

A Comparison of Contemporary Cemented and Cementless Femoral Stems in Hip Arthroplasty Following Femoral Neck Fracture

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INTRODUCTION:

Cemented femoral fixation is widely considered the gold standard when performing total hip arthroplasty (THA) and hemiarthroplasty (HA) for femoral neck fractures (FNF) due to a lower periprosthetic fracture risk compared to cementless fixation. However, there has been a recent increase in utilization of cementless fixation in hip arthroplasty for FNF. With the introduction of newer cementless stem designs, it is unclear if the historical risk profile between cemented and cementless stems remains. The purpose of this study was to evaluate the utilization of cemented versus cementless fixation following FNF and evaluate outcomes based on fixation method and stem design.

METHODS: A retrospective review identified 2,829 patients who underwent primary THA or HA for FNF between 12/31/2017-1/29/2024 across a single hospital enterprise. Patients were propensity-matched to compare both fixation type and stem design. Variables controlled for matching included age, gender, body mass index (BMI), American Society of Anesthesiology (ASA) score, and Elixhauser comorbidity index. Outcomes of interest including periprosthetic fracture, hospital length of stay (LOS), mortality, and bone-cement implantation syndrome (BCIS) were compared using Fisher's exact tests and a conditional logistic regression model.

RESULTS:

Cementless fixation was performed in 598 cases (21%). Patients who underwent cementless fixation were on average younger (75 versus 83 years; $P < 0.001$), less likely to be female (56% versus 66%; $P < 0.001$), and more likely to receive a THA (61% vs 7%; $P < 0.001$) (Table 1).

Following propensity matching of cemented to cementless fixation, a total of 346 matched pairs were analyzed. There were no differences in any controlled variables after matching. Most cementless stems (63%) were placed by arthroplasty specialists whereas only 7% of traumatologists opted for cementless fixation ($P < 0.001$). There were no differences in rates of deep venous thrombosis (DVT), surgical site infection (SSI), or mortality between cohorts at any time point postoperatively. Cementless fixation had a higher rate of periprosthetic fracture compared to cemented fixation (7% vs 4%; $P = 0.041$). There was an increased incidence of BCIS with cemented stems ($P = 0.014$) with higher rates of Grade 1 changes (43% vs 32%), but comparable rates of Grade 2 and Grade 3 (Table 2).

A separate propensity match was then performed comparing cemented stems to metaphyseal filling collared cementless implants. This resulted in 213 matched pairs. While there was no difference in age, gender, ASA score, or Elixhauser comorbidity index between cohorts, the majority of patients who received a cementless stem underwent a THA compared to the cemented cohort (78% vs 14%; $P < 0.001$). Most of the cementless stems were implanted by arthroplasty surgeons (74%). There was a shorter hospital length of stay in the cementless cohort (5 versus 6 days; $P < 0.001$), but no difference in DVT, SSI, or mortality postoperatively (all $P > 0.05$) between cohorts. There were also no differences in the rate of periprosthetic fracture (3% vs 2%; $P = 0.751$) or BCIS ($P = 0.059$) between patients who received metaphyseal filling collared cementless stems and cemented implants (Table 3). A post-hoc power analysis demonstrated 74% power at a significance of 0.05 with 213 matched pairs.

DISCUSSION AND CONCLUSION: Cementless femoral fixation following FNF is most often performed by arthroplasty subspecialists. Periprosthetic fracture risk, while higher in cementless stem designs, may be mitigated with contemporary collared metaphyseal filling stems. BCIS was observed in both fixation cohorts, though it was primarily low-grade and clinically inconsequential. While further research is needed to corroborate these findings, our data suggests that cemented and modern cementless stem designs may have comparable postoperative outcomes in hip arthroplasty for FNF.

Variable	Controlled (N=2231)	Controlled (N=290)	Overall Cohort (N=2020)	P-value
Age (yrs.)	53 (0)	75 (10)	81 (10)	< 0.001
Gender (Female)	1471 (66%)	333 (56%)	1804 (64%)	< 0.001
Body Mass Index	26 (0)	27 (0)	26 (0)	< 0.001
Eltzhauser Comorbidity Index	0 (5)	7 (5)	0 (5)	< 0.001
ASA Score				< 0.001
Unknown	14	7	21	
2	334 (15%)	184 (32%)	518 (18%)	
3	1544 (69%)	354 (61%)	1898 (68%)	
4	346 (16%)	46 (8%)	392 (14%)	
Surgical Procedure				< 0.001
Hemiarthroplasty	2076 (93%)	232 (39%)	2308 (82%)	
Total Arthroplasty	155 (7%)	366 (61%)	521 (18%)	
Surgeon Specialty				< 0.001
Unknown	6	8	14	
Fellow	817 (28%)	377 (64%)	994 (35%)	
Attending (arthroplasty)	744 (33%)	125 (21%)	869 (31%)	
Attending (trauma)	816 (37%)	56 (10%)	874 (31%)	
Attending (other)	48 (2%)	30 (5%)	78 (3%)	

