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Comparison of Digital Image Quality of Postero-Anterior (PA) Projection Thoracic Radiography at Various Film Distance Focuses

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ABSTRACT

Focus film distance (FFD) is the standard distance between the x-ray emission point in the x-ray tube (focal spot) and the image receptor. Based on the author's experience during observations in more than one hospital, where almost all observation places, researchers noticed that officers rarely see the details of the FFD, with an average of 180 cm being used in PA projection thorax examinations. The purpose of this study was to compare the quality of radiographic images in PA projection thorax examinations and to determine which FFD is optimal in the FFD variations of 117 cm, 150 cm, 183 cm in PA projection thorax examinations. The type of research used in this study is a quantitative experimental study through literature studies, observations and questionnaires, in order to achieve the objectives of the study. This study was conducted at the H. Hanafie Muara Bungo Regional Hospital in June. The sample in this study amounted to 5 people. Data collection was carried out by questionnaire, the data obtained was then processed using the SPSS application. The results of this study indicate that in the use of FFD variations there are differences in image quality. The results of SPSS calculations show that the significance value is <0.05, which means that H0 is rejected and Ha is accepted. FFD 150 cm is the optimal distance in producing quality radiographic images in postero-anterior projection thorax examinations.
Keywords: Focus Film Distance; Radiography Image Quality; Thorax

INTRODUCTION

Focus-to-Film Distance (FFD) is one of the primary factors used in radiographic examinations. FFD is the standard distance between the x-ray emission point in the x-ray tube (focal spot) and the image receptor. The FFD setting can affect radiograph quality, such as film density, contrast, x-ray

radiation intensity, detail, and image distortion. Therefore, the FFD setting must be done precisely.(Imam Suyudi, 2024). The effect of changing the FFD distance is increased and the OFD distance is reduced, then the magnification of the image obtained is smaller and closer to the original image or vice versa when changing the FFD distance and the OFD distance is reduced in the object illumination, then the magnification obtained is greater.(Yudha et al., 2025). FFD is enlarged, OFD remains the same, then the image will be close to its original size.(Mayani & Muflihatun, 2017). Changes in the distance between the FFD and OFD significantly affect the image results; the further the FFD, the sharper the image. One radiographic examination that is affected by changes in the FFD is the thorax radiograph examination.(Tjuanda, 2021).

The quality of this radiograph has an important role in confirming the diagnosis(Yudha et al., 2023)Image quality is determined by several factors including density, contrast, sharpness, and detail.(Sari et al., 2020). FFD settings can affect the quality of radiography, such as: film density, x-ray radiation intensity, detail, and distortion of the object image so that FFD settings must be carried out precisely.(Sumariyah et al., 2014)The relationship between CTR (Cardio Thorax Ratio) and the normal size of the heart is to determine whether the patient's heart size is enlarged, and CTR itself is to determine whether the heart size is enlarged or not.(Faradina Pratiwi et al., 2023)In Maulana's 2020 study, using an FFD of 150 cm, the CTR value obtained with an FFD variation of <50%, so it was still within the normal range, but the magnification of the width of the heart and lungs(Nugraha M., 2020)(Mayani & Muflihatun, 2017). The results of the study with FFD variations of 150 cm, 160 cm, 170 cm, 180 cm, 190 cm and 200 cm showed no difference in CTR in these FFD variations. The lowest magnification value or closest to the size of the original object was produced at the 200 cm FFD variation.

Most conventional radiological examinations are thoracic examinations.(Labania et al., 2021). Thorax PA examination uses an FFD of 180 cm and the use of a minimum FFD of 183 cm(Imam Suyudi, 2024)(Oktavia Puspita Sari, Dipl.Rad., S.Si. et al., 2024). In clinical practice in hospitals, the use of FFD for thoracic examinations uses an FFD of 150 cm.(Mayani & Muflihatun, 2017). In Muthia Adela's research, 2023, the results of this study showed that when using FFD variations of 150 cm, 165 cm, 180 cm, there were differences in image quality.(Adela, 2023). from the research results FFD 150 cm is the optimal distance in producing quality radiographic images in the examination of the Thorax posteroanterior projection, while in Triana Aulia's research From the research results, the use of variations in Focus Film Distance 120 cm, 150 cm and 183 cm causes differences in the quality of radiographic images in the examination of the Thorax posteroanterior projection (PA), from the research results the use of FFD 120 cm is the optimal distance in producing quality radiographic images in the examination of the Thorax PA projection(Aulia, 2021)

Based on the author's experience during observation in the hospital, where the researcher noticed that officers rarely see the details of the FFD.

