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DETECTION OF CALCIFICATIONS AND MASS LESIONS USING COLOR DISPLAY IN THE MONITOR FOR THE INTERPRETATION OFMAMMOGRAM

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ABSTRACT

Objective: The patients having breast cancer increase, and the mortality from breast cancer increases, too. As for breast cancer, early detection is important, and mammography is the most common as this examination. Amonitor diagnosis is common now for the interpretation of the mammogram. It is often diagnosed by gray indication in many institutions. However, there are some reports that the color display is higher in the detectability of the lesion than gray indication. As for the mammography, detection of the calcification is associated with detection of breast cancer. Also, a directly mass lesion may be detected. Therefore, the detectability was compared with the calcification and the mass lesion using ROC analysis for gray indication and color display. Methods: The 44 diagnosed oblique presentation images (five calcification, mass lesion three) in the past 3 years. In addition, we obtain the consent of the Ethical Review Board of the institution before a study. Each image was monitor interpretation and was gray by a color display and was changed the six kinds of yellow, green, cyan, blue, rainbow, and ROC analysis was performed about the presence of the lesion by the observer of six radiologists. Statistical analysis was conducted in the area AUC under the ROC curve and was compared about the lesion detectability of each color. **Results:** The AUC was significantly higher in yellow and cyan as compared with other colors.

KEYWORDS: Mammography, Breast Density, Color, Monitor Diagnosis.

1. INTRODUCTION

The patients having breast cancer increase, and the mortality from breast cancer increases, too,[3] Early detection of breast cancer is important, The mammography is the most common as the examination of breast legion. Moreover, common, but a monitor diagnosis often diagnoses the interpretation of the mammography by gray indication now in many institutions.[4]

However, there are reports that the color display is higher in the detectability of the lesion than gray indication recently.

Because depiction of the calcification was important to detection of breast cancer.[6-15]

Therefore, we examined the association of the color display about depiction of the calcification and the depiction of the mass lesion.

2. MATERIAL AND METHODS2-1. PATIENTS

The evaluation image was 44 oblique images which mammography was imaged, and abnormal findings were diagnosed (age 45-71 years old, average age 55.3 years old) of in the past 3 years. The lesion was calcified image 5 breast, mass image 3 breast. The findingsless images of 32 breasts (Category 1) were included in the evaluation image.

2-2. Device of mammography and the image display system and scanning parameters

The imaged mammography device was Siemens company MAMMOMAT Inspiration. The, scan condition was photographed at fully automatic (tube voltage 0 ~ 30V, tube electric current 0 ~ 0mA). The image display system used in an observation experiment was RadiForce RX560-BK (5Mpixel) color LCDmonitor (maximal brightness 770cd/ m2) (EIZO Corporation), and the Work station (WS)was Ziostation2, (ZAIO software Co., Ltd). was used.2-3. Observer evaluations.

The images of the presence or absence of breast cancer findings were extracted, and 20 pieces of images were sorted at random, and these were displayed with six color patterns of Gray, Yellow, Cyan, Green, Blue, Rainbow, and and a observer evaluation of the presence or absence of lesion was performed using by ROC analysis. The color table of six of Gray, Yellow, Cyan, Green, Blue, Rainbow in Figure 1. In addition, the representative breast images at each table are shown in Figure 2 to 7. It

was assumed that the lesion included mass lesion and calcification.

2-4. The visual observers
The visual observers always assumed mammography interpretation, four breast surgeons (breast specialists) and eight radiological technologists (examination mammography scan radiological technologist authorization person).

In each color display, the presence or absence of calcified lesion, the presence or absence of mass lesion were evaluated by the ROC analysis.

It was assumed that window level and window width at observation were controlable by an observer at any time, and they assumed the observation time and the observation distance to monitor, and the observation environment the freedom of the observer.
Also, the turn of the observation image was random.

2-5. Analysis (ROC)
ROC analysis was evaluate for the presence or absence of lesion as compared with the site which lesion presence established by other examinations results including pathological examination, ultra sounds and the MRI. In addition, the area (AUC) under the ROC curve was calculated.

2-6. Evaluation of the fatigue
When they performed interpretation of an image, 12 observers replied it with ten phases with the fatigue (fatigue of eyes, fatigue of the head) of the observer every each color.

2-7. Statistical Analysis
The Kruskal–Wallis one-way analysis of variance was performed to determine differences in the detectability of calcifications and the induced eye fatigue among the different color scales. Differences were confirmed with the Mann–Whitney U test. P-values of < 0.05 were considered to indicate statistical significance.

