

The Relationship of Acetabular and Femoral Version in Patients Undergoing Periacetabular Osteotomy (PAO)

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INTRODUCTION

- While hip dysplasia has classically been diagnosed with an AP Pelvis radiograph center edge angle (CEA) measurement of $<25^\circ$, we now understand that dysplasia is a much more complex, three dimensional (3D) diagnosis.

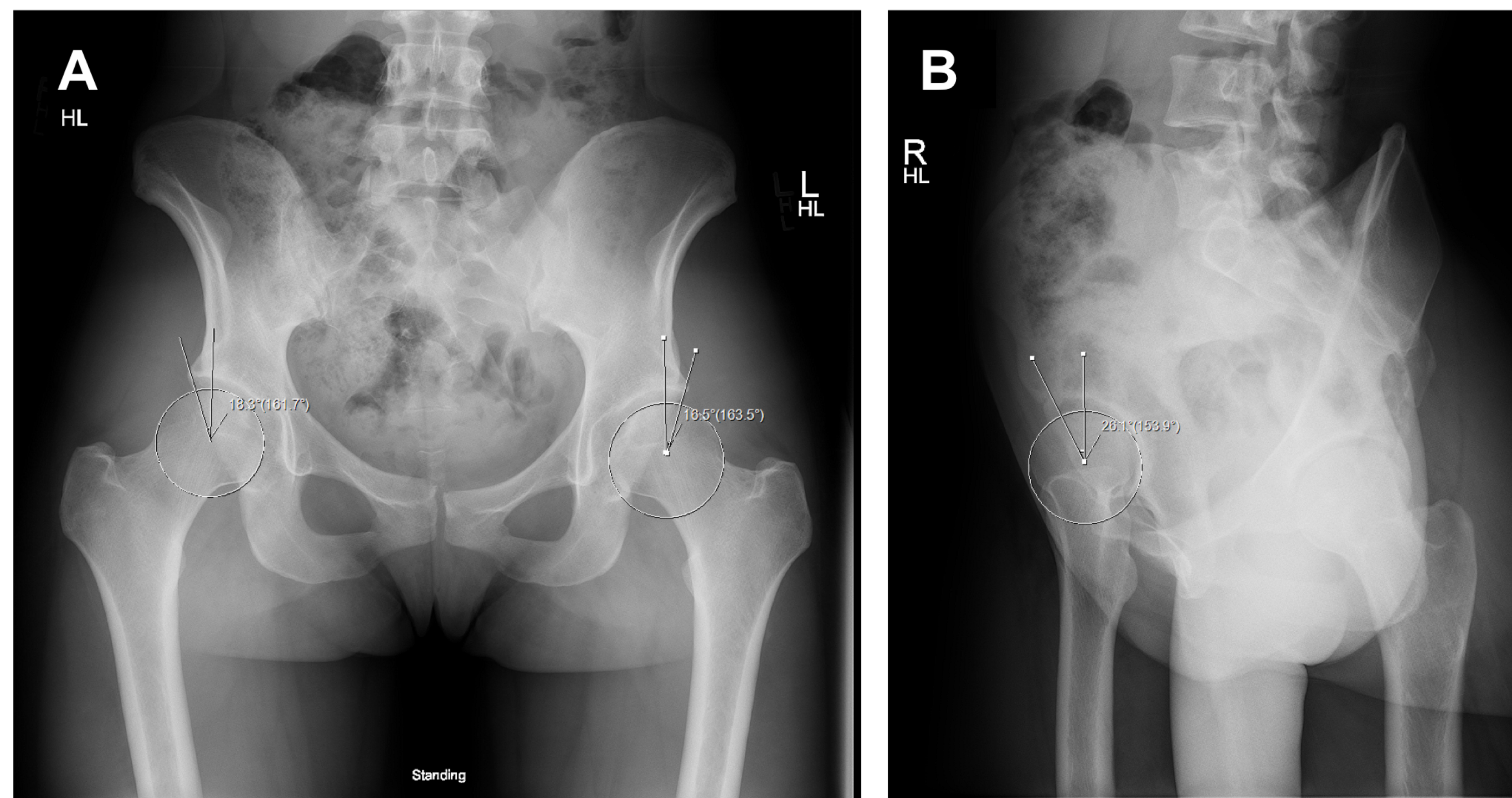


Figure 1: (A) Standing AP pelvis radiograph of patient with "classic" radiographic diagnosis of bilateral hip dysplasia (LCEA $<25^\circ$). The patient is symptomatic only on the right side. (B) False profile view of the right hip.

- Little is known about version (acetabular, femoral and the relationship between the two) in dysplastic patients.

