Observer agreement in ultrasound assessment of pubertal breast development in girls

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INTRODUCTION

Clinical assessment of pubertal breast development using Tanner staging is subjective. Ultrasound staging is a promising novel approach, but information on the reliability of the method is lacking.

OBJECTIVES

To investigate intra- and inter-observer agreement of breast maturity staging using ultrasound.

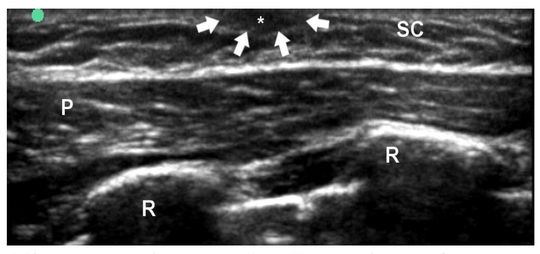
METHODS

Fifty-seven healthy girls (mean age 10.9 years, range 6.1 to 15.9 years) were examined independently by two observers using ultrasound to score the glandular maturity stage on a 0-5 scale (see figures), and to measure the depth and diameter of the left breast. One observer repeated the examination to assess intra-observer agreement. Cohen's kappa with linear weights was used to examine intra- and inter-observer agreement of the ultrasound staging.

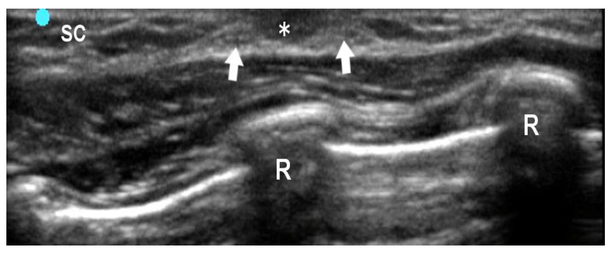
CONCLUSION

Ultrasound staging is a reliable method to assess and monitor the development of glandular breast tissue during puberty in healthy girls.

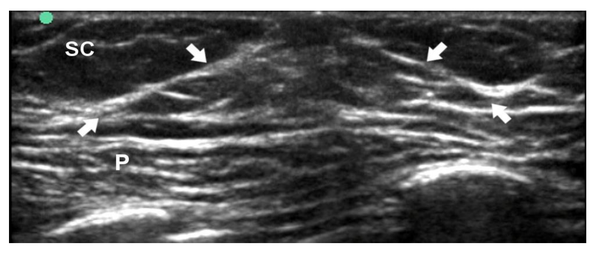
ULTRASOUND STAGES OF PUBERTAL BREAST DEVELOPMENT



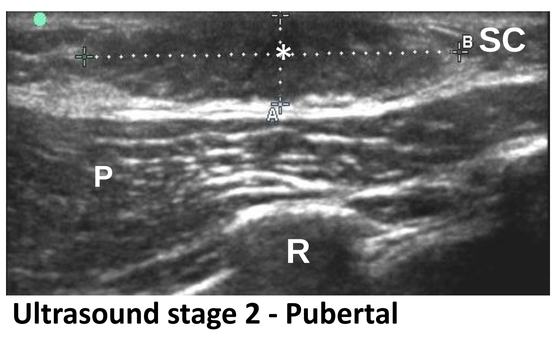
Ultrasound stage 0 – Prepubertal
Mid-sagittal view through the breast in a 7.5y old girl, showing ultrasound stage 0. A small round /elongated mass (arrows) which appears hypoechoic (asterisk) relative to the surrounding subcutaneous (SC) fatty tissue. The ribs (R) are located posterior to the pectoral muscle (P).



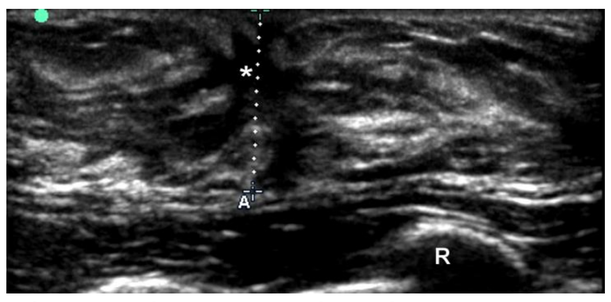
Ultrasound stage 1 – Prepubertal
Mid-sagittal view through the breast in a 7.5y old girl. A small, sub-areolar hypoechoic mass (similar to US 0) (asterisk) with two small triangle-shaped areas on both sides (arrows) which appear hyperechoic in relation to the subcutaneous tissue (SC), and the sub-areolar mass.



