1

. . . .

: (Computer- aided detection, CAD)
.

: 34 (27 , 7) (20- 66 , 47.9)
10`- 45 (25) CAD
(ImageChecker M1000- DM, version 3.1; R2 Technology) .
19 15 , 12 . CAD ,
.

: CAD 80%
(12/15), 67% (10/15) 100% (12/12) .
50% (15/30), 50% (15/30)
92% (22/24) 79% (19/24) . 0.21- 0.22/
0.03- 0.04/ 0.24- 0.26/ . 132
59% (78/132)
22% (15/69) . 67% (12/18)
71% (17/24) . 8% (4/53),
14% (1/7) . 23% (16/71)
58% (18/31) .

: CAD
. CAD
CAD .

, 12,860 CAD
(recall rate) 6.5% 7.5% ,
(1). 41 49 1,000
20% CAD 3.2% 3.8% .
(2). (double reading) CAD
(Computer- aided detection, CAD)
. Birdwell (mark) .
, CAD 77% (reproducibility) CAD
(3) ,
CAD Freer Ulissey CAD
20% (8/41) (4). 95- 99% 39- 53%
(5, 6).

(7). CAD
. CAD

:

19

100%   .   15 ,   12   ,
CAD   .   10 mm   3
                              .   ,   , 11- 20 mm 4 , 21- 30 mm 5 , 31- 40 mm 2 , 41
                    CAD   mm   1 .   10 mm   9 ,
                    .   11- 20 mm 3   .
                                    CAD   ,
          ,   PACS   LCD   , CAD
      .   ,   2
                                                                        . CAD

2003   11   2004   5   7   .   ,
                                              CAD   (broader sensitivity)
    (ImageChecker M1000- DM, version 3.1; R2   (strict sensitivity)   .
Technology, Sunnyvale, Calif, U.S.A.)   34   ,
    (20- 66 ,   47.9)   .   .
                                                                                    2   32
      ,
      .   2   .   (30)   (4)
      . 34   30   (.   CAD
    4 ,   22 ,   4)   .   34
                              27 (1 ,   ,
              26),   7 (1 ,   .
2 ,   4)   .
                                    (Senographe
2000D FFDM, GE medical systems, Buc, France)
                    (craniocaudal view)   (mediolat-   34
eral oblique view)   .   CAD
                              ,   (kVp)   ,   80% (12/15)
      (mAs)   37   67% (10/15)   100% (12/12)
    1.5%   15%   .   ,
      .   50% (15/30)   50% (15/30)
                              50%   8   92% (22/24)   79% (19/24)   .
, 50%   26   .   34   0.21- 0.22/   0.03- 0.04/
                              19 ,   0.24- 0.26/   (Table 1).
              15   .   (8)   (26)
    19   1   10 ,   5 ,
    1   4 ,   1   3   10 , 9
          2   ,   1   2   CAD
          ,   2   1   ,   (60%, 80% vs. 45%, 35%).
      3   1   .   ,   (100%,

Table 1. Detection Sensitivity and False Positive Rate of Mass and Microcalcifications by CAD System (n = 34)

MMG No.	Sensitivity of Mass (%)		Sensitivity of Cluster (%)		False Positive Rate per Image	
	Broader	Strict	Broader	Strict	Mass	Cluster
1st.	80 (12/15)	50 (15/30)	100 (12/12)	92 (22/24)	0.22 (29/132)	0.04 (5/132)
2nd.	67 (10/15)	50 (15/30)	100 (12/12)	79 (19/24)	0.21 (28/132)	0.03 (4/132)