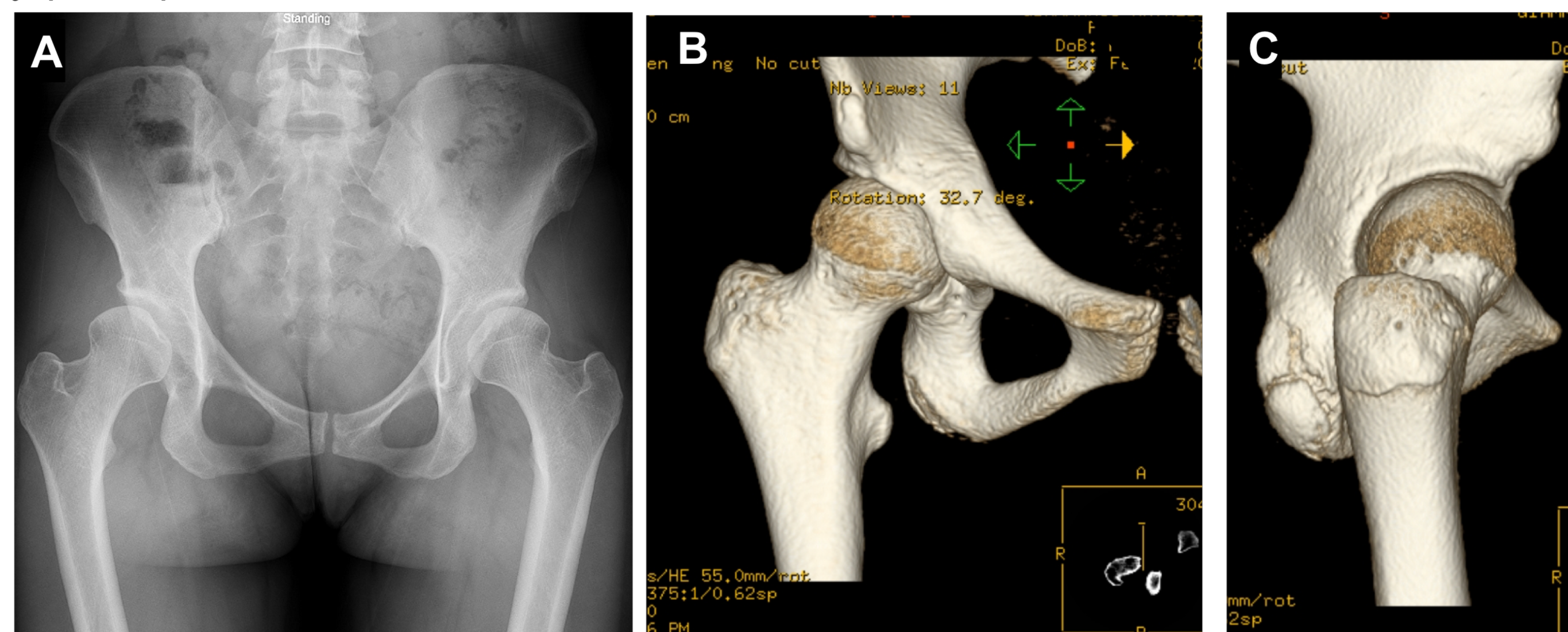


Figure 2: (A) Standing AP pelvis radiograph of patient with radiographic diagnosis of bilateral hip dysplasia (LCEA $<25^\circ$). The 3D computed tomography (CT) reconstructions allow us to obtain acetabular version and femoral version measurements. In this patient, excessive acetabular anteversion (B) was combined with femoral anteversion (C).

- With our increased understanding of hip mechanics and advancements in hip imaging capabilities, understanding the version differences between symptomatic dysplastic and non-dysplastic patients can guide us in our surgical correction of dysplastic hips.

PURPOSE

- We sought to determine:
 - the relationship between femoral and acetabular version in patients with acetabular dysplasia, and
 - patient reported outcomes associated with femoral and acetabular version.
- We hypothesized an association between acetabular and femoral version, and an association between version and patient reported outcome measures.



3D CT reconstruction of a left hip

METHODS

- We retrospectively identified all patients who had periacetabular osteotomy (PAO) from March 2010 and October 2015 with a minimum of 1 year follow-up.

