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 : 37 2 (HDI - 3000, ATL, U.S.A.) 3
 (Voluson 530D, Medison, Korea)
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가
 (Computed Tomogram, CT) (Magnetic Resonance Image, MRI)
 가 , 3 (3 dimensional, 3D)
 (1). 2 (2 dimensional, 2D)
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 (2 - 4). 가 (5 - 7).
 , 3 가
 Hunerbein (8) 5
 20

5 4
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29 , 29 ,
8 37
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3 2
1998 1 1998 6
2 3
37 ,
20 , 9 , 8
16 85
39 13 , 9 , 4
11
2D
3D
HDI - 3000 (ATL, U.S.A.) 5 - 7 MHz , 3D

Table 1. Comparison of Detection Rate of Lesions According to Size of Breast Masses(n=37)

	2D > 3D	2D < 3D	2D = 3D
< 1 cm	2		9
1 - 3 cm			23
> 3 cm			3

2D: two-dimensional ultrasonogram

3D; three-dimensional ultrasonogram

>: better than , =: equal to , <: worse than

Table 2. Comparison of Sonographic Features of 3D-US and 2D-US of Breast Masses

	3D > 2D			3D < 2D			3D = 2D		
	FA (20)	Ca (9)	FCD (8)	FA (20)	Ca (9)	FCD (8)	FA (20)	Ca (9)	FCD (8)
Evaluation of internal echo	8	5	1	3	1	1	9	3	6
Assessment of boundary echo	10	6	1	3	1	1	7	2	6
Differentiation of tumor/non-tumor		1	1	9	1	1	11	7	6

2D: two-dimensional ultrasonogram, 3D; three-dimensional ultrasonogram

>: better than, =: equal to, <: worse than

FA: fibroadenoma , Ca: breast cancer , FCD: fibrocystic disease

: 3
Voluson 530D (Medison, Korea) 5 MHz
. 3
(surface mode)
(light mode) 3D
. 3D
(volume scan)
(Fig. 1).
cm , 1 cm 3 cm , 3 cm
2D 3D
Duncan 's multiple range test
2D 3D

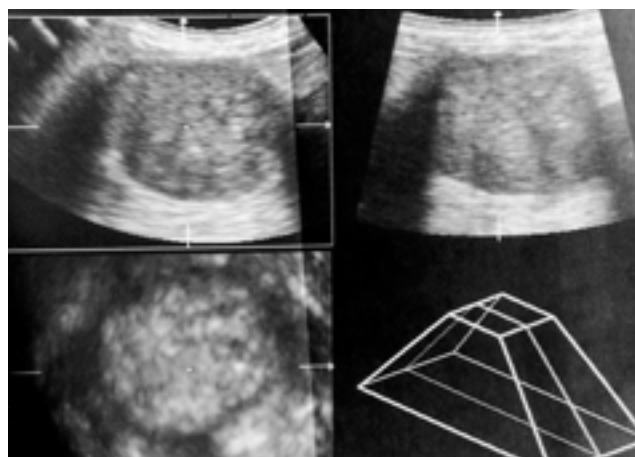


Fig. 1. Multiplanar 3D-US image are shown. Coronal plane image, which cannot be obtained with 2D-US, is well demonstrated. Top left : transverse plane image. Bottom left : coronal plane image.

Top right : sagittal plane image. Bottom right : schematic drawing of volume data.