3. RESULTS

3-1. Analysis (ROC)
The ROC curve of each color display of the calcified lesions was shown in Figure 8.

A figure of box mustache of the AUC is shown in Figure 9. Yellow indication was significantly high in detectability for calcification lesion, Moreover, cyan was high next.

Also, we made the results of each color display of the mass lesion for Figure 10,11. The detectability was significantly high in yellow, and detectability was high in cyan next. ($P>0.01$) The ROC curves of each color display of the calcification and mass for each colure were shown in Figure 12. A figure of box mustache of the AUC is shown in Figure 13. The detectability was significantly high in yellow.

3-2. Fatigue at observation
Fatigue at interpretation observation is shown in figure 14.
There was the least fatigue, gray, and Rainbow and Blue turned out high in fatigue.The yellow and the cyan were fatigue of the intermediate degree.

4. DISCUSSION

The detectability of the lesion may improve a calcified lesion and the mass lesion by changing the colordisplay at the interpretation from the present gray display to the yellow display.

The detectability had high cyan, too, but yellow indication was high in detectability in the calcification in particular.

Therefore, it is considered when the yellow that detectability is high in for a mass lesion for calcification is suitable for interpretation of the mammography.

The past study using the phantom is results and agreement of this study.[5]

The capacity of the human eye to detect objects differs according to the wavelength of light registered – i.e., the color of the perceived object. The colors to which human photopic vision is the most sensitive and, hence, that enable the most accurate visual discrimination are green and yellow in a luminous efficiency function (18-21). However, we speculated that the characteristics of vision may also differ according to contrast. The present study therefore compared the effect of different color scales on the detectability of microcalcifications at low contrast.

In addition, even a diagnosis of cerebral infarction CT is equal with results of this study because it is reported that yellow indication is good.[2] We found that visualizing mammograms in yellow scale achieved superior resolution and distinction at low contrast. Taken in the context of previous findings, thedetectability of both low-contrast and minute high-contrast lesions may benefit from the use a yellow-scale display rather than gray-scale images, which are currently the most common in digitaldiagnostic assessments.

In addition, the interpretation diagnosis work often lasts for long time, and the interpretation physician often feels fatigue of eyes and mental fatigue.

We may be suitable in that because the yellow has little fatigue of eyes.

By this experiment, there was little gray fatigue, but thinks with a thing by the habituation (custom) because this did interpretation in gray conventionally. This study was subject to the important limitation of not having assessed the effect of color-scale on eye fatigue over a

long period. Future studies should examine the association between eye fatigue and display color over time.

Therefore, fatigue thinks that becomes more when we switch to yellow, and time passes.

5. CONCLUSIONS

The diagnosis of the mammography is difficult, and BIRADS points out that the detection of the lesion is difficult and diagnosis may be impossible for high breast density and in the lack of pressure of mammography.[17]

Therefore, at first the physician describes the breast density concentrations in a medical certificate and then describes diagnosis findings.

In particular, calcification and a low-concentrated mass are undetectable about high breast density of young people.

It is the detectability of the lesion including breast cancer successively, but yellow indication looks good at the interpretation of the mammography because the detectability of the yellow color display was high at all background breast concentrations as for this.

These are equal with the detection of cerebral infarction of the preliminary research and the mammary calcification.

We will be associated with retinal photoreceptor cells properties of human eyes.

It may need courage to change the color of the very familiar monitor, but yellow thinks that what we change is for the patients in our study because the detectability of the lesion is the highest.

6. Disclosures of Conflicts of Interest Conflict of interest
All authors of this manuscript declare no relationship with any company whose products or services may be related to the subject matter of article.

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Figure legends

1. Six kinds of color tables which we used in this study.
2. One case of the green indication of Mammography.
3. One case of the yellow indication of Mammography.
4. One case of the cyan indication of Mammography.
5. One case of the green indication of Mammography.
6. One case of the blue indication of Mammography.
7. One case of the gray indication of Mammography.
8. ROC curve of each color display of the calcified lesions.
9. A figure of box mustache of the AUC of the calcified lesion. The AUC was significantly highin yellow ($P < 0.01$).
10. ROC curve of each color display of the mass lesion
11. A figure of box mustache of the AUC of the mass lesion. The AUC was significantly high inyellow ($P < 0.01$).
12. ROC curve of each color display of the calcification and the mass lesion.
13. A figure of box mustache of the AUC of calcification and the mass lesion. AUC wassignificantly high in yellow.
14. A comparison of the fatigue of eyes when we saw each color. rainbow was the highest in fatigue, and fatigue was the lowest gray ($P < 0.01$).