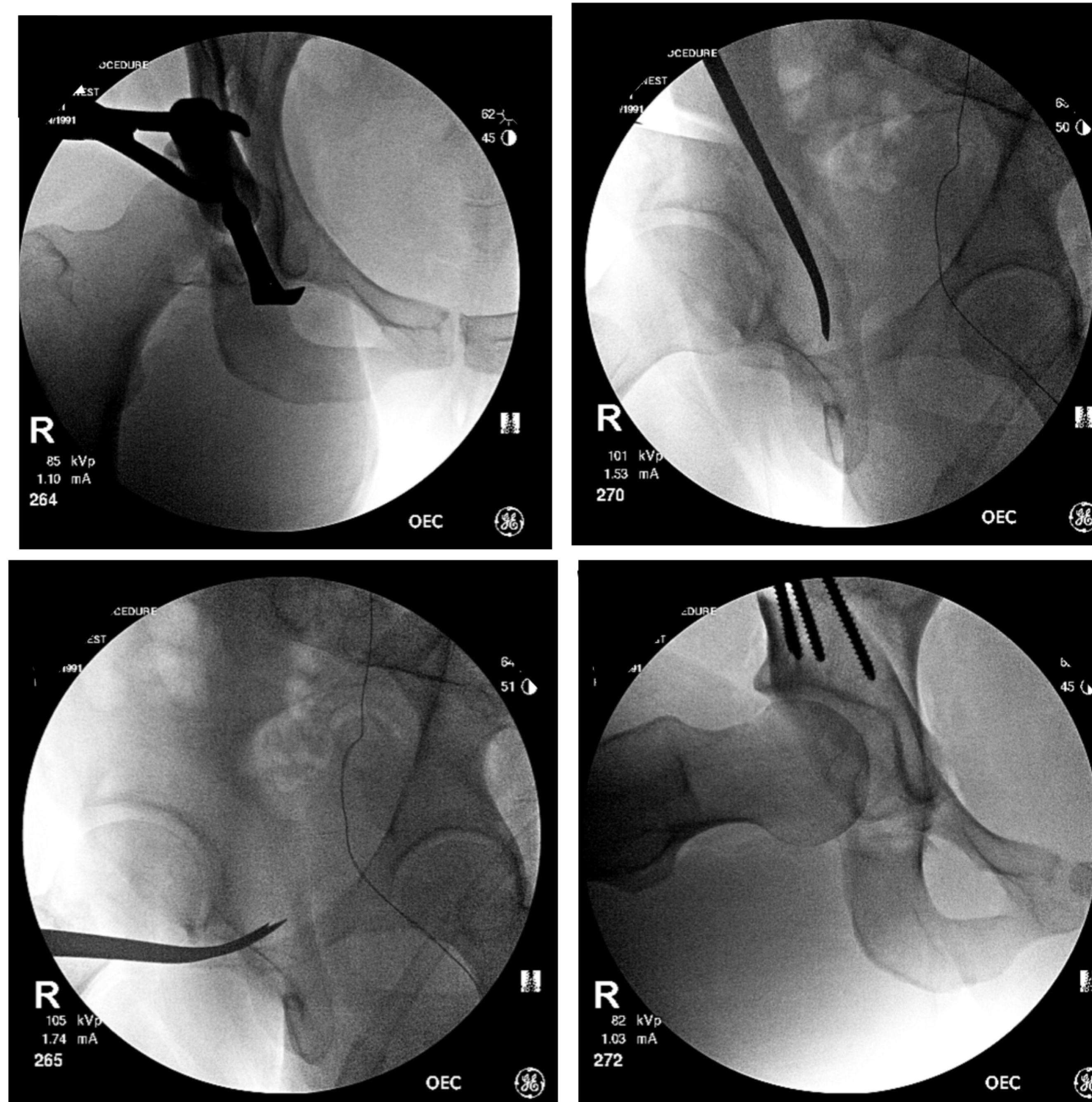


Figure 3: Intra-operative photos of the PAO procedure. (A) AP of the ischial cut. (B) False profile view of the ischial cut. (C) False profile view of the posterior column cut. (D) AP view after fixation of the acetabular fragment with screws.

- We created a non-dysplastic (CEA $>25^\circ$) comparison group of patients.
- We calculated the association between acetabular version, femoral version and hip range of motion, as well as between preoperative femoral version, acetabular version, age, sex, and preoperative and 1 year postoperative modified Harris Hip Score (mHHS), Hip Outcome Score (HOS), and International Hip Outcome Tool 33 (iHOT33) score.

RESULTS

- We identified 87 dysplastic PAO patients (93% female, mean age 23.7) and 928 non-dysplastic patients (41% female, mean age 25).
- Acetabular version at the 1, 2 and 3 o'clock positions was significantly different between the dysplastic and non-dysplastic groups (7° vs 1° , $p<0.001$ at 1 o'clock; 14° vs 9° , $p = 0.006$ at 2 o'clock, and 21° vs 16° , $p<0.001$ at 3 o'clock). Femoral version was also significantly different between the groups (14° vs 20° , $p<0.001$). The dysplastic patients had significantly more anteversion of the acetabulum and femur than non-dysplastic patients.
- We found a weak correlation between acetabular version at 1 o'clock, 2 o'clock and 3 o'clock and femoral version.
- There was no association between mHHS, HOS- activities of daily living (ADL), HOS-sport specific (SS), or iHOT-33 scores and pre-operative femoral version, acetabular version, age, or sex.

