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ANALYSIS OF DIFFERENCES IN IMAGE QUALITY WITH VARIATIONS IN SLICE THICKNESS IN CT-SCAN BRAIN EXAMINATIONS WITH TRAUMA CASES AT THE RADIOLOGY INSTALLATION

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ABSTRACT

Research has been carried out on the analysis of differences in image quality with slice thickness variations in CT-Scan brain examinations with trauma cases at the Radiology Installation at RSI Siti Rahmah Padang. This study aims to determine the difference in image quality with varying slice thicknesses of 3 mm, 5 mm, and 7 mm in CT-Scan brain examinations with trauma cases and what slice thickness is capable of producing optimal image quality in establishing a diagnosis in CT-Scan brain examinations. with trauma cases. This research was conducted in January 2022 - June 2022 with a quantitative type of research with experimental methods, using purposive sampling techniques and questionnaire data distributed to respondents were processed using the weight mean score formula and the SPSS Friedman method. According to the weight mean score formula, the highest average value for the slice thickness variations of 3 mm, 5 mm and 7 mm is a slice thickness of 3 mm with an average value of 3.64, contrast resolution has an average value of 3.67, noise is 3. 49 and the results of the CT-Scan brain examination in the bone window in trauma cases had an average of t3.74. Based on the SPSS results of the Friedman method, it was found that there was a significant difference in the results of slice thickness variations of 3 mm, 5 mm and 7 mm in the CT-Scan brain examination with trauma cases because (p-value < 0.05), this shows that H_o was rejected and H_a was accepted. A good slice thickness variation for showing trauma on a CT-Scan brain examination is a slice thickness of 3 mm in the bone window, because if there is a very small fracture it can be seen more clearly.

Keywords : CT-Scan brain, Trauma, Slice thickness, Contrast resolution

BACKGROUND

CT-Scan is a combination of X-ray and computer technology so that it can display an anatomical image of the human body in the form of slices. The working principle of a CT scan uses X rays as a radiation source (Bontrager, 2018). In general, there are several types of CT-Scan examinations that can be carried out, including the head CT-Scan examination technique (Utami dkk., 2018). Head injury is a traumatic disorder of brain function accompanied or without interstitial bleeding in the substance of the brain without disruption of brain continuity (Syaripudin, 2018). One of the parameters that influences image quality is the selection of slice thickness. Choosing the right slice thickness can confirm the diagnosis well (Sookpeng dkk., 2019). Research on image quality is very important because good image quality can provide appropriate information for the medical team so that appropriate medical action can be taken (E, 2016). The thicker the slice thickness, the better the contrast resolution and the noise value is reduced (Karina dkk., 2017). Slice thickness is the thickness of a slice. The thinner the slice thickness, the better the image detail obtained, high accuracy and calcification can be seen, however, a thin slice thickness can also produce high noise in the image and increase the radiation dose received by the patient (Louk & Suparta, 2014) (Utami dkk., 2018). The choice of slice thickness when creating a CT-scan image has a direct influence on the resulting spatial resolution. With increasing slice thickness (thinner), the spatial resolution of the image gets better, and vice versa (Dewi dkk., 2022). Good CT-Scan image quality is influenced by several factors, spatial resolution, contrast resolution, noise and artifacts. Of the four image quality factors, only contrast resolution and noise are related to slice thickness (Karina dkk., 2017). On CT-Scan examination of the brain, slice thickness values range from 2 mm to 10 mm (Neseth, 2000). Research conducted by Hutami in 2021, variations in slice thickness affect the CNR value, where the greater the slice thickness, the greater the CNR value and the better the image quality (Hutami dkk., 2021). The slice thickness variations used are 1, 2, 3, 4.6, and 8 mm. From the description above, research was carried out regarding the analysis of differences in image quality with variations in slice thickness in CT-scan brain examinations with trauma cases with variations in slice thickness of 3, 5 and 7 mm. This research was carried out at the radiology installation at the Siti Rahmah Islamic Hospital in Padang using brain CT-Scan patient data with existing clinical trauma and then reconstructing the slice thickness

to 3, 5 and 7 mm. Next, the slice thickness is determined which produces optimal image quality at each slice thickness.

