Pulvinar and pubic cartilage measurements for the diagnosis of developmental dysplasia of the hip: How do they compare to alpha angle and percentage bony coverage?

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INTRODUCTION:

Radiographic diagnosis of developmental dysplasia of the hip (DDH) is widely based on ultrasound (US) morphology of the acetabular bony roof (alpha angle, α) and percentage bony coverage (%BC) of the femoral head. Radiologist observations of increased pulvinar (fatty joint structures indistinguishable from ligamentum teres on ultrasound) prompted the authors to question how to incorporate this finding, particularly for otherwise radiographically normal hips. The Couture and Treguier method measures pubofemoral distance (PFD), comprising pubic cartilage (CT) plus pulvinar thickness (PT) (Figure 1). Thick PT is abnormal but thick CT is normal. The purpose of this study is to evaluate whether PFD correlates with α and %BC and determine the true/false positive rate should this method be widely used.

METHODS:

This is a retrospective study on infants < 6 months screened with hip US at one institution from 2016-2020. Patients with syndromes, neuromuscular disorders or inadequate US quality were excluded. Demographic and clinical data were collected. A radiologist measured α, %BC, PFD, PT, and CT on patients' first US. Normal PFD, PT and CT were ≤ 6, ≤ 4.2 and ≤ 2.4 mm, respectively. Normal α and %BC were ≥ 60° and ≥ 50%, respectively.

RESULTS:

130 patients with 252 hips were included: 70% F, mean age 5.94 ± 5.69 weeks (median 5 weeks) at time of US. Table 1 lists demographic data. 157 hips (62%) had DDH based on abnormal α and/or %BC; 43 hips (17%) based on abnormal PFD; 159 hips (63%) based on abnormal α, %BC, and/or PFD. Among 209 hips (83%) with normal PFD, mean α was 61 ± 8.2°: 136 (65%) had normal α and 73 (35%) had abnormal α; mean %BC was 50 ± 11%: 108 (52%) had normal %BC and 101 (48%) had abnormal %BC. Among 43 hips (17%) with abnormal PFD, mean α was 46 ± 11°: 5 (11%) had normal α and 38 (88%) had abnormal α; mean %BC was 34 ± 12%: 4 (9%) had normal %BC and 39 (91%) had abnormal %BC. Of the hips with abnormal PFD: "false positives" represented 9 hips (21%) (thick CT, normal PT) while "true positives" represented 29 hips (67%) (normal CT but thick PT: 21 hips (48%) or thick CT and thick PT: 8 (19%) hips). Bivariate analysis demonstrated associations between PFD and α ($r = -0.337$, $p=0.05$) and %BC ($r = -0.569$, $p = 0.01$). There was no correlation between PFD and age. Multivariate analysis will be performed.

DISCUSSION AND CONCLUSION:

Measurement of PFD may refine US screening of DDH but requires radiologist experience in this method. PFD significantly correlates with α and %BC. A 21% false positive rate could lead to overtreatment of DDH, but measurement of CT and PT when PFD is abnormal can prevent this.

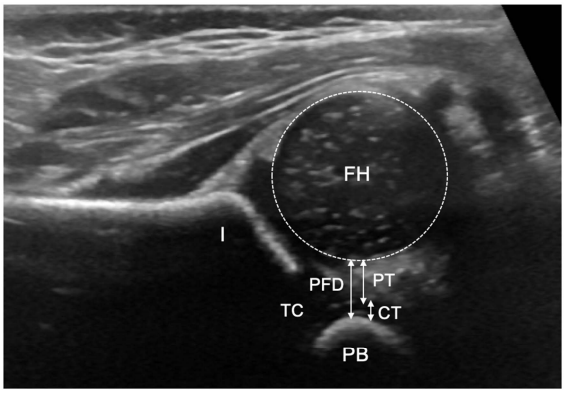

Figure 1. Coronal ultrasound section of a mildly dysplastic hip at 6 weeks of age, with α 48° and %BC 47%. I: Ilium. F: Femoral head. TC: Triradiate cartilage. PB: Pubic bone. PFD: Pubofemoral distance (5.5 mm). PT: Pulvinar thickness representing the location of pulvinar and ligamentum teres (4.1 mm). CT: Pubic cartilage thickness (1.4 mm).

Table 1. Patients' characteristics

Characteristic	Number of Patients, N (%) Total=130
Sex	
Female	100(76.9)
Male	30(23)
Family History	
Yes	4(3)
No	126(96.9)
Breech	
Yes	47(36)
No	83(63)
First Born	
Yes	59(45)
No	49(37)