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Comparison of Exposure Factor Using Moving Grid and Lisholm to Get the Same Density

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ABSTRACT
Grid was an effective tool to reduce scattering radiation to the film. based on observations at Aisyiyah Hospital, the average examination used a moving grid compared to lisholm. In some types of radiological examinations need to be considered in the selection of the grid, because the grid used at high exposure factors, usually more than 60 kV. This study aims to determine what exposure factors were given to the moving grid and lisholm to get the same density.The type of research carried out was an experimental quantitative conducted at Aisyiyah Hospital Padang in May 2019. Data processing was carried out by calculating the density value from the results of the image using a densitometer and displayed in the form of tables and graphs of density equations. The results obtained by the equation of lisholm density values at 60 kV tube voltage with a moving grid at 66 kV tube voltage were 0.26 and 0.74. And it was shown in the graph of the density value equation, so it can be concluded that the use of moving grids requires a higher exposure factor than lisholm.

Keywords: *Exposure Factor, Grid, Density*

1. INTRODUCTION

In the medicine world, especially in the radiology field to help diagnose a disease, it is necessary using supporting examination X-Rays. trough that examination, will be produced radiograph that containing diagnostic information. Radiograph must have a good quality including contrast, density, optimal sharpness and detail. One of the method to produce optimal radiographs is using a grid, especially on thick objects (Fauber, 2000).

Grid is one of an effective tool to reduce scattering radiation to film. The amount (intensity) of scattering radiation is caused by several factors, including tube voltage (kVp), current strength (mAs), and object thickness. The grid is design only to produce good images from X-ray sources, i.e. X-ray tubes. A qualified grid is a grid capable of absorbing 80% - 90% useless scattering radiation for contrast improvement. There are several types of grids depending on the direction of the metal plates arranged in the grid. The arrangement of the metal plates also affect show it is used and the ability of a grid to withstand or transmit the primary radiation generated (Bushong, 2001). A number of types of grids according to the arrangement of slabs of metal stripes or their arrangement include parallel grids, focused grids, pseudo focused grids, and cross grids. Meanwhile, according to the movement, there are stationary grid and moving grid. Moving grid is a type of grid that is directly attached to the table where the patient is examined. During the exposure time this grid will move, while the stationary grid is a separate type of grid from the examination table, when it used, it is placed on a radiographic cassette (Rasad, 2015). In some types of radiological examinations, it is necessary to consider using a grid because the use of a high exposure factor, usually more than 60 kV will increase the scattering radiation so that the contrast of the radiographic image becomes low. Each object has a different material thickness, density and atomic number. If an object has a high thickness of material, very tight density, and has a high atomic number, then the object requires the use of a high exposure factor in order to produce quality X-rays. so it is necessary to consider using a grid. (Rasad, 2015) Based on observation at one of the Hospital in Padang city, many examinations are carried out using a moving grid compared to Lisholm, the use of a moving grid has a gap between the backy table and the cassette, while using Lisholm is placed directly on the cassette so there is no gap between the cassette, the grid and the object. Therefore, the authors are interesting in knowing further how much influence the use of the exposure factor for the different types of grids has on the quality of the resulting radiographs, one of them is density.

2. MATH AND EQUATIONS

The type of research was experimental quantitative which was conducted in April 2020 at Aisyiyah General Hospital Padang. Data were obtained by preparing research materials, then conducting research and then measuring the data using lisholm and moving grids. Furthermore, the results were measured using a densitometer and shown in the table.

2.1.1. Tools

The tools used in this research are:

1. X-Rays Computer Radiography (CR) 2. Radiographi
2. cassette sized 24 x 30 cm. 3. Grid lisholmwith ratio 1:10 4. Moving gridwith ratio 1:10 5. Film Computed Radiographysized 24 x 30 cm 6. Stepwegde with leveleleven (11), high 3,2mm, dimension : 14x6 cm 7. Densitometer

2.1.2. Material

The material used in this research was Computed Radiography Film sized 24 x 30 cm with the Carestream film brand

3. RESEARCH PROCEDURE

The type of research was experimental quantitative which was conducted in April 2020 at Aisyiyah General Hospital Padang. Data was obtained by preparing research materials, then conducting research and then measuring the data using lisholm and moving grids.

The steps taken by Lisholm were to prepare the X-ray machine to be used, the stepwedge was placed on the cassette, adjust the condition of the X-Ray, center the collimator lamp in the middle of the stepwedge, right on step 6 and set the FFD to 100

cm, with the direction of the beam vertically. adjust the collimation as needed, adjust the exposure factor, in this study the exposure factor used was a tube voltage of 60 kV and strength currents was 5 mAs, after that do the exposure. The tool used to produce the image was Computed radiography. After getting the results, the density value of each step was measuring use a densitometer. Furthermore, the research used a moving grid, was preparing the X-ray plane to be used, placing the cassette under the backy table, put the Stepwedge on a 24 x 30 cm cassette in the middle of the examination table, adjusting the condition of the X-ray plane, concentrating the collimator lamp in the middle of the step wedge, precisely at step 6th and set FFD 100 cm, with vertical beam direction perpendicular, adjust collimation as needed, adjust exposure factor with tube voltage (kV) and current strength (mAs) (60:5, 62:5, 64:5, 66 :5) which was varies to get the same density value used the Lisholm grid, then did the exposure, the image was generated using Computer radiography, then the density value of each step was measured using a densitometer.