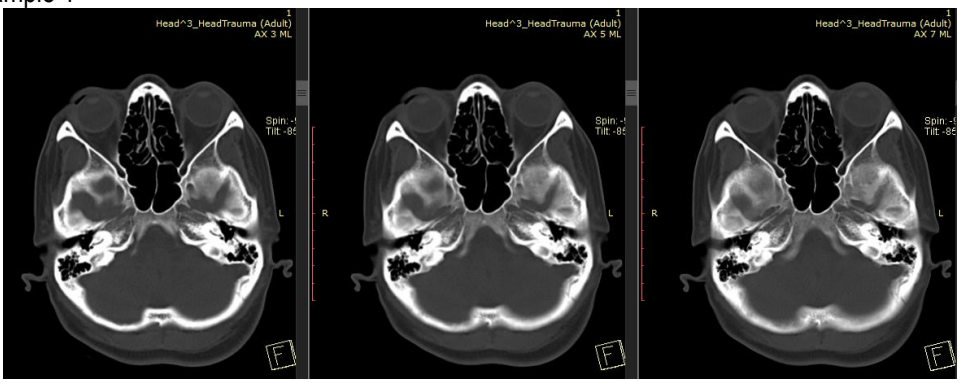
METHOD

The type of research used in this research is quantitative research with experimental methods (Sugiono, 2020). This research was conducted at the Radiology Installation of RSI Siti Rahmah Padang in January - June 2022. The total examination population in November - January 2022 was 42 people with 8 samples, by giving questionnaires to respondents by showing the CT-Scan results. exams with the Radiation Dicom Viewer application, the questionnaire results are calculated. After obtaining the average weight mean score processing value above, the data was processed using SPSS using the Friedman method to see the difference between slice thickness variations of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations and trauma cases. With research hypothesis H_0: There is no difference in image quality in CT-Scan brain examinations with trauma cases at slice thicknesses of 3 mm, 5 mm and 7 mm. H_a: There is a difference in image quality in CT-Scan brain examinations with trauma cases at slice thicknesses of 3 mm, 5 mm and 7 mm. With a significant value for the Slice Thickness variation (p value < 0.05).

RESULT

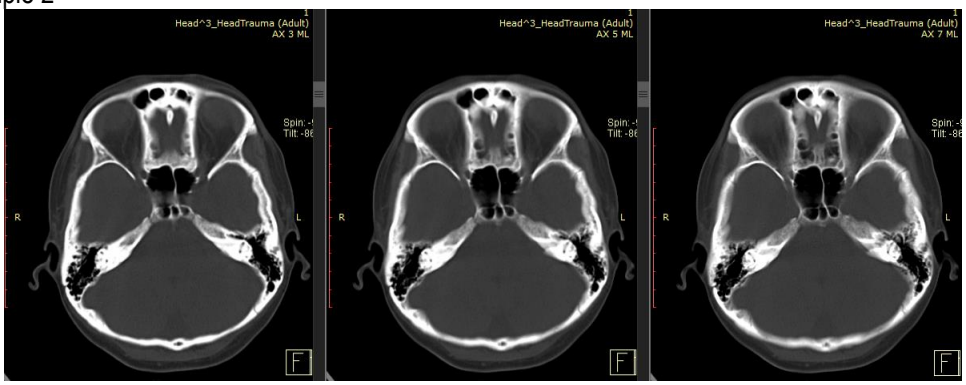
After conducting research on 8 patients, we found differences in image quality with slice thickness variations of 3 mm, 5 mm and 7 mm in brain CT scans and trauma cases.

