

1

2 3 4

:  
:  
149 169  
:  
12 (25%) , 36  
(75%) 97 (96%)  
4 (4%) 75%; 96%; 89%;  
90%; 89%  
( $p = 0.03$ ).

가  
(1) 가 (6-8)  
(7, 8).  
(criteria) 가  
(2-4). 6 mm 가  
가  
(5). (compressi-  
bility), 가

2004 5 2006 6  
169  
20 149 ( 88%)  
90 , 59 8.3 (1-15 )  
가 가 149 48  
(32%)  
2004 가  
2007 2 2 2007 7 16  
483

101 (68%) 2

99

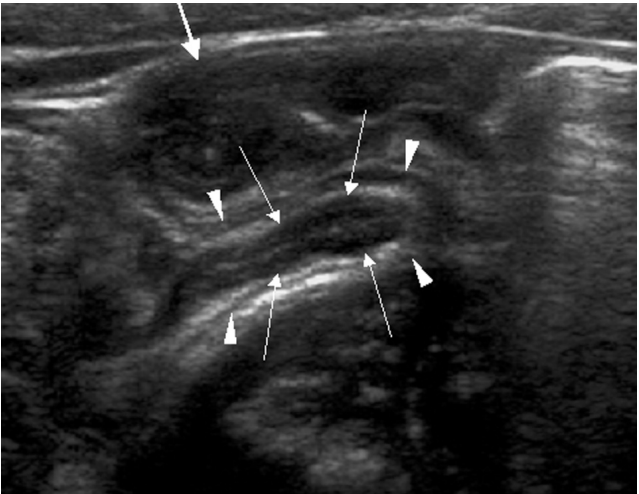
가 (7, 8) (B.S.K., G.M.C.)

ATL (Advanced Technology Laboratories, bothell, WA) HDI 5000

4 - 7 MHz

, Puylaert (1)

(graded - compression technique) 5 - 12 MHz



**Fig. 1.** An eight-year-old boy with terminal ileitis. Longitudinal image shows a normal appendix (arrowheads) with inner hypoechoic bands (long arrows). Thickened wall of terminal ileum (arrow) is noted, anterior to appendix.



**Fig. 2.** A seven-year-old boy with mesenteric lymphadenitis. Transverse US image shows a normal appendix (arrowheads) with inner hypoechoic bands (long arrows).

:

(linear) 가 (ileocecal valve)

가 (Fig. 1, 2), (caliper)

(ovoid)

(muscularis)

(neutrophil) (early appendicitis), (suppurative appendicitis), (gangrenous appendicitis)

가 (6).

student t - test (SPSS version 12.0, Statistical Package for the Social Sciences)

48 (75%) 36 (25%) (Fig. 3, 4), 12

23 (64%) (Table 1).

(6, 17%) 36

(1, 8%) 5

101 4 97

75%, 96%, 89%, 90%, 89%

1.02

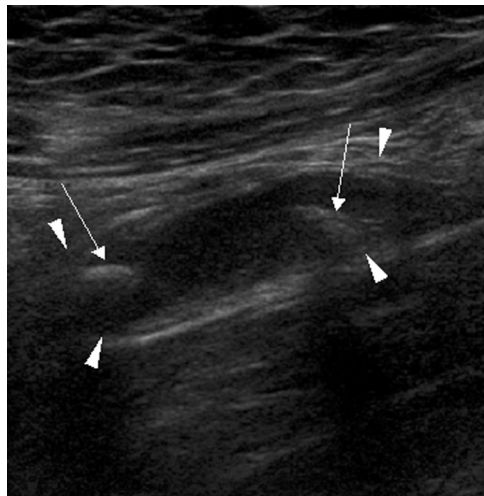
mm (0.6 - 2.1 mm) 0.86 mm (0.4 - 1.4 mm)

(p= 0.03) (Fig. 5).

