Establishing an Optimal Age to Consider Cemented versus Uncemented Total Hip Arthroplasty using Stratum-Specific Likelihood Ratios

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INTRODUCTION:

Although total hip arthroplasty (THA) implants can be cemented, uncemented, or utilize hybrid fixation, uncemented total hip arthroplasty has become dominant in the United States accounting for about 85% of all cases. But, the use of uncemented components in the elderly remains controversial, with concern about the increased risk of periprosthetic fractures in these patients. As the elderly population continues to grow, the demand for primary total hip arthroplasty is likely to increase, and efforts to keep periprosthetic fracture rates as low as possible are warranted. The aim of this study was to determine at which specific age cutoffs surgeons should consider cemented total hip arthroplasty over uncemented total hip arthroplasty to reduce periprosthetic fracture risk.

METHODS:

Geriatric patients (defined as age >65) who underwent primary cemented or uncemented total hip arthroplasty from 2010 to 2020 were identified using a large national insurance database. Age cohorts were identified using the stratum-specific likelihood ratio (SSLR) methodology, which is an adaptive technique that allows for identification of age cut-offs at which the risk of periprosthetic fractures in uncemented total hip arthroplasty increase significantly. In our study, the optimal age cutoff identified by the stratum-specific likelihood ratio analysis was 74 years of age for uncemented total hip arthroplasty (Figure 1). Univariate analysis was conducted on demographic characteristics, comorbidities, and postoperative complications using Pearson chi-square analysis. Patients were followed for as long as data were available, with a maximum follow up of 10 years. If a postoperative outcome was significant on univariate analysis ($p < 0.05$), a multivariable analysis using Cox proportional hazards model was conducted to adjust for other potential risk factors. In order to determine such factors, demographics and comorbidities with p-values <0.2 were included in the multivariable analysis. Additionally, Kaplan-Meier analysis was used to estimate survival free of periprosthetic fracture in both age cohorts.

RESULTS:

In total, 52,165 patients over the age of 74 underwent uncemented total hip arthroplasty and 29,520 underwent cemented total hip arthroplasty. In comparison, 46,572 patients between the ages of 65 to 73 underwent uncemented total hip arthroplasty and 6,487 underwent cemented total hip arthroplasty. Patient demographic information and comorbidities can be found in Table 1. Univariate analysis demonstrated patients between 65 to 73 who received an uncemented total hip arthroplasty had a lower incidence of periprosthetic fracture than those who underwent cemented total hip arthroplasty (0.80% vs. 1.43%; $p<0.001$; Table 2). Among patients over the age of 74, patients who underwent an uncemented total hip arthroplasty were found to have higher incidence of periprosthetic fracture (1.49% vs. 1.09%; $p<0.001$; Table 2). Multivariable Cox proportional hazards analysis confirmed these findings, with patients aged 65 to 73 who underwent uncemented total hip arthroplasty demonstrating a lower hazard ratio for periprosthetic fracture compared to those who underwent cemented total hip arthroplasty (HR 0.683; $p<0.001$; Table 3) and patients over 74 years old who underwent uncemented total hip arthroplasty demonstrating a higher hazard ratio for periprosthetic fracture (HR 1.392; $p<0.001$; Table 3). This is shown graphically in Figures 2 and 3.

DISCUSSION AND CONCLUSION:

Uncemented total hip arthroplasty is known to be associated with increased risk of periprosthetic fractures in the elderly. Using stratum-specific likelihood ratio analysis, we identified that patients specifically aged 74 and higher who receive an uncemented total hip arthroplasty are at a significantly increased risk of periprosthetic fracture. This age threshold should be considered alongside other markers of poor bone health to help surgeons optimize which patients may be better served with cemented total hip arthroplasty.

Table 2: Univariate Analysis of Periprosthetic Fractures Rates Following Total Hip Arthroplasty

Periprosthetic Fracture	Uncemented		Cemented		P-value
	n	%	n	%	
Age 65 to 73	778	0.80%	93	1.43%	**<0.001**
Age 74+	776	1.49%	321	1.09%	**<0.001**

Table 3: Multivariate Cox Proportional Hazards Model Analysis of Periprosthetic Fracture Rates Following Total Hip Arthroplasty

Periprosthetic Fracture	Uncemented		Cemented		
	Adjusted Hazard Ratio (SE)	P-value	Adjusted Hazard Ratio (SE)	P-value	P-value
Age 65 to 73	0.683 (0.333-0.842)	**<0.001**	-	-	-
Age 74+	1.392 (1.233-1.572)	**<0.001**	-	-	-

Figure 1: Stratum-specific likelihood ratio (SSLR) analysis of patients who underwent cemented vs. uncemented Total Hip Arthroplasty. Likelihood ratio group was established at age 74.

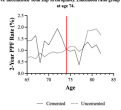

Figure 2: Kaplan Meier Survival Free from Periprosthetic Fracture in Patients Between 65-73 Years of Age

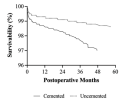

Figure 3: Kaplan Meier Survival Free from Periprosthetic Fracture in Patients Over 74 Years of Age

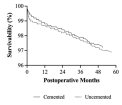

Table 1: Demographics and Comorbidities of Patients Who Underwent Uncemented vs. Cemented Total Hip Arthroplasty