		Non-Dysplasia	Dysplasia	Adjusted Difference in Means (95% CI)	P value
Pre-op acetabular version at 1 o'clock (CT)	Count	928	89		
	Mean	1	7		
	SD	9	10	6 (3, 8)	<0.001
Pre-op acetabular version at 2 o'clock (CT)	Count	928	89		
	Mean	9	14		
	SD	9	10	3 (1, 5)	0.006
Pre-op acetabular version at 3 o'clock (CT)	Count	928	89		
	Mean	16	21		
	SD	7	8	3 (1, 5)	<0.001
Pre-op femoral version (CT)	Count	928	89		
	Mean	14	20		
	SD	10.3	12.9	6 (3, 9)	<0.001

Table 1: The pre-operative acetabular version and femoral version measurements obtained from CT scan. A comparison between the dysplasia group and the non-dysplasia group demonstrated significant differences in acetabular and femoral version.

CONCLUSIONS

- Hip instability can be very challenging to diagnose, and historical diagnosis of hip dysplasia using the CEA alone may not comprehensively describe acetabular coverage.
- Our study investigates the nuances of acetabular coverage by examining CT measurements of acetabular and femoral version in dysplastic and non-dysplastic patients.
- We found no association between acetabular/femoral version and patient reported outcomes, however there was a weak correlation between acetabular and femoral version in patients with dysplasia.
- We also found that dysplastic patients had significantly more acetabular anteversion than non-dysplastic patients at the 1, 2 and 3 o'clock positions, as well as significantly more femoral anteversion.
- The results of this study confirm that there are more complex bony morphologic differences in patients with hip dysplasia than just lateral acetabular coverage (as measured by CEA).

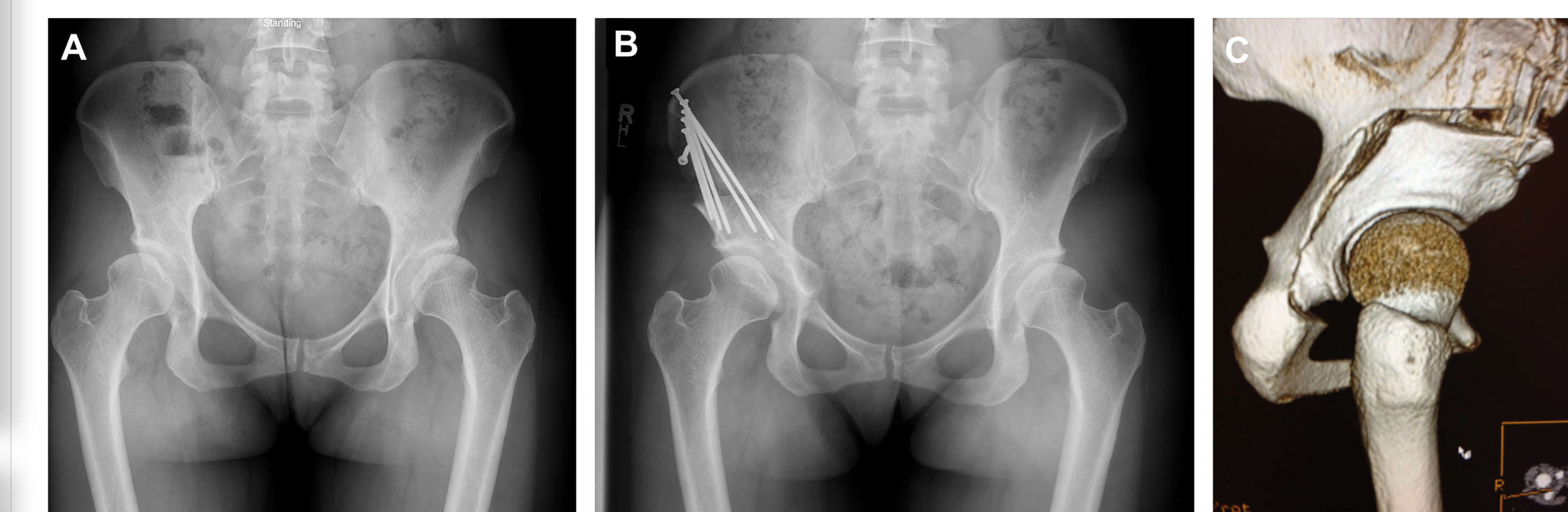


Figure 4: (A) The AP standing pelvis radiograph of a patient before PAO and (B) after PAO, demonstrating acetabular repositioning to increase lateral and anterior coverage of the acetabulum while maintaining desired acetabular version. (C) A patient's 3D CT scan after PAO demonstrating correction achieved.

REFERENCES

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