

# ATS-539

## 가<sup>1</sup>

. 2 . 3 . 4 . 5 . 6 . 7 . 8

: ATS-539

: 120 가 108 3.0 - 5.0 MHz

. ATS-539

가 , , , 가 , , , , 8  
/ 가 , Mann -  
Whitney U test ROC 가 .  
: , , 91.7%, 94.4%, 76.9%  
가 가 . , 108 78 가 (72.2%).  
가 8 mm 62.4% 69.3%

: ATS-539

72.2% , 8 mm  
가 .

5 가 가 (1).  
가

가

. 2003

ATS-539 (ATS Laboratories, Bridgeport,  
CT, U.S.A.) (2).

2004  
, CT, MR

가

가

가 /

가가

ATS-539

8가 가

1  
2  
3  
4  
5  
6  
7  
8

2006 4 1 2006 11 30  
 120  
 (ADC; Analogue Digital Converter,  
 Petamotion 2.0 , ) ATS-539  
 (3).

8가

5가 가

1) 2004 273 , 5,471

784 1  
 87 4,600 (84.1%)

2) 15

3)

가

4)

가 가

(software)

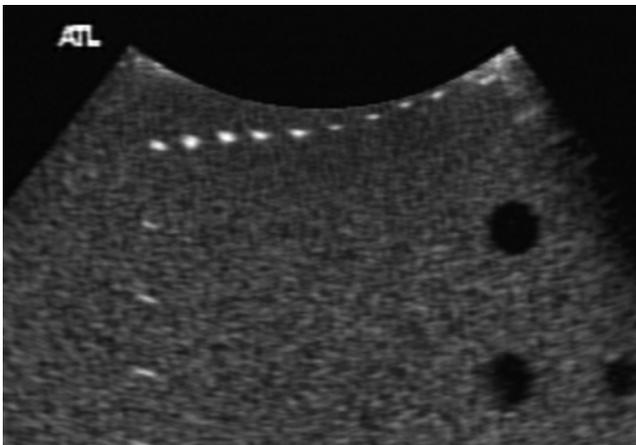


Fig. 1. Dead zone. Nine echoes are positioned 2-10 mm below the scan surface with 1 mm distance. All nine echoes are clearly visualized.

1)

2) 14 - 16 cm

3)

4)

5)

6)

3 가

ATS-539

ATS-539

1)

pulsing/receiving section

2 - 10 mm

5 가

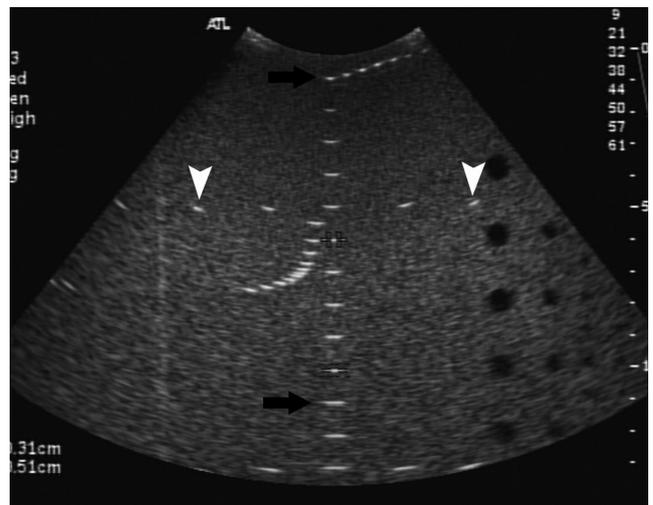


Fig. 2. Vertical and horizontal measurement. 10 cm distance at perpendicular line is measured from 1 cm to 11 cm (black arrows) below the scan surface for the vertical measurement, and 8 cm between horizontal targets (white arrows) are measured for the horizontal measurement.

