DIRECT MAGNIFICATION RADIOGRAPHY AND PATIENT EXPOSURE

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ABSTRACT

Direct magnification radiography (size of focal spot of X-ray tube 0,010 mm) visualizes details below the threshold of standard radiography. In combination with high speed film/screen systems up to a fourfold magnification the exposure of a normal radiogram is not exceeded. In this respect Digital Luminescence Radiography (DLR) with its high speed and imageprocessing capability is idealy suited.

INTRODUCTION

Radiographic objects contain innumerable details varying in size and contrast. Direct magnification radiography visualizes details below the threshold of standard radiography [1,2,3,4,5,6]. A microfocal tube, however, is a prerequisite for direct magnification. At University of Münster a microfocal tube with a size of focal spot of 0,01 mm is in clinical use, a second one with a size of the focal spot of 0,001 mm is used experimentaly.

As magnification ratio is inversely related to the spatial resolution of the film/screen, best resolution is achieved when the geometrical blurring of the microfocus and the film/screen system are equal [7]. This is called the optimum magnification ratio [8,9]. A magnification exeeding the optimum ratio leads to overmagnification with further gain in resolution [10]. A small degree of overmagnification will be tolerated despite some blurring as larger objects are preceived more easily.

CONCLUSIONS

Up to a fourfold magnification the patient exposure of a normal radiogram will not be exceeded due to the air gap between patient and film that renders anti-scatter grids unnecessary and due to the necessity for high speed film/screen systems. Filter materials are cruical to patient exposure as well. Investigations with different filter materials proved K-edge filters of no value except for mammography [11,12]. Al-filters should be the

material of choice for any other application.

As low spatial resolution of film/screen systems may be compensated to a large extent by direct magnifacation the application of digital liminescence radiography seems to be ideally suited. The full range of contrast enhancement and image processing capabilities becomes available at the unrivaled spatial resolution of radiographic imaging. This may be of special interest in direct magnification mammography as well.

For clinical use the following combinations of size of the focal spot and film/screen are specially suited:

type of image	focus size (µm)	magnification	filter (µm)	expo-. sure (cGy)	time (s)	screen/film system speed (S)	resolution (mm)
mammogr. 30 kV	25	2	76 Mo	0,30	9,5	0,002 cGy S = 50	< 0,09
tissue 40 kV	25	2	1500 Al	0,10	2,2	0,001 cGy S = 100	< 0,09
fluoroscop 100 kV	100	5	50 Cu	0,45	0,2	0,0005 cGy S = 200	< 0,120

Object 5 cm, focus-film distance 60 cm (mammography) others 90 cm.

REFERENCES

1. Reuther,G., Kronholz,H.-L., 1991, Direktradiographische Vergrößerung in Kombination mit digitaler Radiographie für Sklettdiagnostik, Radiologe 31:424-429

2. Poulsen Nautrup,C., Berens von Rautenfels,D., 1991, Direktradiographische Vergrößerung in der experimentellen Medizin, Radiologe 31:430-434.

3. Hüttenbrink,K.B., 1991, Direkte radiographische Vergrößerung in der experimentellen Hals-Nasen-Ohrenheilkunde, Radiologe 31:435-438.

4. Wahl,G., Hüttenbrink, K.B. 1991, Direktradiographische Vergrößerung in der experimentellen Zahn-,Mund- und Kieferheilkunde, Radiologe 31:439-442.

5. Winkler,S., Richter,K.-D., 1991, Direktradiographische Vergrößerung bei Knocheninfektionen, Radiologe 31:447-451

6. Bajonowski,T., et al, 1991, Direktradiographische Vergrößerung in der forensischen Medizin, Radiologe 31:452-455.

7. Stargard,A.,Angerstein,W.,1975, Der optimale Abbildungsmaßstab bei der direkten Röntgenvergrößerung, Fortschr Geb Röntgenstr 123:73-78

8. Ferrant,W., San Nicolo, M.R., 1954, Die förderliche Röntgenvergrößerung, Fortschr Geb Röntgenstr 81:194-295

9. Rosenkranz,G. et al, 1975, Ermittlung eines optimalen Vergrößerungsfaktors mittels objektiver und subjektiver Bildgütekriterien, Radiologica diagnostica 16:429-435

10. Angerstein,W., et al, 1987, Grundlagen der Strahlenphysik und der radiologischen Technik in der Medizin, Thieme, Leipzig.

11. Kronholz,H.-L., 1991, Direktradiographische Vergrößerung und Strahlenexposition, Radiologe 31:413-417

12. Nagel,H.D., 1989, Comparison of the performance charcteristics of convertional and K-edge filters in general diagnostic radiology, Phys Med Biol 34:1269-1287