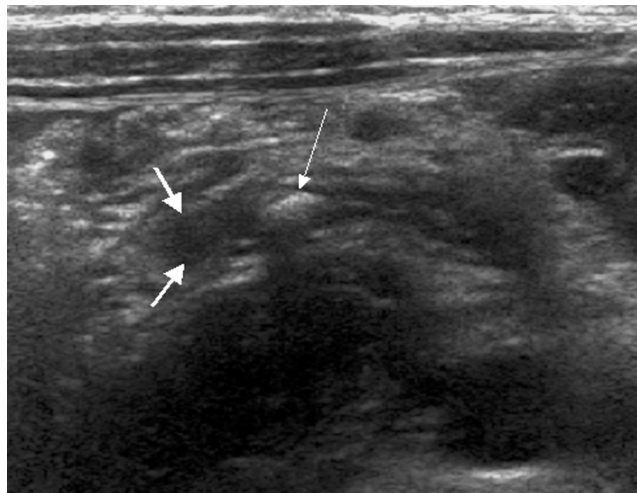
101 6 mm

**Table 1.** Comparison of US Finding, and Surgico-pathologic and Clinical Follow-up Results

	Appendicitis (n = 48)				Negative Appendicitis (n = 101)
	Early Appendicitis (n = 4)	Suppurative Appendicitis (n = 37)	Gangrenous Appendicitis (n = 7)	Total	
Absence of Inner Hypoechoic Band	1	28	6	36 (75%)	4 (4%)
Partial	0	11	1	13 (36%)	4 (100%)
Whole	1	17	5	23 (64%)	0
Entire visible Inner Hypoechoic Band	2	9	1	12 (25%)	97 (96%)

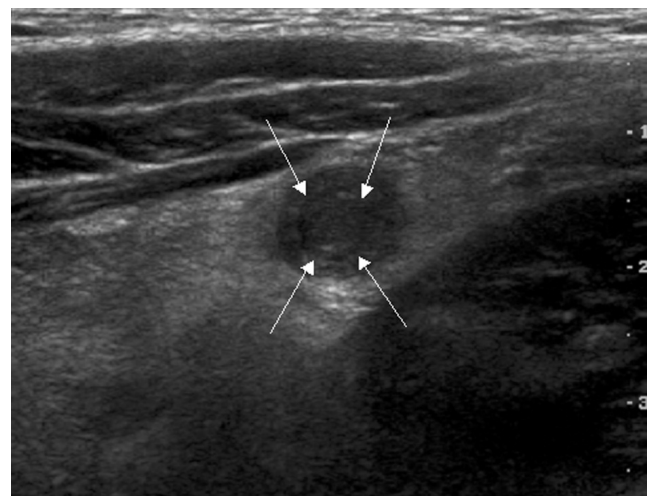


**Fig. 3.** An 11-year-old boy with acute suppurative appendicitis. Longitudinal US image shows an acutely inflamed appendix (arrowheads) with entire loss of inner hypoechoic band. Two intraluminal appendicoliths with acoustic shadowing (long arrows) behind it are seen.

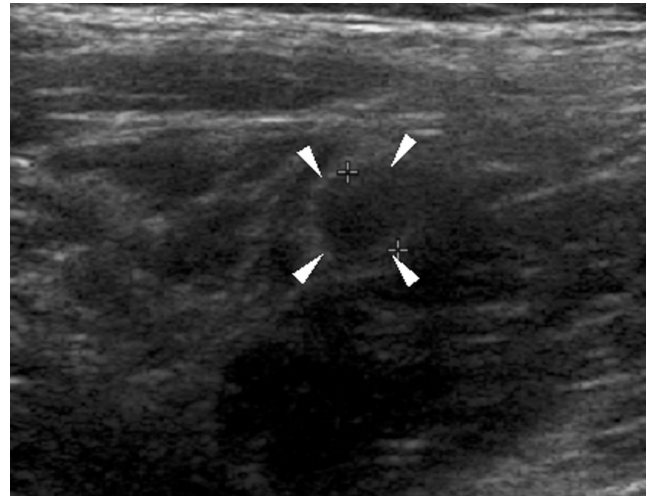


**Fig. 4.** A five-year-old boy with acute suppurative appendicitis. Longitudinal US image shows an acutely inflamed appendix with partial loss of inner hypoechoic band (arrows). An intraluminal appendicolith with posterior shadowing (long arrows) is seen in mid portion of the appendix.

20 , 19 (95%)가  
(Fig. 6).  
6 mm 4 ,  
(Fig. 7).  
48  
가  
30% - 45%  
(9).  
10  
가  
(9 - 11).  
Puylaert (1)  
(2, 11, 12).



**Fig. 5.** A 12-year-old girl with acute suppurative appendicitis. Transverse US image shows an acutely inflamed appendix with decreased thickness of inner hypoechoic band (long arrows).