가 9 가

2) (Vertical measurement) (Fig. 2)

1.0 ± 0.1 cm 가

10 cm ( , 10 ± 1 cm).  
3) (Horizontal measurement)

± 1 mm . 2 cm 2 cm  
cm ( , 8 cm ± 4 mm).

4) / (Axial/lateral resolution) (Fig. 3)

3.0 mm, 4.0 mm 가 가  
5.0 mm .  
11

5) (Focal zone)  
(focal point) 가  
가

6 - 7 cm  
4 cm

$$(\%) = \frac{6-7 \text{ cm}}{4 \text{ cm}} \frac{(\text{in focus})}{(\text{out focus})} \times 100$$

6) (Sensitivity; , maximum depth penetration) (Fig. 4)

8 mm, 6 mm, 4 mm, 3 mm, 2 mm  
6 mm 2 cm 1 cm  
16 cm . 8 mm  
가 16.0 ± 1.0 cm

7) (Functional resolution definition and fill-in)

8 mm  
180 °

8) (Gray scale and dynamic range) (Fig. 5)

가

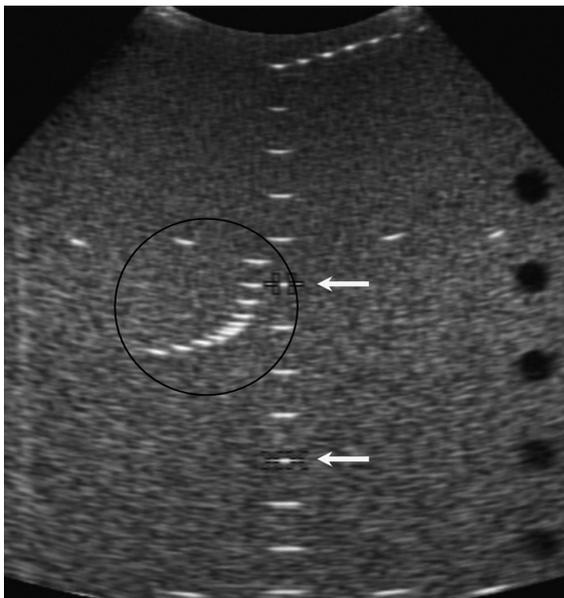


Fig. 3. Focal zone and axial/lateral resolution. Eleven targets with curved array must be visualized separately for acceptable axial/lateral resolution. Transverse length of targets located at 6 cm and 10 cm in depth are measured for the evaluation of focal zone.

