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Comparison of the image contrast of the monochromatic X-ray and the diagnostic X-ray

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1 Introduction

The diagnostic X-ray image judges the propriety of a image by a visual assessment method in many cases.

For this reason, in clinical, the result of physical evaluation is dealt with by reference rather than is absolute.

Since the diagnostic X-ray image is created by exposure by continuous-spectrum X-rays and image contrast falls easily, image creation through the monochromatic X-ray is demanded.

This experiment performed comparison of the monochromatic X-ray and the diagnostic X-ray paying attention to the image contrast obtained in process of MTF measurement.

2 Experiment

ⅰ station : BL-14C

ⅱ diagnostic X-ray equipment : KXO-32R
（TOSHIBA MEDICAL ）

ⅲ intensifying screen : HR-4 (FUJI FILM)

ⅳ X-rays film : SuperHR-30s (FUJI FILM)

ⅴ square wave chart（Fig.1）
material : Pb
thickness : 0.05 mm
spatial frequency : 0.0,0.5,1.0,1.5,2.0,2.5,3.0, 4.0,5.0,6.0,8.0,10.0 Lp/mm
(Type1,KASEI OPTONIX)

ⅵ densitometer
diffusion : 301RS (FUJI FILM)
specular(microdensitometer) : PDM-7
(KONICA MINOLTA)

3 Method

Ⅰ. Creation of the sample film for MTF measurement

The monochromatic X-ray and the diagnostic X-ray were created by the contrast method (spatial frequency: 0.0Lp/mm → input contrast) by a square wave chart.

ⅰ The sample film of the monochromatic X-ray（Fig.4）
- X-rays energy : 33 keV
- distance : 110 cm（Fig.2）
- field : 40 mm × 40 mm
- spatial frequency : 0.0・3.0・4.0・5.0・6.0・8.0・10.0Lp/mm

ⅱ The sample film of the diagnostic X-ray（Fig.4）
- tube voltage : 80 kV
（added filter: 0.5mmCu+4.0mmAl）
- distance : 200 cm（Fig.3）
- field : 10cm×15cm
- spatial frequency : 0.0・0.5・1.0・1.5・2.0・2.5・3.0・4.0・5.0・6.0・8.0・10.0 Lp/mm

Ⅱ. Density measurement of a sample film

The microdensitometer – width : 10 μ m and height : 100 μ m and movement speed : it set up in 0.05 mm / sec, and carried out concentration measurement.

Ⅲ. Calculation of image contrast

By the usual contrast method, input image contrast and spatial frequency : 0.5~10.0Lp/mm were computed as output image contrast spatial frequency : 0.0Lp/mm.