1. Sample 1



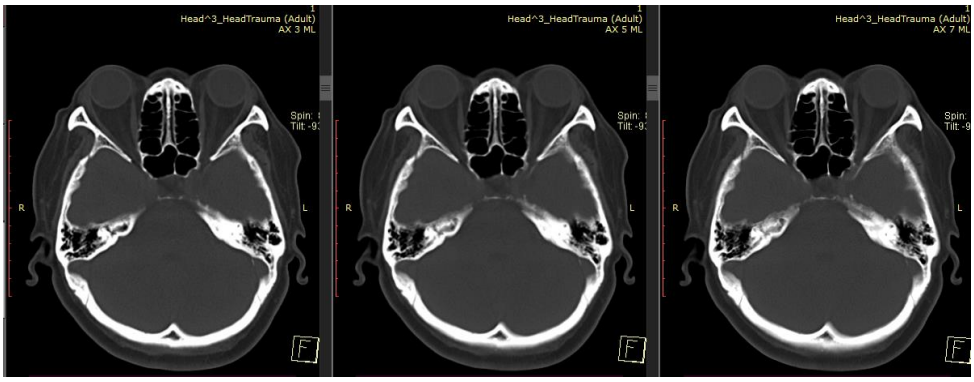
a) *Slice Thickness* 3 mm b) *Slice Thickness* 5 mm c) *Slice Thickness* 7 mm

2. Sample 2



a) *Slice Thickness* 3 mm b) *Slice Thickness* 5 mm c) *Slice Thickness* 7 mm

3. Sample 3

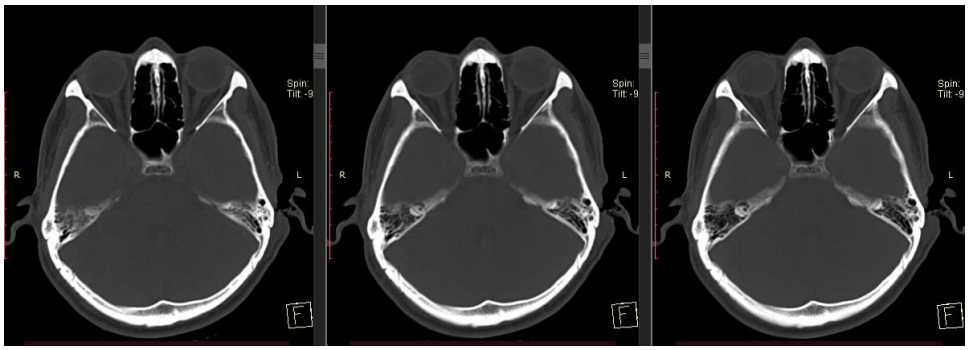


a) *Slice Thickness* 3 mm b) *Slice Thickness* 5 mm c) *Slice Thickness* 7 mm

4. Sample 4

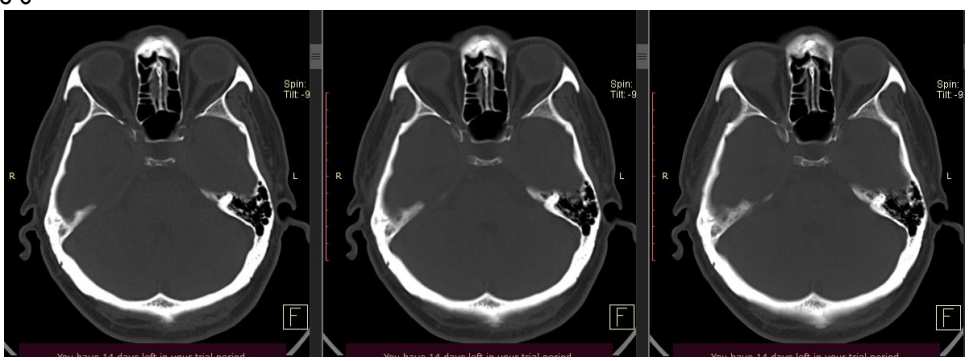
a) Slice Thickness 3 mm b) Slice Thickness 5 mm c) Slice Thickness 7 mm