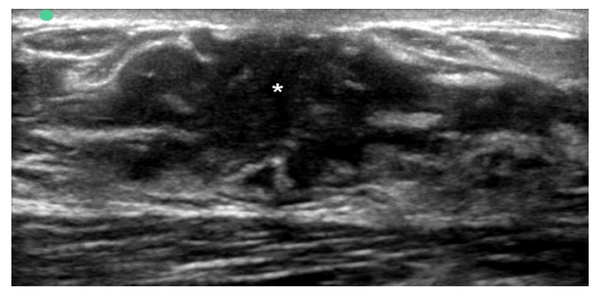
Ultrasound stage 1 – Prepubertal
Image of the breast in a 9y old girl .
A triangular hyperechoic mass (arrows) compared to the surrounding tissue (not to the pectoral muscle).



Ultrasound stage 2 - Pubertal
Mid-sagittal view through the breast in a 10.5y old girl with ultrasound stage 2 has a hypoechoic, round center (asterisk), and shows well-defined tissue that appears hyperechoic in relation to the subcutaneous tissue (SC) (but not to the pectoral muscle). The ribs (R) are also visible.



Ultrasound stage 3 - Pubertal
Mid-sagittal view through the breast in an 11y old girl shows well-defined tissue which appears hyperechoic in relation to the subcutaneous tissue with a hypoechoic "octopus-shaped" center (asterisk). The hypoechoic "arms" extend into the glandular tissue .



Ultrasound stage 4 - Pubertal
US image of the left breast in a 12.5 y old girl. Hypoechoic tissue in the retro areolar area that has a rounder, more prominent shape, and often larger (compared to stage 3). The interface between hypo- and hyperechoic glandular tissue is less defined than in stage 3.
Ultrasound stage 5 (not shown)
Mature breast, a heterogeneous hyperechoic mass *without* any hypoechoic center.

RESULTS

The agreement of ultrasound staging on a 0-5 scale was very good (kappa 0.84; 95%CI: 0.78 – 0.91) for intra- (Table 1) and good (kappa 0.71; 95%CI: 0.62 – 0.80) for inter-observer (Table 2). We also examined observer variation of direct measurements of glandular depth and diameter (Bland Altman analysis - data not shown), but differences within and between observers were relatively large.

Table 1*: Intra-observer agreement (observer 1)

		Second assessment						
		0	1	2	3	4	5	**Total**
First assessment	0	**11**	4	-	-	-	-	15
	1	-	**8**	-	-	-	-	8
	2	-	-	**6**	-	-	-	6
	3	-	-	1	**5**	2	-	8
	4	-	-	1	2	**7**	4	14
	5	-	-	-	-	3	**3**	6
Total		11	12	8	7	12	7	57

Table 2*: Inter-observer agreement (observer 1 versus observer 2)

		Observer 2						
		0	1	2	3	4	5	**Total**
Observer 1	0	**5**	9	1	-	-	-	15
	1	1	**6**	1	-	-	-	8
	2	-	-	**2**	-	3	-	5
	3	-	1	-	**3**	4	-	8
	4	-	-	-	2	**9**	3	14
	5	-	-	-	-	2	**4**	6
Total		6	16	4	5	18	7	56

*Numbers in bold indicate the number of girls sharing the same US stage in both examinations by one observer (Table 1), or two observers (Table 2)

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References:
1) Bruserud, I. S., Roelants, M., Oehme, N. H. B., Eide, G. E., Bjerknes, R., Rosendahl, K., & Juliusson, P. B. (2018). Ultrasound assessment of pubertal breast development in girls: intra- and interobserver agreement. *Pediatr Radiol*. Springer © 2018