(3 - 5, 7, 10, 13).  
60% 90% 가  
(8, 13). 가  
(6 mm ) 가 가 (14).  
90 - 100% 60 - 70% 100% 89% (round)  
37% 85% ) ,  
79% (3 - 5). 가 90% ( )  
6 mm  
(in 20 19 (95%)  
vitro) (8) 5 가  
(lamina propria)  
(8). 가  
가 가  
가 가

1. Puylaert JB. Acute appendicitis: US evaluation using graded compression. *Radiology* 1986;158:355-360
2. Jeffrey RB Jr, Laing FC, Townsend RR. Acute appendicitis: sonographic criteria based on 250 cases. *Radiology* 1988;167:327-329
3. Rettenbacher T, Hollerweger A, Macheiner P, Rettenbacher L, Frass R, Schneider B, et al. Presence or absence of gas in the appendix: additional criteria to rule out or confirm acute appendicitis-evaluation with US. *Radiology* 2000;214:183-187
4. Rettenbacher T, Hollerweger A, Macheiner P, Gritzmam N, Daniaux M, Schwamberger K, et al. Ovoid shape of the vermiform appendix: a criterion to exclude acute appendicitis-evaluation with US. *Radiology* 2003;226:95-100
5. Rettenbacher T, Hollerweger A, Macheiner P, Rettenbacher L, Tomaselli F, Schneider B, et al. Outer diameter of the vermiform appendix as a sign of acute appendicitis: evaluation at US. *Radiology* 2001;218:757-762
6. Kumar V, Abbas AK, Fausto N. *Robbins and Cotran Pathologic basis of disease*. 7th ed. Philadelphia:Elsevier Saunders,2005:870-872
7. : .  
2004;51:663-667
8. Spear R, Kimmerly MB, Wang KY, Sillery JK, Benjamin DR, Sawin RS. Appendiceal US scans: histologic correlation. *Radiology* 1992;183:831-834
9. Siegel MJ. Acute appendicitis in childhood: the role of US. *Radiology* 1992;185:341-342
10. Sivit CJ, Newman KD, Boenning DA, Nussbaum-Blask AR, Bulas DI, Bond SJ, et al. Appendicitis: usefulness of US in diagnosis in a pediatric population. *Radiology* 1992;185:549-552
11. Vignault F, Filiatrault D, Brandt ML, Garel L, Grignon A, Ouimet A. Acute appendicitis in children: evaluation with US. *Radiology* 1990;176:501-504
12. Abu-Yousef MM, Bleicher JJ, Maher JW, Urdaneta LF, Franken EA Jr, Metcalf AM. High-resolution sonography of acute appendicitis. *AJR Am J Roentgenol* 1987;149:53-58
13. Rioux M. Sonographic detection of the normal and abnormal appendix. *AJR Am J Roentgenol* 1992;158:773-778
14. Sivit CF, Siegel MJ Applegate KE, Newman KD. When appendicitis is suspected in children. *Radiographics* 2001;21:247-262

## Usefulness of the Inner Hypoechoic Band of the Vermiform Appendix as Ultrasonographic Criteria for the Diagnosis of Acute Appendicitis in Children<sup>1</sup>

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**Purpose:** We wanted to evaluate the usefulness of the inner hypoechoic band in pediatric appendices as an ultrasonographic criterion to exclude or confirm acute appendicitis.

**Materials and Methods:** Among the 169 consecutive children with right lower abdominal pain, the 149 appendices depicted on US were prospectively evaluated for an inner hypoechoic band in the appendiceal walls. The sensitivity, specificity, positive and negative predictive values and accuracy were assessed for loss of the inner hypoechoic band as a diagnostic criterion for acute appendicitis.

**Results:** The appendices in 12 (25%) patients with acute appendicitis show entire inner hypoechoic bands and those in 36 patients (75%) did not. The appendices in 97 (96%) patients without acute appendicitis showed entire inner hypoechoic bands, and those in 4 (4%) did not. The loss of inner hypoechoic band confirmed acute appendicitis with a sensitivity of 75%, a specificity of 96%, positive and negative predictive values of 89% and 90%, respectively, and an accuracy of 89%. The thickness of the inner hypoechoic band in patients without appendicitis was significantly higher than that in patients with appendicitis ( $p = 0.03$ ).

**Conclusion:** The visualization of entire thickened inner hypoechoic band in the appendiceal wall helps to rule out acute appendicitis. However, the loss of the inner hypoechoic band is suggestive of acute appendicitis.

**Index words :** Appendicitis

Appendix, ultrasonography

Child

Acute disease

Reference standards

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