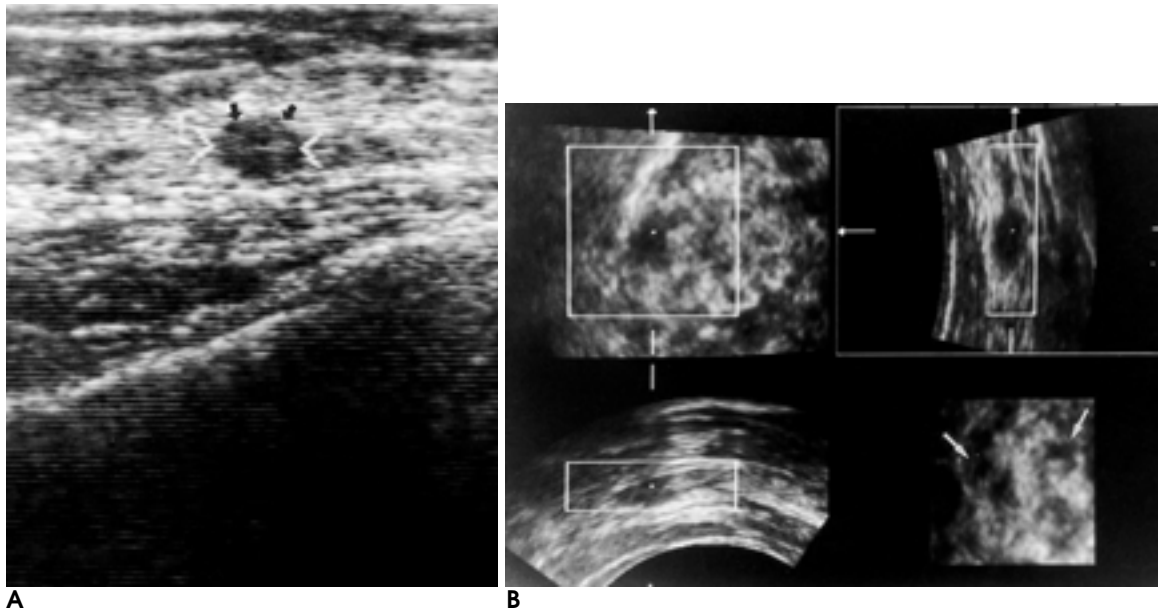


Fig. 2. Fibroadenoma of less than 1cm in diameter in 26-year-old female with palpable mass in the left breast.

A. 2D-US image shows an 0.7×0.5 cm sized well margined homogeneous hypoechoic mass(black arrows).

B. 3D-US image shows also a well margined hypoechoic nodule on axial and sagittal plane images, But 3D-reconstructed US image fails to define the true mass due to multiple ill-defined hypoechoic nodular which reveal ill-defined hypoechoic mass on coronal images (arrows) around lesion at the same area.

Top left : coronal plane image. Bottom left : axial plane image. Top right : sagittal plane image. Bottom right : 3D reconstructed image.

Table 3. Statistical Analysis of Sonographic Findings of Breast Masses

	Evaluation of Internal Echo				Assessment of Boundary Echo				Differentiation of Tumor/non-Tumor			
	FA	Ca(%)	FCD	Ave	FA	Ca(%)	FCD	Ave	FA	Ca(%)	FCD	Ave
3D>2D	40.0	55.6	12.5	36.2 ^{ab1)}	50.0	66.7	12.5	43.2 ^a	0	11.1	12.5	7.8 ^b
3D=2D	45.0	33.3	75.0	51.0 ^a	35.0	22.2	75.0	44.0 ^a	55.0	77.8	75.0	69.3 ^a
3D<2D	15.0	11.1	12.5	12.8 ^b	15.0	11.1	12.5	12.8 ^a	45.0	1.1	12.5	22.8 ^b

1) Means with different letter(a, b) within a column are significantly different from each other at $\alpha = 0.05$ as determined by Duncan's multiple range test($a > b$).

2D: two-dimensional ultrasonogram, 3D ; three-dimensional ultrasonogram

>: better than, =: equal to, <: worse than

FA: fibroadenoma, Ca: breast cancer, FCD: fibrocystic disease, Ave; average

가

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2D 3D

2

3

1

1 cm

11

2

3

2

2 가

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3

3

가

1 cm

26

1 cm - 3 cm

23

3

cm

3

2

3

가 1 cm

(Fig. 2).