4. DATA ANALYSIS AND PROCESSING

The data was taken by making a stepwedge photo as an object using a moving grid and lisholm. After getting the results,take density measurements using a densitometer andthen analyzed to get the same demsias value and displayed in tabular form.

5. RESULTS AND DISCUSSION

Based on the results of research in April 2020 about the comparison of exposure factors in the use of moving grids and lisholm at Aisyiyah Padang General Hospital by using a stepwedge as an object where the tube voltage on lisholm used a tube voltage of 60 kV, a current strength of 5 mAs, and the moving grid tube voltage varied. starting from 60 kV with a fixed current, the increase in tube voltage on the moving grid used an exposure chart technique, were the variable tube voltage (kVp) and fixed current (mAs) technique, the tube voltage can be increased to 2 for every 1cm increase in object thickness while the current strength was maintained . The base tube tension was the initial kVp value that has been determined for the anatomic area in the radiograph. After obtaining the picture then the density of the film was measured using a densitometer. Based on the research results can be seen in the table 1.

From the results of the data in the table 1, it explained that the highest density obtained from the thinner object, is step 1 because more X-rays transmitted to the film, while the lowest density is the highest step, that is step 11 because it's thicker so X rays transmitted less to the film so that the density value is lower. The density value shows the degree of blackness of the radiograph based on the thickness of the object shown according to the level on the stepwedge.

The difference in the absorption of the material will affect the quality of the radiographic image. The greater the difference in thickness or density between two areas of the material, the greater the more difference in density. The use of low tube voltages will generally produce high-contrast radiographs, this was because low radiation energy more easily attenuated so that the ratio of photo transmitted through the thick and thin areas were larger with less radiation energy, such as the

stepwedge image, a thick step will produced a low density compared to a thin step will produce a high density. From the measurement results can be seen in the graph of the difference in density values.

Table 1. The results of density measurements in the radiograph using a moving grid and Lisholm.

STEP	*Gid Lisholm* kV : 60, mAs : 5	DENSITY VALUE *Moving Grid* kV 60 mAs 5	kV 62 mAs 5	Kv 64 mAs 5	kV 66 mAs 5
1	2,54	2,57	2,57	2,59	2,63
2	2,06	2,13	2,15	2,18	2,21
3	1,68	1,72	1,73	1,75	1,78
4	1,37	1,39	1,41	1,50	1,51
5	**1,26**	1,14	1,16	1,21	**1,26**
6	0,95	0,96	0,98	1,02	0,97
7	0,87	0,85	0,85	0,89	0,84
8	**0,74**	0,77	0,79	0,82	**0,74**
9	0,67	0,65	0,66	0,70	0,68
10	0,64	0,45	0,46	0,51	0,59
11	0,57	0,38	0,41	0,43	0,59

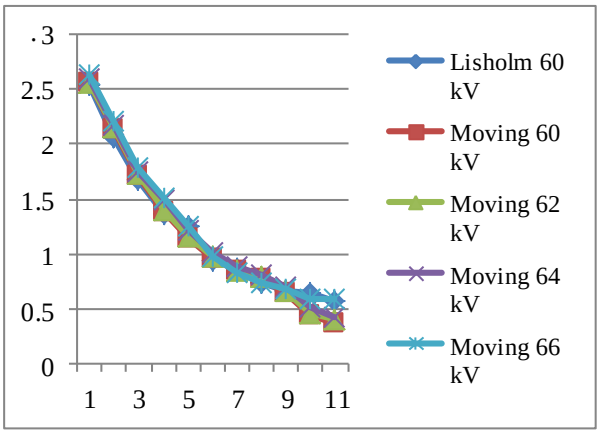

Image 1. Grapich comparison of density value

The graph above shows the density values between radiograph used a moving grid and Lisholm. The low density value on the moving grid are due to the gap between the backy table and the cassette. So, there are a number of escaped files in the backy table so it requires a higher exposure factor to get the same density. While on the lisholm grid there's no gap between the grid and the cassette which allows all the files that pass from the lisholm to get to the film so that the resulting density is higher when using a moving grid. (Bushong, 2001)

The similarity of radiographic density values between the use of Lisholm and moving grids in certain exposure factors were at the fifth and eighth step, Lisholm has the same density values as the fifth and eighth steps at a tube voltage of 66 kV, the density values (1,26) and (0, 74). This can be seen in the graph that used moving coincides with the fifth and eighth steps with the graph that use Lisholm. The change in exposure factor to reach the point of similarity in density values between radiographs using a moving grid and Lisholm was very far. Radiograph using 60 kV lisholm tube voltage has a high density value, while the moving grid requires the used an exposure factor with 66 kV tube voltage in order to have the same density value with lisholm.

6. CONCLUSION

Comparison of exposure factorin the use of moving grid and Lisholm are very different, the density equation was obtaining in the exposure factor of moving grid at 66 kV tube voltage.

7. APPRECIATION

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