5. Sample 5



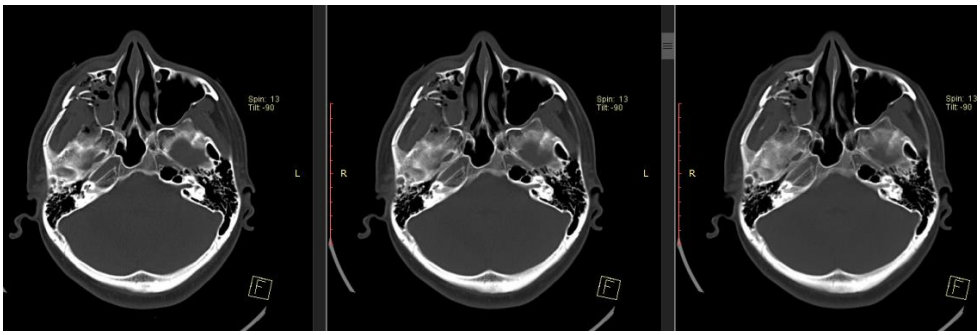
a) Slice Thickness 3 mm b) Slice Thickness 5 mm c) Slice Thickness 7 mm

6. Sample 6



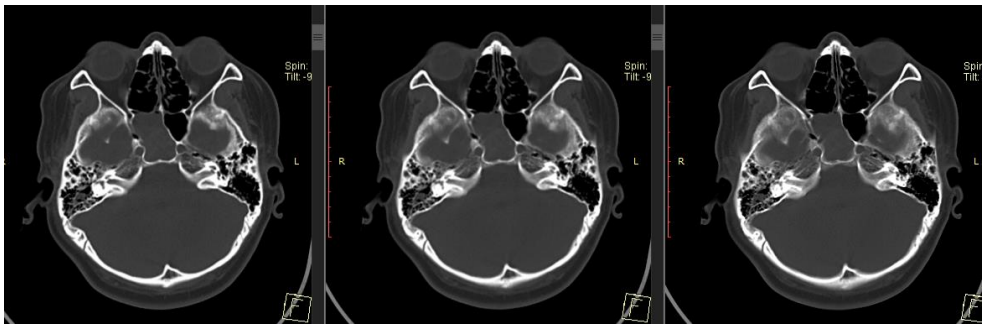
a) Slice Thickness 3 mm b) Slice Thickness 5 mm c) Slice Thickness 7 mm

7. Sample 7



a) Slice Thickness 3 mm b) Slice Thickness 5 mm c) Slice Thickness 7 mm

8. Sample 8



a) Slice Thickness 3 mm b) Slice Thickness 5 mm c) Slice Thickness 7 mm

The results of the calculation of the average weigh mean score formula in table 4.4 show that the average value of CT-Scan brain examinations with trauma cases at slice thickness variations of 3 mm, 5 mm and 7 mm.

Tabel 1.1 Hasil rata-rata weight mean score pada slice thickness 3 mm, 5 mm dan 7 mm

No	Nama	Variasi *slice thickness*		
		3 mm	5 mm	7 mm
1	Sampel 1	3,47	3,57	3.14
2	Sampel 2	3,66	3,61	3.37
3	Sampel 3	3,66	3,38	2,99
4	Sampel 4	3,66	3,33	2,80
5	Sampel 5	3,66	3,38	2,95
6	Sampel 6	3,66	3,33	2,66
7	Sampel 7	3,61	3,47	2,9
8	Sampel 8	3,71	3,42	2,99
Jumlah		**3,64**	**3,44**	**2,98**

The results of the calculation of the average weigh mean score formula in table 1.1 show that the average value of CT-Scan brain examinations with trauma cases at slice thickness variations of 3 mm, 5 mm and 7 mm in samples 1 to sample 8 with slice thickness variations of 3 mm is obtained. The average value is 3.64, at a slice thickness of 5 mm the average value is 3.44 and at a slice thickness of 7 mm the average value is 2.98. So the highest average value in samples 1 to 8 using the weight mean score formula with slice thickness variations of 3 mm, 5 mm and 7 mm is the slice thickness of 3 mm with a value of 3.64.