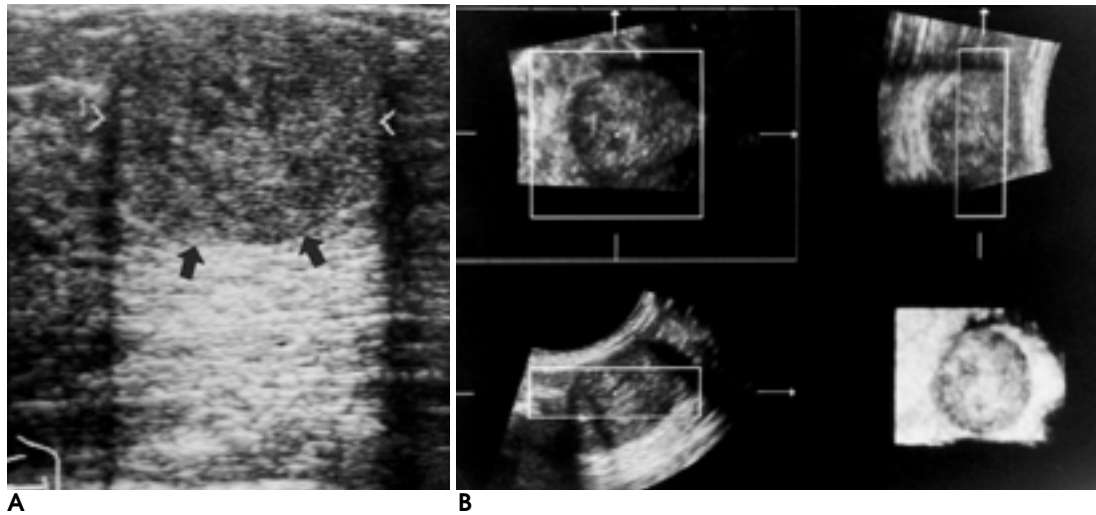


Fig. 3. Fibroadenoma in 16-year-old female with a palpable mass in the right breast.

A. 2D-US image shows a well margined 2.5×1.9 cm sized oval hypoechoic mass(black arrows) with homogeneous internal echoes.

B. Internal and boundary echoes are more distinctively demonstrated on 3D-US image than on 2D-US image.

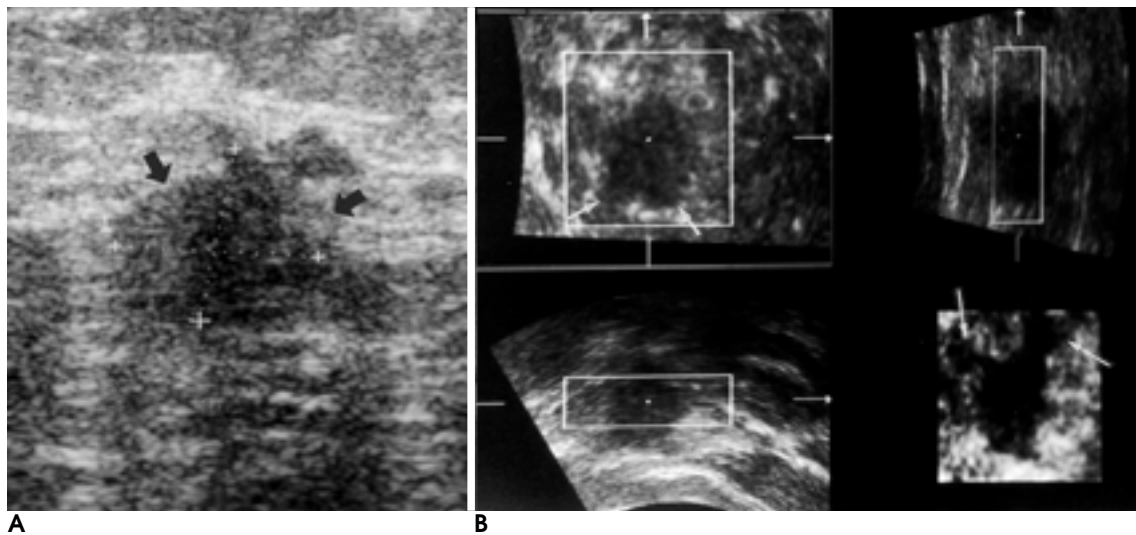


Fig. 4. Breast cancer in 60-year-old female with a palpable mass in the left breast.

A. 2D-US image shows an ill-defined hypoechoic mass (black arrows) with heterogeneous internal echo pattern.

B. Boundary echoes and multiple spiculations around the mass are more distinctively noted on coronal plane image (short arrows) and 3D-reconstructed US image (long arrows).

