter short and standard-length stems to our knowledge.

National Joint Registry data can support evidence-based practice, implant surveillance, hospitals, surgeons, and PROMs. They can also identify subtle trends that would not be easily identifiable through other methods. Such trends can be then investigated through other scientific means [12]. We were unable to allow for potential confounders such as the severity of joint disease or the precise complexity of patient comorbidities and medications. We were also unable to control for surgical choice on a particular case and therefore acknowledge the potential for selection bias. We have used age and ASA as proxy indicators for patient comorbidities with the rationale that these are the best indices in recent research [13]. All-cause revision rates do not capture patients too unwell to undergo revision surgery or for whom the joint replacement may be functioning poorly. The decision to revise a THR depends on patient factors such as patient choice and comorbidity, surgical factors such as perceived risk/benefit analysis, and departmental resources. The NZJR does not record revisions for soft tissue procedures. Moreover, no radiographic comparisons have been made in our study cohort, and we therefore cannot critique cementing technique or implant alignment. The anteversion of the femoral stem is not accounted for in our study, and excessive cement stresses can occur with highly anteverted stem positions in finite element models [14]. Our primary outcome measure was revision for aseptic femoral loosening, yet 42.4% of Short 37− stems were revised for acetabular component loosening (30/39, 81% of these cases had cemented acetabular components). This suggests that the small femoral stem geometry and stem design are not the only reasons for failure in this group, and it could in fact be the underlying diagnosis of hip dysplasia or related to cup fixation.

Shorter Exeter stems were introduced to address femora which were either smaller or had fluted or narrower internal geometries. Accurate preoperative templating will permit the surgeon to predict the need for a short stem in most cases. During surgery, the perceived inability to gently pass the larger T-handled fluted reamer can indicate that a short stem is required. While a Short 37− stem is undoubtedly desirable to recreate the correct biomechanics, the observed higher rate of failure may be significantly a function of the underlying diagnosis and the stem geometry.

Conclusions

At 20 years, there was a significant difference in not only all-cause but also aseptic stem loosening revision rates with Standard Exeter stems outperforming Short 37− stems. The Short 37+ group has performed similarly to the Standard group to date.

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