After obtaining the average weight mean score processing value above, the data was processed using SPSS using the Friedman method to see the difference between slice thickness variations of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations and trauma cases. Based on the descriptive test results, the average value (Mean) for Slice Thickness 3 mm is 3.64, Slice Thickness 5 mm is 3.44 and for Slice Thickness 7 mm is 2.98. So the highest average variation in Slice Thickness is the Slice Thickness variation of 3 mm, namely 3.64. Based on the results of the Friedman test, it can be seen that the asimp.sig value or significant value obtained from the research results is 0.00 (p value <0.05). This shows that there is a significant difference, so Ho is rejected and Ha is accepted, meaning there is a significant difference in the Slice Thickness variations of 3 mm, 5 mm and 7 mm.

The average value of noise, resolution contrast and image results at slice thickness 3 mm, 5 mm, 7 mm can be seen in table 1.2 below :

Tabel 1.2. Nilai rata-rata noise, kontas resolusi dan hasil gambaran pada *slice thickness 3 mm, 5 mm, 7 mm*

No	Variable	Rata-rata	*Contras Resolusi*	*Noise*	Nilai gambaran pemeriksaan *CT-Scan brain*
1	*Slice thickness 3 mm*	3.64	3,67	3,49	3,74
2	*Slice thickness 5 mm*	3.44	3,42	3,44	3,37
3	*Slice thickness 7 mm*	2.98	3,13	2,58	2,83

The average value of noise, contrast resolution and image results on slice thickness 3 mm, 5 mm, 7 mm obtained the average value on slice thickness 3 mm is 3.64, the average value of contrast resolution is 3.67 and the value on noise has an average of 3.49. The average value at a slice thickness of 5 mm is 3.44. The average value for resolution contrast is 3.42 and the value for noise has an average of 3.44 and the average value for a slice thickness is 7. mm is 2.98, the average value for resolution contrast is 3.13 and the value for noise has an average of 2.58.

DISCUSSION

Good CT-Scan image quality is influenced by several factors, spatial resolution, contrast resolution, noise and artifacts. Of the four image quality factors, only resolution contrast and noise are related to slice thickness (Putu dkk., 2021). One of the parameters that influences image quality is the selection of slice thickness. The thicker the slice thickness, the better the contrast resolution and the noise value is reduced (Kartawiguna & Rusmini, 2017).

Based on the results of research conducted by researchers regarding the differences in image quality with slice thickness variations of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations and trauma cases. According to calculations, the average slice thickness of 3 mm has an average value of Contras resolution (3.67), an average value of noise (3.49) and the results of CT-Scan brain examination on the bone window in trauma cases have an average -average (3.74). The slice thickness variation of 5 mm has an average value of Contras resolution (3.42), an average value of noise (3.44) and the results of the CT-Scan brain examination on the bone window in trauma cases have an average of (3 .74) and variations in slice thickness of 7 mm have an average value of Contras resolution (3.13), an average value of noise (2.58) and the results of CT-Scan brain examination in the bone window in trauma cases have an average -average (2.83). According to the weight mean score formula, the average value of CT-Scan brain examinations with trauma cases obtained at slice thickness variations of 3 mm, 5 mm and 7 mm in samples 1 to sample 8 with slice thickness variations of 3 mm obtained an average value of 3.64 , at a slice thickness of 5 mm the average value was 3.44 and at a slice thickness of 7 mm an average value was 2.98. So the highest average value in samples 1 to 8 using the weight mean score formula with slice thickness variations of 3 mm, 5 mm and 7 mm is the slice thickness of 3 mm with a value of 3.64.