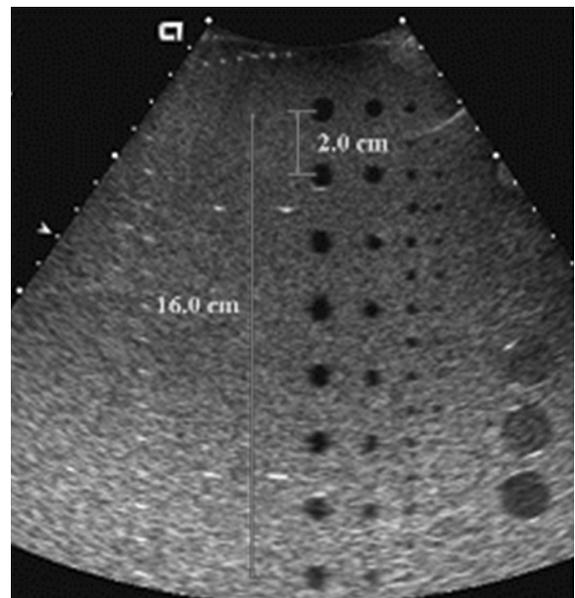


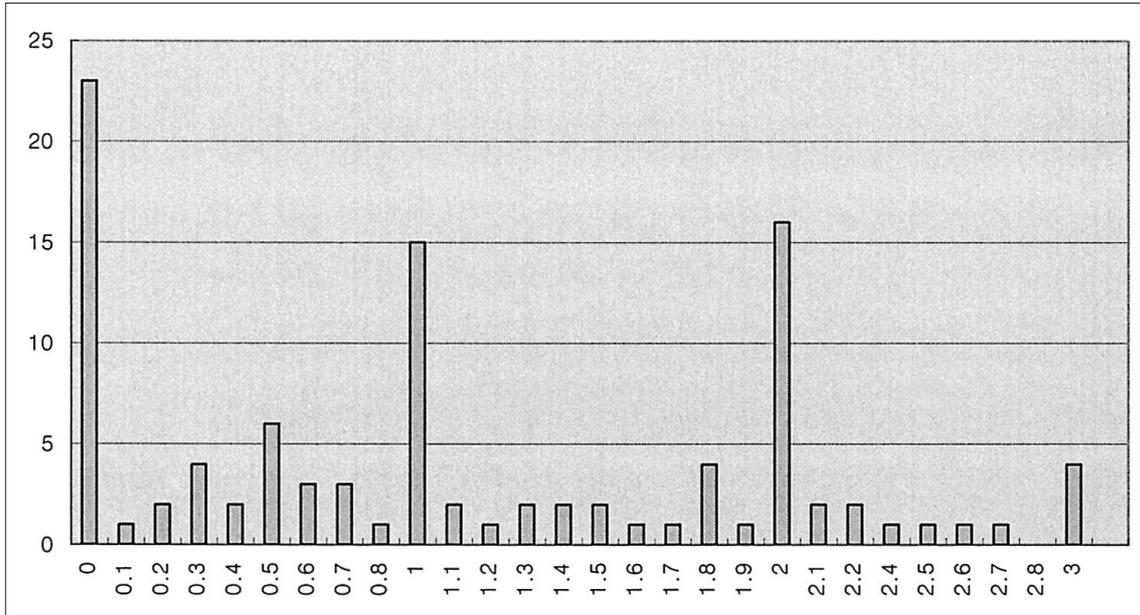
Fig. 4. Sensitivity and functional resolution. 8 mm sized cystic structures are well visualized on the most of ultrasound equipments. Cystic structures clearly demonstrated over 180 ° are counted.



**Table 1.** Number of US Equipments on Detection of Dead Zone Targets

No. of dead zone targets	9	8	7	6	5	4	3	2	1	Total
No. of US equipments	99	4	2	1	0	1	0	0	1	108
(%)	91.7	3.7	1.9	0.9	0.0	0.9	0.0	0.0	0.9	100

**Table 2.** Number of US Equipments on Error in Vertical Measurement



3 가 8 , 20 1

. 18

15 ,

가 3 .

5,471 120 , 4,580 가

108 , 4,458

가 .

1)

91.7% 9 (Table 1).

2)

3

4

10%

3)

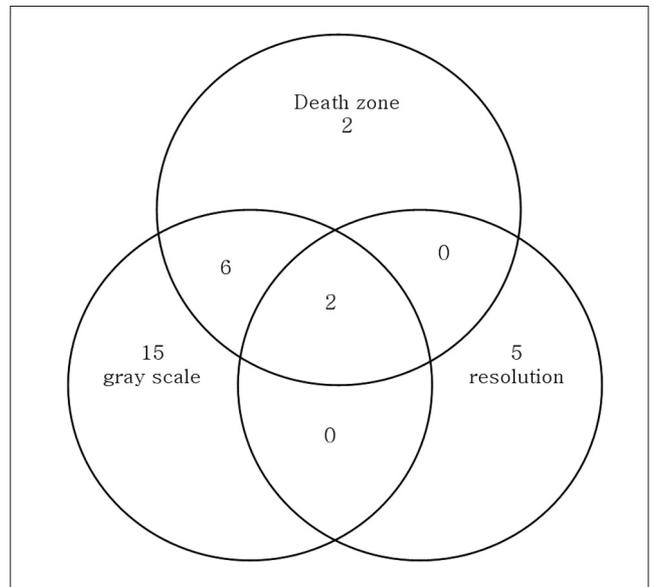
3

105 가 2 cm 1 4) /

mm 가 8 cm 4 mm 가 11 94.4%

29.6%가 . 6 mm (Table 4).