Meanwhile, in Bontranger's theory, the FFD range of 150-180 cm is used in Thorax examinations. Based on this, the researcher wants to further examine the comparison of image quality with 3 different FFDs, namely: 117 cm, 150 cm, 183 cm with postero anterior (PA) projection Thorax examinations. Using the minimum FFD of 117 cm, the maximum FFD of 183 cm. and using an FFD with a range of 33 cm.

METHODOLOGY

The type of research used in this study is quantitative research with experimental studies. Quantitative research is conducted by collecting data in the form of numbers. This data is then processed and analyzed to obtain scientific information behind the numbers.(Sugiyono, 2019). The location of this research was conducted at the H. Hanafie Muara Bungo Regional Hospital.

The sample used in this study is a non-random (non-probability) sampling method using the purposive sampling method. Non-random sampling is a sampling method(Notoadmojo, 2020). The respondents who will assess the results of this radiograph are 7 radiographers with the respondent criteria being radiographers who have STR and who have a D-III/DIV radiographer education. Data analysis was carried out by filling out a questionnaire sheet assessing the quality of the images given to the 7 radiographers.(Nansih, 2022)The results obtained after respondents completed the assessment questionnaire were presented on a Likert scale. The data obtained was converted into numbers.

RESULTS AND DISCUSSION

After conducting the research, a comparison of the results of the radiographic images of the thorax examination with postero anterior projections with FFD variations of 117 cm, 150 cm, 183 cm was obtained.

Figure 1. FFD 117 Cm

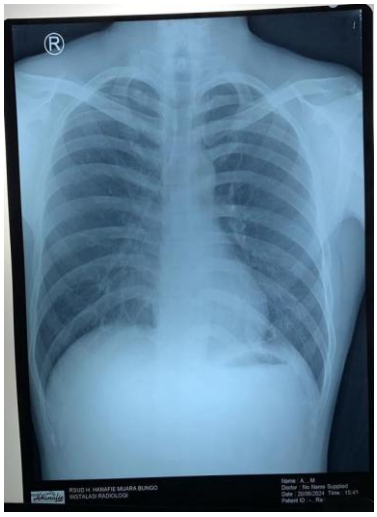

Figure 2. FFD 150 Cm

Figure 3. FFD 183 Cm

After conducting research on the effect of variations in focus film distance (FFD) on postero anterior (PA) projection thorax examination on image quality with the aim of finding out which FFD has better image quality, the FFD used was 117 cm, 150 cm, 183 cm.

The study continued with a questionnaire completed by seven respondents, seven of whom were radiographers. The questionnaire contained questions about image quality information. Respondents were asked to assess the image quality generated by the study by checking all the questions provided. The resulting scores were then compiled into a collection of questionnaire data from each respondent.

Table 1. Thorax PA Image with FFD 117 Cm

Table 1 Thorax Radiographic Image

Question	PA with FFD 117 cm								Mean
	TB		CB		B		SB		
	N	%	N	%	N	%	N	%	
P1	0	0	33	94.3	2	5.7	0	0	7.09
P2	0	0	26	74.3	9	25.7	0	0	
P3	0	0	8	22.9	27	77.1	0	0	

Based on table 1, in question 1, the highest frequency was found in the answers quite good as many as 33 checklists (94.3%), good as many as 2 checklists (5.7%), in question 2, the highest frequency was found in the answers quite good as many as 26 checklists (74.3%), good as many as 9 checklists (25.7%). In question 3, the highest frequency was found in the answers good as many as 27 checklists (77.1%), quite good as many as 8 checklists (22.9%).

Table 2. Thorax PA Image with FFD 150 Cm

Question	Thoracic Radiographic Image PA with FFD 150 cm								Mean
	TB		CB		B		SB		
	N	%	N	%	N	%	N	%	
P1	0	0	0	0	9	25.7	26	74.3	11.43
P2	0	0	0	0	10	28.6	25	71.4	
P3	0	0	0	0	1	2.9	34	97.1	

Based on table 2, in question 1 the highest frequency was found in very good answers with 26 checklists (74.3%), good as many as 9 checklists (25.7%), in question 2 the highest frequency was found in very good answers with 25 checklists (71.4%), good as many as 10 checklists (28.6%). In question 3, the highest frequency was found in very good answers with 34 checklists (97.1%), good 1 checklist (2.9%).

Table 3. Thorax PA Image with FFD 183 Cm

Question	PA Thorax Radiographic Image with FFD 183 cm								Mean
	TB		CB		B		SB		
	N	%	N	%	N	%	N	%	
P1	0	0	0	0	34	97.1	1	2.9	8.74
P2	0	0	18	51.4	17	48.6	0	0	
P3	0	0	0	0	27	77.1	8	22.9	

Based on table 3, in question 1, the highest frequency was found in 34 checklists of good answers (97.1%), 1 checklist was very good (2.9%), in question 2 the highest frequency was 18 checklists in fairly good answers (51.4%), 17 checklists were good (48.6%). In question 3, the highest frequency was found in good answers with 27 checklists (77.1%), good answers for 8 checklists (22.9%).