Top left : coronal plane image. Bottom left : axial plane image. Top right : sagittal plane image. Bottom right : 3D reconstructed image.

, 2 3 (Table 3) . 3

, 2 (Table 2) . (Fig. 3, 4) 2

Duncan's multiple range test , 가 (Table 2, 3). 가

, 3 2 가

가가 , 2 가 3 가

가 가 2 가

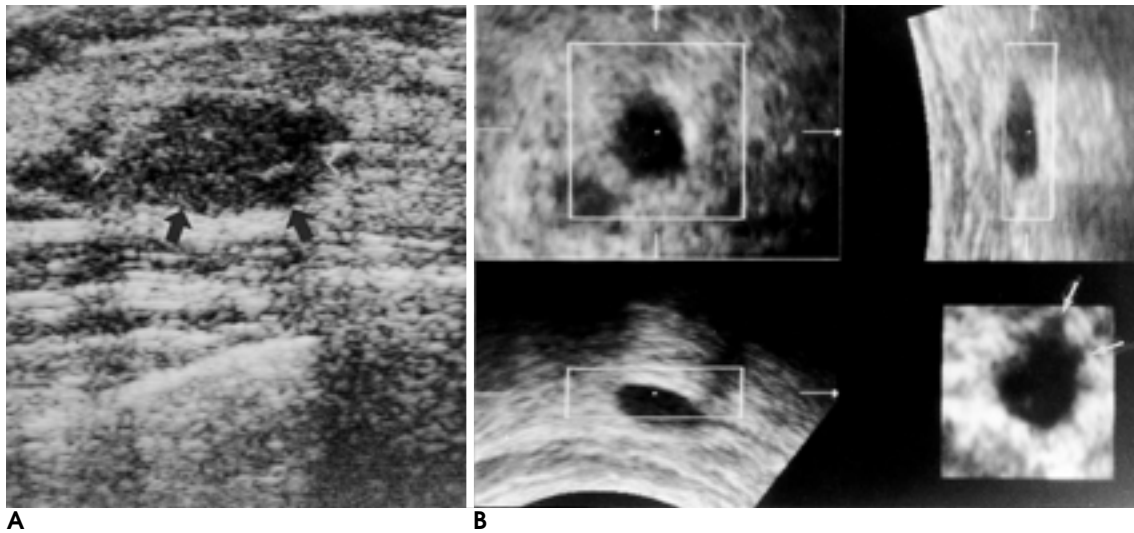


Fig. 5. Fibroadenoma in 26-year-old female with a palpable mass in the right breast.

A. 2D-US image shows a 1.5×0.9 cm sized well margined hypoechoic mass (black arrows) with homogeneous internal echo. Diagnosis based on 2D-US image was fibroadenoma

B. 3D-US image also shows homogeneous internal echo of the mass. On 3D-US image, multiple pseudospicules (arrows), which seem to be produced by summation artifact during 3D reconstruction phase, were demonstrated around mass. These pseudospicules may be a possible pitfall in the diagnosis of breast cancer. Diagnosis based on 3D-US image was breast cancer but histologic diagnosis was fibroadenoma.

Top left : coronal plane image. Bottom left : axial plane image. Top right : sagittal plane image. Bottom right : 3D reconstructed image.

Table 4. Comparison of Diagnostic Accuracy of 2D and 3D-US in Breast Tumors

	sensitivity(%)	specificity(%)	positive predictive value(%)	negative predictive value(%)
Fibroadenomas				
2D-US	100	89	95	100
3D-US	85	100	100	75
Breast cancer				
2D-US	89	100	100	95
3D-US	100	85	75	100

2D-US: two-dimensional ultrasonogram, 3D-US : three-dimensional ultrasonogram

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3 2 가 3 3
가 , 가 3
2 3 2
(Table 4) . 2 2
가 , 3
가 1 (9).
2 100% (20/20)
89% (8/9) . 3 3
85%
(17/20) 100% (9/9)
가 75% (9/12) (Fig. 5).
321

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 ductal carcinoma) 1 3
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 Rotten (11) 186
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 verging type) 가 2
 (compressive pattern) 3 2
 (summation artifact) 가
 가 1 cm 가
 (pseudospicule sign) 3
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 가 2 3