ASA = American Society of Anesthesiologists score

Variable	Cemented (N = 146)	Cementless (N = 346)	P-value
Preoperative Variables			
Age (yrs.)	79 (10)	78 (10)	0.504
Gender (Female)	218 (63%)	236 (63%)	0.349
Body Mass Index	26 (0)	26 (0)	0.618
Eltzhauser Comorbidity Index	0 (0)	0 (0)	0.314
ASA Score			0.491
1	2 (1%)	6 (2%)	
2	44 (28%)	77 (22%)	
3	271 (64%)	229 (66%)	
4	39 (11%)	37 (11%)	
Surgical Procedure			1.00
Hemiarthroplasty	205 (99%)	205 (99%)	
Total Hip Arthroplasty	141 (41%)	141 (41%)	< 0.001
Surgeon Specialty			
Fellow	7 (2%)	20 (6%)	
Attending (arthroplasty)	124 (85%)	219 (63%)	
Attending (trauma)	100 (11%)	23 (7%)	
Attending (other)	107 (21%)	84 (24%)	
Postoperative Variables			
Change in Hb (g/dL)	-3 (1)	-3 (1)	0.527
Postoperative Transfusion	37 (11%)	39 (9%)	0.512
Length of Hospital Stay (days)	6 (0)	5 (0)	0.595
30-day DVT/PE (%)	8 (2)	11 (3)	0.471
90-day DVT/PE (%)	13 (4%)	16 (6%)	0.705
30-day SSI (%)	5 (1%)	4 (1%)	1.001
90-day SSI (%)	11 (3%)	8 (2%)	0.491
In-hospital mortality (%)	1 (1%)	1 (0.3%)	0.524
30-day Mortality (%)	13 (4%)	15 (4%)	0.701
90-day Mortality (%)	22 (6%)	30 (9%)	0.261
1-year Mortality (%)	47 (15%)	64 (18%)	0.451
1-year Reoperation (%)	0 (0.0%)	2 (1%)	0.841
All-time Periprosthetic Fracture (%)	12 (4%)	24 (7%)	0.014
Bone Cement Implantation Syndrome			
Grade 0	179 (92%)	213 (92%)	
Grade 1	150 (63%)	110 (52%)	
Grade 2	14 (4%)	20 (6%)	
Grade 3	2 (1%)	2 (1%)	

ASA = American Society of Anesthesiologists score, Hb = hemoglobin, DVT = Deep Venous Thrombosis, PE = Pulmonary Embolism, SSI = Surgical Site Infection. Matching based on age, gender, BMI, Eltzhauser Comorbidity Index, ASA Score, and Surgery Type. * P value cannot be generated.

Variable	Collared Cemented (N = 213)	Collared Cementless Metaphyseal Filling (N = 213)	P-value
Preoperative Variables			
Age Categories			
Less than 80 years	148 (70%)	148 (70%)	1.001
More than 80 years	65 (31%)	65 (31%)	
Gender (Female)	136 (64%)	133 (62%)	0.763
Body Mass Index (BMI)			1.00
High (> 25)	123 (58%)	123 (58%)	
Low (< 18.5)	7 (3%)	7 (3%)	
Normal (18.5-25)	83 (39%)	83 (39%)	
Eltzhauser Comorbidity Index			0.315
0	0 (0%)	7 (3%)	
1	2 (1%)	2 (1%)	
2	63 (30%)	63 (30%)	
3	133 (62%)	133 (62%)	
4	15 (7%)	15 (7%)	< 0.001
Surgical Procedure			
Hemiarthroplasty	184 (86%)	47 (22%)	
Total Hip Arthroplasty	29 (14%)	160 (78%)	< 0.001
Surgeon Specialty			
Fellow	6 (3%)	7 (3%)	
Attending (arthroplasty)	44 (21%)	151 (74%)	
Attending (trauma)	81 (38%)	26 (13%)	
Attending (other)	62 (29%)	20 (9%)	
Postoperative Variables			
Change in Hb (g/dL)	-2 (1)	-3 (1)	< 0.001
Postoperative Transfusion	20 (9%)	6 (3%)	0.012
Length of Hospital Stay (days)	6 (5)	5 (3)	< 0.001
30-day DVT/PE (%)	5 (2%)	3 (1%)	0.224
90-day DVT/PE (%)	7 (3%)	7 (3%)	1.00
30-day SSI (%)	4 (2%)	2 (1%)	0.421
90-day SSI (%)	6 (3%)	3 (1%)	0.563
In-hospital mortality (%)	2 (1%)	1 (1%)	0.993
30-day Mortality (%)	4 (2%)	7 (3%)	0.543
90-day Mortality (%)	11 (5%)	14 (7%)	0.681
1-year Mortality (%)	28 (13%)	20 (9%)	0.121
1-year Reoperation (%)	2 (1%)	2 (1%)	1.00
All-time Periprosthetic Fracture (%)	4 (2%)	6 (3%)	0.751
Bone Cement Implant Syndrome			
No BCIS	123 (58%)	115 (54%)	0.059
Grade 1	82 (39%)	77 (36%)	
Grade 2	8 (4%)	10 (5%)	
Grade 3	0 (0%)	3 (1%)	

ASA = American Society of Anesthesiologists score, Hb = hemoglobin, DVT = Deep Venous Thrombosis, PE = Pulmonary Embolism, SSI = Surgical Site Infection. Matching based on age, gender, BMI, Eltzhauser Comorbidity Index, and ASA Score. * P value cannot be generated.