Discussion

Based on the results of the research that has been carried out, the research by comparing the results of the quality of the chest radiograph examination image postero anterior projection with variations in Focus Film Distance (FFD) namely 117 cm, 150 cm, 183 cm through the results of the questionnaire that has been obtained from 7 respondents, namely radiologists, obtained varying results.

In the postero anterior projection thorax examination with variations in Focus Film Distance (FFD), namely using 117 cm, 150 cm, 183 cm, which compares the results with 3 questions on each questionnaire sheet, the first question How is the spatial resolution of the thorax radiograph results, the second question How is the contrast resolution of the thorax radiograph results, the third question How is the noise in the thorax radiograph results. In the postero anterior projection thorax examination with variations in FFD, namely using FFD 117 cm, 150 cm, 183 cm, this technique is by setting the patient upright in front of the bucky stand facing the bucky. Adjust the height of the IR so that the upper limit is approximately above the relaxed shoulder, Center the midsagittal midline of the patient's body to the midline of the IR, Extend the patient's chin up or past the top of the grid device, Ask the patient to bend the arm and place the back of the hand on the hip. Then set the kV, mAs and exposure. After the exposure is complete, it is processed using computer radiography (CR)(Rahmadianti et al., 2023).

From the results of statistical analysis using the Kruskall Walis test obtained a p value of 0.000 (<0.05) then Ho is rejected and Ha is accepted meaning There is a difference in FFD variations on image quality. In Muthia Adela's study The

results of this study indicate that in the use of FFD variations of 150 cm, 165 cm, 180 cm there is a difference in image quality. from the results of the study FFD 150 cm is the optimal distance in producing radiographic image quality in the postero anterior projection Thorax examination, While in Triana Aulia's study, 2021 using FFD 120 cm got a higher value based on the results of the questionnaire from the 3 respondents seen from the mean rank Friedman test(Aulia, 2021).

Based on the questionnaire results from the 7 respondents, it can produce good image quality seen from the FFD 150 cm. because the FFD 150 cm can show the smallest objects in the thorax clearly, can clearly distinguish the difference in gray in two adjacent areas and produces little noise while the FFD 117 cm only produces good details but gets a lot of noise and the FFD 183 cm produces good noise but does not show good details.

In Muthia Adela's research, 2023, the results of this study indicate that when using variations of FFD 150 cm, 165 cm, 180 cm, there are differences in image quality. From the results of the study, FFD 150 cm is the optimal distance in producing quality radiographic images in the postero-anterior projection of the Thorax examination.(Adela, 2023)In Triana Aulia's 2021 study, using a 120 cm FFD, the questionnaire results from three respondents obtained higher scores, as seen from the Friedman mean rank test.(Aulia, 2021)The resulting radiograph image is able to show more optimal anatomical details so that it is easy to analyze such as costae, apex pulmo, clavicle, scapula, thoracic 1-4, sinus costae phrenicus, sinus cardiophrenic, trachea(YUSRIWAN TJUANDA, 2021). From the test results used, namely the Friedman test, it was used to determine whether there was an effect of FFD variations on image quality. According to the test, the results showed that from the 3 samples of FFD variations, there was an effect of FFD variations on image quality.

Based on the mean rank results generated from variations in focus film distance for postero-anterior (PA) thorax examinations, the FFD value of 150 cm is higher with a value of 87.49 compared to the FFD values of 117 cm and 183 cm. Using an FFD of 150 cm is more optimal for PA thorax examinations because it can produce good image quality.(Amroji et al., 2019)(Prayoga et al., 2022).

Using a 150 cm FFD is more optimal because it can produce good image quality.(Takagi et al., 2019)(Fitriani et al., 2019). The resulting radiographic image is able to show the smallest objects in the thorax clearly (hilus), the difference in gray in two adjacent areas is clear, and there are no visible spots that interfere with the image.

CONCLUSION

In the research results that the author obtained in the study of Comparison of the Quality of Postero Anterior Projection (PA) Thorax Radiographic Images on Focus Film Distance Variations, it can be concluded that in this study and the

processing of the data obtained Based on the test results, From the results of statistical analysis using the Kruskall Walis test obtained a p value of 0.000 (<0.05) meaning that the three FFD variations have a comparison of FFD variations on the quality of postero anterior projection thorax radiographic images. FFD 150 cm which produces good image quality, because it can show good spatial resolution, good resolution contrast and little noise(Kuwahara et al., 2019).

It is better to use a 150 cm FFD for posteroanterior (PA) projection thorax examination because it can produce good quality radiograph images.

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