Radiologic evaluation of hip measurements: MR versus X-ray correlation

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PURPOSE: Hip dysplasia is not an uncommon entity encountered in adult hips, and when subtle, radiographic evaluation can be difficult. Since many patients currently first receive an MR examination for chronic hip pain, or do not have plain radiographs available at the time of the MR, our purpose was to determine the concordance of MR and plain films measurements for hip disorders.

MATERIALS & METHODS: Measurements of the acetabular angle (AA), center edge angle (CE), acetabular index (AI) and articulotrochanteric distance (ATD) were performed in 15 patients who had an MRI (coronal T1W 1.5T) within two months of a pelvic radiograph. In order to access for observer differences as opposed to modality differences, a second observer repeated the measurements. Lastly, the second observer repeated a subset of measurements to access for intra-observer variation. The measurements were compared using a mixed model analysis of variance (ANOVA). Statistical significance was defined as $p<0.05$.

RESULTS: Mean acetabular angle, center edge angle, acetabular index, and articulotrochanteric distance were 53.9 (5.3), 37.5 (6.7), 48.6 (5.8) and 2.0 (0.6) on X-ray and 43.0 (4.9), 35.6 (8.7), 30.0 (5.7) and 0.4 (0.1) on MR images respectively. The mean hip measurements between the left and right sides were not significantly different. For all measurements, the XR values were greater than on MR (*table 1*).

Table 1 Mean Values (s.d.)

	AA	**CE**	**AI**	**ATD**
XR	53.9 (5.3)	37.5 (6.7)	48.6 (5.8)	2.0 (0.6)
MR	43.0 (4.9)	35.6 (8.7)	30.0 (5.7)	0.4 (0.1)
p- value	< 0.0001	0.079	< 0.0001	< 0.0001

AA: acetabular angle *CE*: center edge angle *AI*: acetabular index *ATD*: articulotrochanteric distance

There was no significant difference between XR and MR with respect to the center edge angle ($p= 0.08$) and there was a significant positive correlation ($r= 0.56$). There was a highly significant difference with respect to the mean level of the acetabular angle even after differences between readers are accounted for ($p< 0.0001$). Evaluation of the acetabular angle revealed a significant positive correlation ($r=0.54$) and that agreement between XR and MR values will be improved by linear transformation (calibration), indicating both multiplicative and additive bias with development of a correction equation (*table 2*).

Table 2 Correlation Between XR and MR

	Correlation coefficient (r)
AA	0.537
CE	0.559
AI	0.177
ATD	0.343

In each case, the XR values for the acetabular index were at least 2 units higher than the MR values and the XR values for the articulotrochanteric distance were at least 2-fold higher than the MR values. For both the acetabular index and the articulotrochanteric distance there was no significant correlation between the XR and MR values ($r= 0.18$ and $r=0.34$ respectively), and therefore while applying a linear transformation will improve correlation, the two values will still not exhibit a close correlation (*table 2*).

There was also a significant difference between readers when measuring the acetabular index and the articulotrochanteric distance on MR, indicating a highly subjective nature of these measurements on this modality. Intra-reader differences were low, 10% on XR, but tended to be higher on MR.

CONCLUSION: On MR, only the center edge angle can be used similar to XR, although there are potential correction equations that can be developed, the high inter-observer variability questions the use of the other traditional angles and lines when applied to MR.