Based on the SPSS test results using the Friedman method with slice thickness variations of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations in trauma cases. get average descriptive results at Slice Thickness 3 mm 3.64 at Slice Thickness 5 mm 3.44 and at Slice Thickness 7 mm 2.98. So the highest average value of the Slice Thickness variation is the 3 mm Slice Thickness variation, namely 3.64. Based on the SPSS results of the Friedman test regarding the differences in image quality with slice thickness variations of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations with trauma cases, researchers obtained A simp sig values or significant values for Slice Thickness variations of 3 mm, 5 mm and 7 mm. is 0.00. So the value is significant for the Slice Thickness variation (p value < 0.05). This shows that there is a significant difference, so Ho is rejected and Ha is accepted, meaning there is a significant difference in the Slice Thickness variations of 3 mm, 5 mm and 7 mm. The thinner the slice thickness, the better the image detail obtained, high accuracy and calcification can be seen, however, a thin slice thickness can also produce high noise in the image and increase the radiation dose received by the patient (Utami dkk., 2018). In accordance with the research results, the best slice thickness, namely slice thickness 3 mm, has an average value of 3.64, contrast resolution has an average value of 3.67, noise is 3.49 and the results of CT-Scan brain examination images on the bone window with trauma cases having an average of 3.74. These results are in accordance with research (Karina dkk., 2017) namely the average value of a 3 mm slice thickness is (3.775) with an average contrast resolution value of 3.475 and has an average noise value of 2.525, a 5 mm

slice thickness is (2.975) with The average resolution contrast value is 2.975, and has an average noise value of 2.025 and a slice thickness of 7 mm with an average value of (1.175) with an average resolution contrast value of 2.025, and, has an average noise value of 1.175.

A head CT scan is a computerized tomography examination to determine abnormalities in the intracranial area. One of the indications for a head CT-Scan examination is traumatic brain injury. In head CT-Scan examinations in cases of traumatic brain injury, what needs to be paid attention to is the selection of parameters. Considering that trauma cases are emergencies, the choice of parameters is very important, one of which needs to be considered is the application of slice thickness (Bushong, 2001). When examining small organs or to see small abnormalities, a thin slice thickness is used, and vice versa for large organs, a thick slice thickness can be used. In examinations that require image reconstruction in sagittal and coronal sections, a thin slice thickness is required, because if you use a thick slice thickness the image will appear large (Bontrager, 2018).

Slice thickness is the thickness of a slice. The thinner the slice thickness, the better the image detail obtained, high accuracy and calcification can be seen, however, a thin slice thickness can also produce high noise in the image and increase the radiation dose received by the patient (Utami dkk., 2018). Based on the results of research that has been carried out with variations in slice thickness of 3 mm, 5 mm and 7 mm, the best way to show trauma on a brain CT scan is a slice thickness of 3 mm in the bone window, because if there is a very small fracture it can be seen more clearly. The results of CT-Scan brain examinations in trauma cases at a slice thickness of 5 mm were also able to show fractures but not as detailed as a slice thickness of 3 mm, for a slice thickness of 7 mm it was too thick so the anatomical detail obtained was low and the noise value was reduced. It can be compared to thickly sliced bread, so if there are raisins in the bread that are smaller than the slice, the raisins may not be visible because in the slice, the thinner the slice thickness, the better the quality (Makmur dkk., 2013)

CONCLUSION

Differences in image quality with variations in slice thickness of 3 mm, 5 mm and 7 mm in CT-Scan brain examinations with trauma cases, the average for a 3 mm slice thickness is 3.64, a 5 mm slice thickness is 3.44 and for a 7 mm slice thickness is 2.98 . So the highest average value in the slice thickness variations of 3 mm, 5 mm and 7 mm is a slice thickness of 3 mm with an average value of 3.64. The slice thickness produces optimal image quality in establishing a diagnosis on a CT-Scan examination brain with trauma cases is at a slice thickness variation of 3 mm. From the results of research carried out to confirm the diagnosis in CT-Scan brain examinations in trauma cases, it is best to use a slice thickness of 3 mm. The choice of slice thickness should be adjusted to the clinical course because the choice of slice thickness will affect the quality of the CT-Scan image. This research can be continued using the ROI method. ROI (Region of interest) is a software facility in the form of an application program for the CT-Scan component which is used to calculate CNR (contrast resolution) and noise. On the monitor it appears on the tools select button for ROI measurements and is shaped like a circle.

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