

Visual C-arm Alignment in Total Hip Arthroplasty Frequently Fails to Match Preoperative Radiographs

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INTRODUCTION:

Surgeons performing total hip arthroplasty (THA) via the direct anterior approach (DAA) often use intraoperative fluoroscopy (IF) to assess cup position. A common technique involves visually aligning the C-arm to replicate the preoperative anteroposterior (AP) pelvic radiograph. This study aimed to evaluate how accurately DAA THA surgeons can match intraoperative fluoroscopic images with preoperative radiographs using visual alignment alone.

METHODS: Preoperative AP radiographs with known pelvic tilt (range: 20° posterior to 6° anterior) were generated for nine THA patients from their preoperative CT scans. For each patient, nine simulated IF images were created at three axial rotation angles (-7°, 0°, 7°) and three tilt angles (0°, 7°, 14°), simulating increasing anterior pelvic tilt. These increments were selected because a 7° tilt error corresponds to a 5° error in cup anteversion. A group of 35 experienced THA surgeons, identified through the senior authors' network, were surveyed. They were asked to select, for each case, the IF image they believed best matched the preoperative radiograph (Figure 1) and respond to general questions about their intraoperative imaging practice. Association between C-arm tilt angle and preoperative pelvic tilt (anterior vs posterior) was assessed using odds ratios.

RESULTS: Among respondents, 66% (23) reported using visual estimation alone to align the C-arm, 20% (7) reported not attempting to match the pre-op AP pelvis, and 11% (4) used assistive technology, Table 1. Across 312 total responses, 62% of selected images involved a tilt and/or rotation error, with 56% reflecting a 7° deviation and 6% reflecting a 14° error, Table 2. Surgeons were 3.8 times more likely (95%CI: 2.3 to 6.4, p<0.001) to select a malaligned IF image in cases where the preoperative pelvic tilt was neutral or anteriorly tilted.

DISCUSSION AND CONCLUSION: Relying on visual alignment alone frequently results in IF malalignment, leading to functional cup orientation errors ≥5°. More precise methods are needed to ensure accurate cup positioning in DAA THA.



Figure 1. Surgeons were asked to select the intra-operative fluoroscopic image among nine images of varying degrees of tilt and rotation (images A-I) that they believed best matched the preoperative radiograph (center image).

Question	n	%
How many years have you been in practice?		
<5	9	26%
5-15	14	40%
15+	9	26%
I am currently in my fellowship	2	6%
How many THA cases do you perform annually?		
<50	2	6%
50-100	2	6%
100-200	13	37%
200+	17	49%
What method do you use to align the C-arm view to your preoperative AP xray?		
I eyeball it	23	66%
I use assistive technology	4	11%
I don't try to match my intraoperative with preoperative views	7	20%
Other	1	3%
If you are involved in aligning the c-arm to the patient, how long do you estimate is spent doing this on average, including any time taken to adjust C-arm positioning/orientation?		
<1 min	6	17%
1-2 min	18	51%
>2 min	6	17%
I'm not involved	3	9%
If you are involved in aligning the c-arm to the patient, how many fluoroscopic images do you estimate are taken when doing this on average?		
1-2 images	3	9%
2-4 images	18	51%
5 or more images	11	31%
I use video fluoroscopy	0	0%
I'm not involved	3	9%

Table 2. Proportion (%) of responses by tilt and rotation

Tilt [°]	Rotation [°]			subtotal
	-7	0	7	
0	7%	39%	7%	53%
7	10%	21%	10%	41%
14	3%	2%	1%	6%
subtotal	19%	62%	18%	100%