Comparative Analysis and Accuracy of Surgeon- and Prosthesis Manufacturer-Generated Radiographic Templates in Total Hip Arthroplasty

Brandon Couch, Allyson Nicole Pfeil, Corey Francis Hryc, Robin Nestor Goytia, Vasilios Mathews

INTRODUCTION: Recently, industry-led initiatives have allowed prothesis manufacturers to start templating in total hip arthroplasty (THA) alongside the surgeon's standard preoperative plans. However, accuracy of these industry-generated templates has yet to be evaluated. We hypothesize a similar accuracy between the surgeon and prosthesis manufacturer (PM) templates.

METHODS: All primary THAs occurring between October 2023 and September 2024 performed by two orthopaedic surgeons were retrospectively reviewed. Surgeon-generated templates and PM-generated templates (Advance Case Management, Depuy, Warsaw, IN) were collected. Comparative data included actual implanted components and body mass index (BMI). Accuracy of acetabular and femoral component sizes, as well as femoral offset, were analyzed using $\chi 2$, with significance at $P<.05$. A subgroup accuracy analysis with respect to BMI was conducted.

RESULTS: A total of 306 surgeon templates and 240 PM templates were analyzed (Table 1). The surgeon templates identified the exact size of the acetabular and femoral components in 45.1 and 28.4% of cases, respectively. PM templates identified the exact size of the acetabular and femoral components in 33.8 and 35.0% of cases, respectively. There was no significant difference between surgeon and PM templates when comparing the proportion of templates that matched acetabular and femoral implanted components within zero, one, two, three, or greater than three sizes (power: 77.1% and 80.5%, respectively). Statistical significance was observed upon offset prediction accuracy between the surgeon and PM (83.7 v 73.3%, respectively; P=0.003). Subgroup analyses revealed a statistically significant negative correlation between surgeon stem accuracy and increasing patient BMI (P<0.001) (Table 2).

DISCUSSION AND CONCLUSION: PM templating demonstrated a promising ability to predict implant sizes in THA, achieving nondifferent results of the femoral and acetabular component to high volume, fellowship-trained arthroplasty surgeons. However, offset was templated more consistently by the surgeons. Regardless, implementing this system will help vendors optimize inventory management to ensure hospitals are adequately supplied.

Table 1: Templating Accuracy and Mismatch of Surgeon and Device Manufacturer by Component and Offset.

	Acetabular		*Femoral*		*Offset*	
Variable	Surgeon (%)	PM (%)	Surgeon (%)	PM (%)	Surgeon (%)	PM (%)
n=	306	240	306	240	306	240
Exact Match	138 (45.1)	81 (33.8)	87 (28.4)	84 (35.0)	256 (83.7)	176 (73.3)
Match within ±1 size	250 (81.7)	188 (78.3)	240 (78.4)	177 (73.8)	-	-
Match within ±2 sizes	289 (94.4)	223 (92.9)	294 (95.4)	231 (96.3)	-	-
Match within ±3 sizes	304 (99.3)	236 (98.3)	305 (99.0)	239 (99.6)	-	-
P-value	.09		.08		**.0003**	

Note: Bold P-values designate statistical significance.

Abbreviations: PM=prosthesis manufacturer.

Table 2: Templating Accuracy of Surgeon and Device Manufacturer by Component and BMI.

BMI	*<30*	*30-35*	*35-40*	*40-45*	*45-50*	*50-55*
Variable	*Surgeon - Acetabulum*					
n=	169	73	37	19	7	1
Exact Match (%)	46.2	37.0	51.4	52.6	57.1	0.0
Match within ±1 size (%)	85.8	80.8	70.3	73.7	71.4	100.0
Match within ±2 sizes (%)	95.3	94.5	91.9	94.7	85.7	100.0
Match within ±3 sizes (%)	99.4	98.6	100.0	100.0	100.0	100.0
P-value	.2					
	PM - Acetabulum					
n=	132	59	28	16	4	1
Exact Match (%)	37.1	35.6	28.6	0.0	50.0	100.0
Match within ±1 size (%)	77.3	79.7	82.1	75.0	75.0	100.0
Match within ±2 sizes (%)	92.4	94.9	89.3	93.8	100.0	100.0
Match within ±3 sizes (%)	99.2	98.3	92.9	100.0	100.0	100.0
P-value	.37					
	Surgeon - Femur					
n=	169	73	37	19	7	1
Exact Match (%)	33.7	24.7	24.3	10.5	14.3	0.0
Match within ±1 size (%)	86.4	72.6	70.3	68.4	28.6	0.0
Match within ±2 sizes (%)	98.2	95.9	91.9	89.5	71.4	0.0
Match within ±3 sizes (%)	99.4	98.6	100.0	100.0	100.0	0.0
P-value	**<.001**					
	PM - Femur					
n=	132	59	28	16	4	1
Exact Match (%)	37.9	32.2	35.7	25.0	25.0	0.0
Match within ±1 size (%)	77.3	72.9	64.3	75.0	25.0	100.0
Match within ±2 sizes (%)	97.0	96.6	92.9	100.0	75.0	100.0
Match within ±3 sizes (%)	100.0	100.0	100.0	100.0	75.0	100.0
P-value	.72					

Note: Bold P-values designate statistical significance.

Abbreviations: BMI=body mass index, PM=device manufacturer.