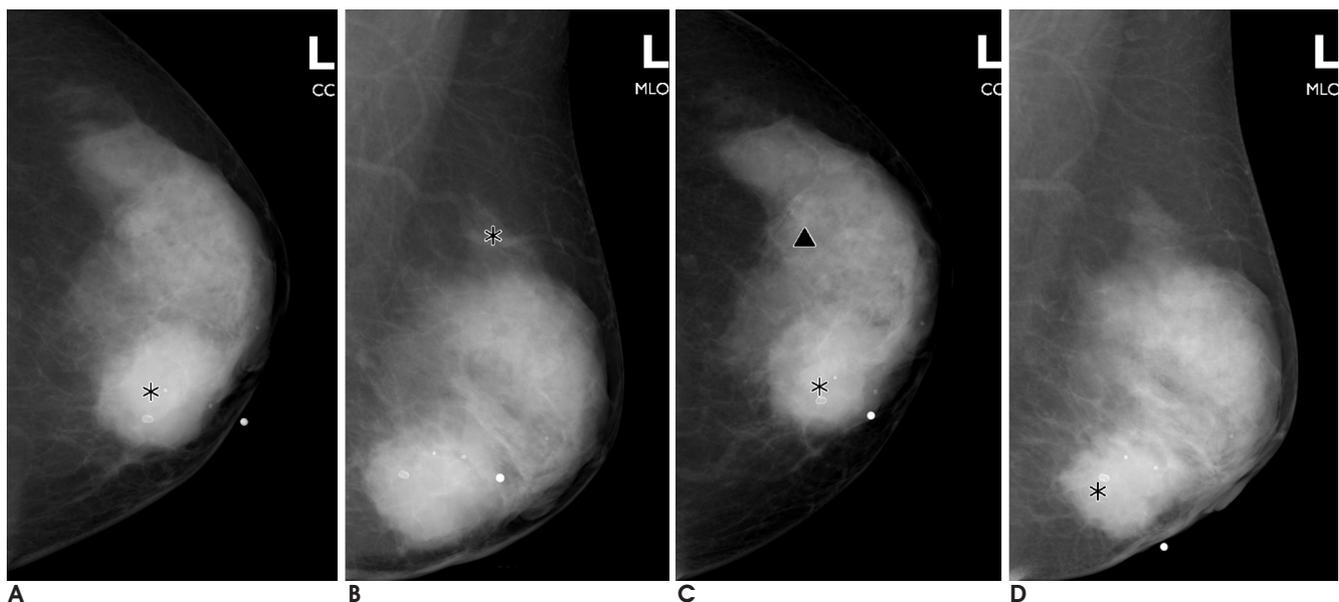**MMG: Mammogram, 1st.: First, 2nd.: Second, No.: Number

67% vs. 89%, 83%).   0.27-   58% (18/31)
0.36/   ,   0.23- 0.24/   33% (34/102)   (Table 3, Fig. 1).
    (Table 2).
    132   (75% vs. 60%),   (20%
  59% (78/132)   vs. 3%)   (39% vs. 15%)
  22% (15/69)   .   .   (67%
    67% (12/18)   vs. 72%)   (57% vs. 58%)
   71% (17/24)   .   (Table 4).
   8% (4/53),   14% (1/7)   34   (30)   (4)
.   23% (16/71)   ,

Table 2. Comparison of Sensitivity and False Positive Rate by CAD System in Different Parenchymal Densities

	MMG	Sensitivity of Mass (%)		Sensitivity of Cluster (%)		False Positive Rate per Image	
	No.	Broader	Strict	Broader	Strict	Mass	Cluster
Fatty Breast	1st.	80 (4/5)	60 (6/10)	100 (3/3)	100 (6/6)	0.33 (10/30)	0.03 (1/30)
(n = 8)	2nd.	80 (4/5)	80 (8/10)	100 (3/3)	67 (4/6)	0.27 (8/30)	0 (0/30)
Dense Breast	1st.	80 (8/10)	45 (9/20)	100 (9/9)	89 (16/18)	0.19 (19/102)	0.04 (4/102)
(n = 26)	2nd.	60 (6/10)	35 (7/20)	100 (9/9)	83 (15/18)	0.2 (20/102)	0.04 (4/102)

Table 3. Reproducibility of Detection Mark on Serial MMG by CAD System (n = 34)

Reproducibility	True Positive Mass		True Positive Cluster		False Positive		Total Mark	
	Broader	Strict	Broader	Strict	Mass	Cluster	Mass	Cluster
Yes (%)	10 (83)	12 (67)	12 (100)	17 (71)	4 (8)	1 (14)	16 (23)	18 (58)
No (%)	2 (17)	6 (33)	0 (0)	7 (29)	49 (92)	6 (86)	55 (77)	13 (42)
Total Mark No.	12	18	12	24	53	7	71	31

Fig. 1. A 57-year-old woman with biopsy-proven infiltrating ductal carcinoma in left breast.
A, B. Mammogram taken at the first time. The breast parenchyma is inhomogeneously dense and the CAD system marks the mass correctly on only CC view (asterisk), and false positive mass mark is seen in left upper breast.
C, D. Mammogram taken at the second time after 27 days of the first mammography. The CAD system marks the mass correctly on CC view, but false positive calcification mark (triangle) is seen in the outer portion of the left breast. On MLO view, the mass is correctly marked also, but the previous false positive mass mark is disappeared now.