1. Martin JE, Moskowitz M, Milbrath JR. Breast cancer missed by

- mammography. *AJR Am J Roentgenol* 1979;132:737-739
2. Donal BD, Aaron F, Facqueline CW. Clinical utility of three-dimensional US. *Radiographics* 2000;20:559-571
3. Hata T, Yonehara T, Aoki S, Manabe A, Hata K, Miyazaki K. Three dimensional sonographic visualization of the fetal face. *AJR Am J Roentgenol* 1998;170:481-483
4. Kelly IMG, Gardener JE, Brett AD, Richards R, Lees WR. Three dimensional US of the fetus. *Radiology* 1994;192:253-259
5. Chou CY, Hsu KF, Wang ST, Huang SC, Tzeng CC, Huang KE. Accuracy of three-dimensional ultrasonography in volume estimation of cervical carcinoma. *Gynecol Oncol* 1997;66:89-93
6. Sehgal CM, Broderick GA, Whittington R, Gorniak RJT, Arger PH. Three-dimensional US and volumetric assessment of prostate. *Radiology* 1994;192:274-278
7. Tracy LE, Donal BD, Shidong T, Carolyn AN, Aaron F. Accuracy of prostate volume measurements in vitro using three-dimensional ultrasound. *Acad Radiol* 1996;3:401-406
8. Hunerbein M, Gretscher S, Ghadimi BM, Schlag PM. Three-dimensional endoscopic ultrasound of esophagus. Preliminary experience. *Surg Endosc* 1997;11:991-994
9. Baba K, Okai T, Kozuma S, Taketani Y, Mochzuki T, Akahane M. Real time processable three-dimensional ultrasound in obstetrics. *Radiology* 1997;203:571-574
10. Rotten D, Levailant JM, Constancis E, Billon AC, Guerinel YL, Rua P. Three-dimensional imaging of solid breast tumors with ultrasound : preliminary data and analysis of its possible contribution to the understanding of standard two-dimensional sonographic images. *Ultrasound Obstet Gynecol* 1991;1:384-390
11. Rotten D, Levailant JM, Zerat L. Analysis of normal breast tissue and of solid breast masses using three-dimensional ultrasound mammography. *Ultrasound Obstet Gynecol* 1999;14:114-124

Usefulness and Limitation of 3D-Ultrasound Diagnosis of Breast Masses¹

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Purpose: To compare 3D ultrasound (3D-US) with 2D ultrasound (2D-US) in terms of their usefulness and limitations in the diagnosis of breast masses.

Materials and Methods: We obtained 2D and 3D US images of 37 breast lesions present in 20 cases of fibroadenoma, nine of cancer, and eight of fibrocystic disease proven in a total of 26 cases [fibroadenoma (n=13), breast cancer (n=9), fibrocystic disease (n=4)] by histologic examination, and by clinical evaluation and clinical evaluation with sonographic imaging in eleven. When comparing 3D and 2D-US images we had no prior information regarding detection rate according to the size of lesions, whether or not internal and boundary echo patterns could be interpreted, accurate differentiation between tumorous and non-tumorous lesions, or the accuracy with which benign and malignant tumors could be differentiated.

Results: For lesions of 1 cm or less in diameter the detection rate of 3D-US was lower than that of 2D-US, but for lesions over 1 cm there was no difference between the two modalities. In fibroadenoma and breast cancer, 3D-US was more useful than 2D-US for the evaluation of both internal and boundary echo, but with fibrocystic disease and in the diagnosis of tumor/non-tumor, there was no significant difference. In breast cancer, however, 3D-US more accurately determined malignancy, and in fibroadenoma, because of the pseudospicule revealed by 3D-US, this modality was less exact in determining benignancy.

Conclusion: In the evaluation of internal and boundary echo in breast mass diagnosis, 3D-US was more useful than its 2D counterpart. For lesions of 1 cm or less in diameter, however, the detection rate of 3D-US was low, and since in some benign cases a pseudospicule was apparent, the possibility of confusion with malignancy arose. For these reasons, the usefulness of 3D-US was limited.

Index words : Breast, US
Breast, neoplasms

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