82.4%가 (Table 3). 5)



**Fig. 6.** Causes of incongruence.



**Table 7.** Number of US Equipments on Gray Scales

No. of gray scale	6	5	4	3	2	1	0	Total
No. of US equipments	5	18	60	22	3	0	0	108
(%)	4.6	16.7	55.6	20.4	2.8	0	0	100

**Table 8.** p-value in Mann-Whitney U Test about Measuring Items of US Phantom

	Vertical	Horizontal	Focal zone rate	Functional resolution 8 mm	Functional resolution 6 mm	Functional resolution 4 mm	Functional resolution 2 mm	Functional resolution 1 mm
Asymp.Sig (2-tailed)	0.139	0.333	0.044	0.001	0.277	0.098	0.135	0.277

**Table 9.** Congruence Rate of Items in US Phantom

	Vertical measurement	Horizontal measurement	Focal zone rate	functional resolution 8 mm	functional resolution 6 mm	functional resolution 4 mm	functional resolution 2 mm	functional resolution 1 mm
AUC*	0.588	0.559	0.624	0.693	0.565	0.601	0.590	0.546

AUC\* = area under the ROC curve.

108 78 72.2% . / 62.4%, 69.3% 가 (Table 9).

가 108 1 41  
 가 30 , / 12 ,  
 . 41 20 가  
 10 가 1 .  
 2 30 가 가 .  
 23 , / 10 , (6).  
 가 가 (Fig. 6). 가 , ,  
 30 7 10 . 가 , .  
 . 10 10 13 10 .  
 . 10 13 5 가 (7, 8).  
 가 (hard copy) 가  
 5가 가  
 가 Mann - Whitney U test  
 reference standard ROC analysis  
 /  
 가 . Mann - Whitney U test 8 mm (video capture card)  
 가 (3).  
 가 (Table 8). ROC , , (in Petamotion  
 focus/out focus ), 8 mm , 6 mm .  
 , 4 mm , 2 mm , 1 mm  
 58.8%, 55.9%, 62.4%, 69.3%, 56.5%,  
 60.1%, 59.0%, 54.6% . 8 mm ,



## Quality Assessment of Ultrasonographic Equipment Using an ATS-539 Multipurpose Phantom<sup>1</sup>

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**Purpose:** To determine the rate of congruence and to standardize assessment of US (ultrasound) phantom images with the use of an ATS-539 multipurpose phantom for US equipment currently utilized in Korea

**Materials and Methods:** US phantom images were scanned with a 3.0 - 5.0 MHz convex transducer and were digitized by use of an analogue-digital converter. Members of a committee with consent evaluated the US phantom images from 108 types of ultrasound equipment. The dead zone, vertical and horizontal measurement, axial/lateral resolution, focal zone, sensitivity, functional resolution and gray scale/dynamic range were evaluated. Congruence or incongruence of ultrasound equipment was determined based on the results of dead zone, axial/lateral resolution and gray scale/dynamic range measurements. Other factors were evaluated for the possibility as criteria with the use of the Mann-Whitney U test and receiver operator characteristic (ROC) curve analysis.

**Results:** The dead zone, axial/lateral resolution and gray scale/dynamic range were 91.7%, 94.4% and 76.9%, respectively, for suitable US equipment. Considering all three factors, 78 types of ultrasound equipment were passed. The congruence rate of focal zone and functional resolution were 62.4% and 69.3% of the US equipment, respectively.

**Conclusion:** Of the US equipment, 72.2% of the equipment was acceptable based on the dead zone, axial/lateral resolution, and gray scale/dynamic range measurements as determined with the use of an ATS-539 phantom. Focal zone and 8 mm-functional resolution can be useful as a standard in the assessment of a US phantom image.

**Index words :** Ultrasonography

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Phantom

Quality control

Quality assessment

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