Table 4. Comparison of Reproducibility of CAD Mark by CAD system in Different Parenchymal Densities

	Reproducibility	True Positive Mass		True Positive Cluster		False Positive		Total Mark	
		Broader	Strict	Broader	Strict	Mass	Cluster	Mass	Cluster
Fatty Breast (*n* = 8)	Yes (%)	4 (100)	6 (75)	3 (100)	4 (67)	3 (20)	0 (0)	9 (39)	4 (57)
	No (%)	0 (0)	2 (25)	0 (0)	2 (33)	12 (80)	1 (100)	14 (61)	3 (43)
	Total Mark No.	4	8	3	6	15	1	23	7
Dense Breast (*n* = 26)	Yes (%)	6 (75)	6 (60)	9 (100)	13 (72)	1 (3)	1 (17)	7 (15)	14 (58)
	No (%)	2 (25)	4 (40)	0 (0)	5 (28)	37 (97)	5 (83)	41 (85)	10 (42)
	Total Mark No.	8	10	9	18	38	6	48	24

13, 10

2 , 2 . 13 (4).

62% (8/13) , . ,

2 .

100% (2/2) . CAD

(50%, 54% vs. 25%, 50%) , ,

,

(90%, 75% vs. 100%, 100%). (5- 7).

(69% vs. 50%), Moon

204 (19)

(65% vs. 100%). 6- 11

2 32 CAD 100%

64 (8). ,

42 66% CAD 100%

(42/64) , . 34

8% (2/24) . 0.2- CAD ,

0.32/ , 10% (3/30) . 59% (78/132)

22% (15/69) .

CAD .

, (kVp) (mAs)

37 15

, 16%

1.2% ,

. , , , 22

. , 1.7% , 14%

, , .

, ,

, , ,

. . CAD

, . (subtraction)

CAD .

(broader sensitivity) 88% (30/34)

80% (12/15), 67% (10/15) ,

100% (12/12) . , .

CAD .

140

CAD

,   CAD   .

.   CAD

       CAD   .

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Reproducibility of Computer-Aided Detection System in Digital Mammograms[1]

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Purpose: To evaluate the reproducibility of the computer-aided detection (CAD) system for digital mammograms.

Materials and Methods: We applied the CAD system (ImageChecker M1000-DM, version 3.1; R2 Technology) to full field digital mammograms. These mammograms were taken twice at an interval of 10-45 days (mean: 25 days) for 34 preoperative patients (breast cancer $n=27$, benign disease $n=7$, age range: 20-66 years, mean age: 47.9 years). On the mammograms, lesions were visible in 19 patients and these were depicted as 15 masses and 12 calcification clusters. We analyzed the sensitivity, the false positive rate (FPR) and the reproducibility of the CAD marks.

Results: The broader sensitivities of the CAD system were 80% (12 of 15), 67% (10 of 15) for masses and those for calcification clusters were 100% (12 of 12). The strict sensitivities were 50% (15 of 30) and 50% (15 of 30) for masses and 92% (22 of 24) and 79% (19 of 24) for the clusters. The FPR for the masses was 0.21-0.22/image, the FPR for the clusters was 0.03-0.04/image and the total FPR was 0.24-0.26/image. Among 132 mammography images, the identical images regardless of the existence of CAD marks were 59% (78 of 132), and the identical images with CAD marks were 22% (15 of 69). The reproducibility of the CAD marks for the true positive mass was 67% (12 of 18) and 71% (17 of 24) for the true positive cluster. The reproducibility of CAD marks for the false positive mass was 8% (4 of 53), and the reproducibility of CAD marks for the false positive clusters was 14% (1 of 7). The reproducibility of the total mass marks was 23% (16 of 71), and the reproducibility of the total cluster marks was 58% (18 of 31).

Conclusion: CAD system showed higher sensitivity and reproducibility of CAD marks for the calcification clusters which are related to breast cancer. Yet the overall reproducibility of CAD marks was low; therefore, the CAD system must be applied considering this limitation.

Index words : Breast neoplasms, diagnosis
Computers, diagnostic aid
Digital radiography

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