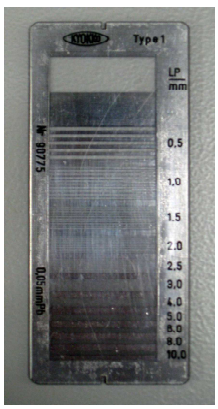

Fig.1 Square Wave Chart

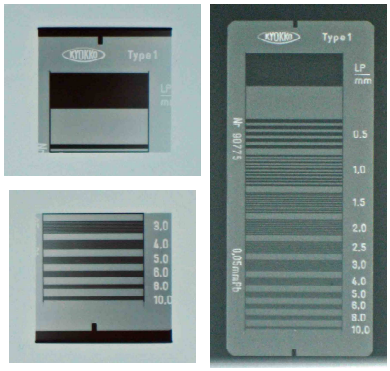

Fig.4 Image of Square Wave Chart

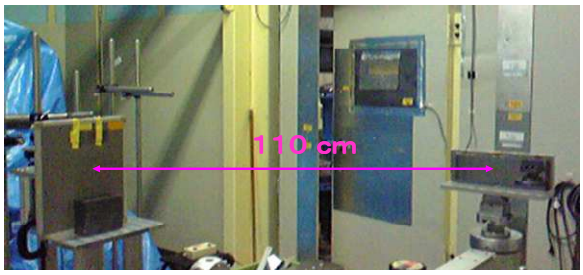

Fig.2 Alignment （Monochromatic X-ray）

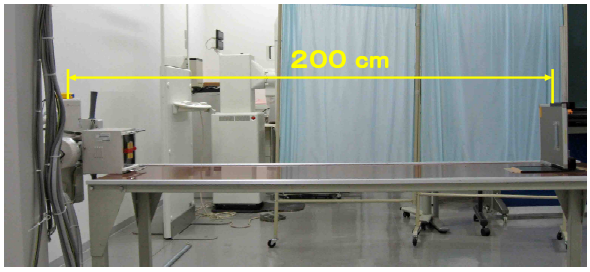

Fig.3 Alignment （Diagnostic X-ray）

Spatial Frequency (Lp/mm)	Monochromatic X-ray	Diagnostic X-ray
0.0	0.656	0.165
0.5	0.600	0.157
1.0	0.544	0.144
1.5	0.488	0.126
2.0	0.432	0.107
2.5	0.375	0.087
3.0	0.327	0.077
4.0	0.226	0.055
5.0	0.161	0.037
6.0	0.097	0.031
8.0	0.060	0.014
10.0	0.053	0.014

Table.1 Contrast

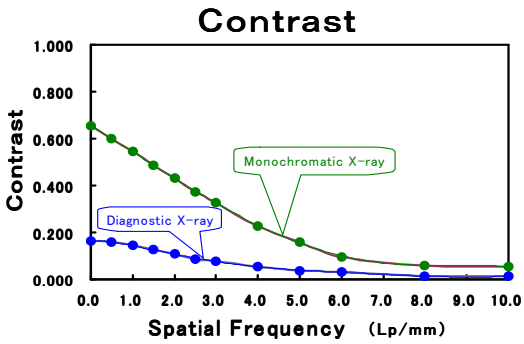

Fig.5

4 Results

The calculation result of image contrast is shown in Table.1 and Fig.5. However, in the monochromatic X-ray, spatial frequency : 0.5~2.5Lp/mm is an estimate.

Ⅰ. Image contrast of the monochromatic X-ray

- input contrast : 0.656
- output contrast : 0.327~0.053

Ⅱ. Image contrast of the diagnostic X-ray

- input contrast : 0.165
- output contrast : 0.157～0.014

Ⅲ. Comparison of the monochromatic X-ray and the diagnostic X-ray

In the frequency between altitude, the monochromatic X-ray were highly obtained about 4.0 times rather than the diagnostic X-ray. Therefore, the image of the monochromatic X-ray can expect high contrast.

5 Discussion

i That monochromatic X-ray showed the result in which contrast is higher than the diagnostic X-ray expresses that it is parallel light with the output with stable monochromatic X-rays.That is, it leads to the image which was suitable for diagnosis compared with the diagnostic X-ray obtaining monochromatic X-ray.

ii Although the X-ray tube side is equipped with an added filter and the X-rays of the long wavelength component are removed by clinical in improvement in contrast of the diagnostic X-ray image, it can be said from the result of this experiment that improvement in contrast is achieved by use of the monochromatic X-ray.

5 Conclusion

i This experiment compared the monochromatic X-ray and the diagnostic X-ray paying attention to image contrast. As a result, it was accepted objective that image contrast shows a value with the higher monochromatic X-ray. That is, the usefulness of the monochromatic X-ray became clear.

ii If it is based on this experimental result in order to realize improvement in image contrast of a clinical image, it can be said that it leads also to advancing monochrome-ization of the diagnostic X-ray.

6 Future problem

i This experiment compared the monochromatic X-ray with the diagnostic X-ray about image contrast only by the imaging system. However, the clinical image requires the image of high contrast in the state where the inside of a sample was described. Therefore, I think that the state where the sample was used from now on being conscious of clinical needs to be experimented.

ii I want to make it develop also into the improvement in contrast to digital imaging from digital imaging being in use now based on the result of this experiment in clinical.

Acknowledgement

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References

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