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Analysis of Window Width Variations on MSCT Stonegraphy Anatomic Image Information at Sanjiwani Hospital of Gianyar Regency

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ABSTRACT

Parameters in MSCT can affect image contrast and brightness are values of Window width and window level. window width will affect the contrast of the image. where the higher the value of window width used, the image contrast will decrease, where is the selection of the value of window width which can improve the quality of MSCT images and provide better diagnostic information. The purpose of this research is to determine the effect of window width variation on anatomy image information and determine the most optimal window width value MSCT Stonegraphy examination. This research is a quantitative with an experimental approach. The data obtained was then analyzed by kappa test to assess the reliability of the respondents, from the results of the respondents then the statistical test used was the Friedman test. Statistical test results p value <0.05. This research has the effect of changing values window width. anatomical image information with value of window width 250 showed optimal results for assessing the urinary tract on Stonegraphy MSCT. In this study there is the effect of variation window width significant to the Stonegraphic MSCT anatomical image information.

INTRODUCTION

Multislice Computed Tomography (MSCT) stonography is an examination of the urinary tract without using oral or intravenous contrast media. MSCT Stonegraphy is one of the examination techniques used to view and diagnose urinary tract abnormalities, namely hydronephrosis, urolithiasis, nephrolithiasis, so MSCT Stonegraphy is used as a substitute for IVU (intravenous urography) examinations, because it cannot provide qualitative diagnostics.

All aspects related to the accuracy of displaying organ structures and tissues in images are included in image quality. Factors that influence image quality include spatial resolution, contrast resolution, noise, and artifacts. To obtain an optimal image, an image display with clear contrast is required. Parameters in MSCT that can affect image contrast and brightness are the window width and window level values (Bontrager & Lampignano, 2014)

To modify the grayscale on MSCT, a process called windowing is used, by setting the CT window width and window level values. The window width level will affect the image contrast, where the higher the window width value used, the image contrast will decrease, where selecting the appropriate window width value can improve the quality of the MSCT image and provide better diagnostic information (Singh, 2020).

A wider Window Width (2000 HU) will display a larger CT number range, so that changes from dark to light areas will occur over a wider area (Nadya, 2021). Therefore, using a wide Window Width will show all the different CT number values, so that soft tissue is not clearly visible. On the other hand, a narrow Window Width is very good for displaying similar anatomical structures such as soft tissue (Nadya, 2021).

The protocol used in the MSCT Stonegraphy examination, namely the MSCT Abdomen protocol, includes kV, mAs, Slice, Slice Thickness, Pitch, FOV, Range, Reconstruction Algorithm and Window Widht and Window Level (Singh, 2020), and uses soft tissue windowing (Soomro, Ather , & Salam, 2016). The Window Widht setting is between 50 to 350 HU, to distinguish networks that have almost the same density (Nadya, 2021), while according to Seeram (2022), use a Window Width of 350-600 HU to see different soft tissue network structures with the same density.

From data obtained at the Radiology Installation at Sanjiwani Hospital, Gianyar, there are approximately 40 patients undergoing MSCT Stonegraphy examinations a month. The MSCT Stonegraphy examination at Sanjiwani Hospital Gianyar is one of the most frequent types of examination every month, with various diagnoses, such as Urolithiasis, kidney stones, Hydronephrosis, and UVJ stones. The management of MSCT Stonegraphy at the Sanjiwani Hospital Gianyar installation uses a plain MSCT Abdomen protocol with a Window Width of 300 HU. Based on the explanation above, the author is interested in conducting research on optimizing Window Width in MSCT Stonegraphy examinations. The aim of this research is to determine the effect of variations in window width on anatomical image information and to determine the optimal value of window width on MSCT Stonegrafi anatomical image information.

LITERATURE REVIEW

Computed Tomography (CT)

CT Scan is a supporting tool for making a diagnosis that uses a combination of X-rays and a computerized system to obtain sliced images of various pieces of human body

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objects. Data processing with a computerized system to produce a cross-sectional view of the image and can also display a three-dimensional image of the internal organs and structure of the body can also help diagnose the internal body in normal or abnormal conditions, CT-Scans are also used in accurate treatment procedures for assists in instrument placement or patient care.

Computed Tomography (CT-Scan) consists of 3 (three) main components: Gantry, computer, and operator console. Computed Tomography (CT-Scan) uses the main principle, namely the rotation of the x-ray tube and emitting x-rays continuously, followed by movement of the patient's table, so that there are multislices in one patient movement.

The X-ray radiation beam will experience an exponential decrease in intensity with the thickness of the object it passes through. The decrease in the intensity of the radiation beam occurs as a result of the radiation interaction process in the form of absorption or scattering, the probability of which occurs is determined by the type of object and the radiation emitted. To get an image of an object in Computed Tomography (CT-Scan), the radiation beam produced by a radiation source will go towards an object from various angles. Scattered radiation will be detected by the detector system to be stored and collected as input data which is then processed using a computerized system to produce images using a method called reconstruction.

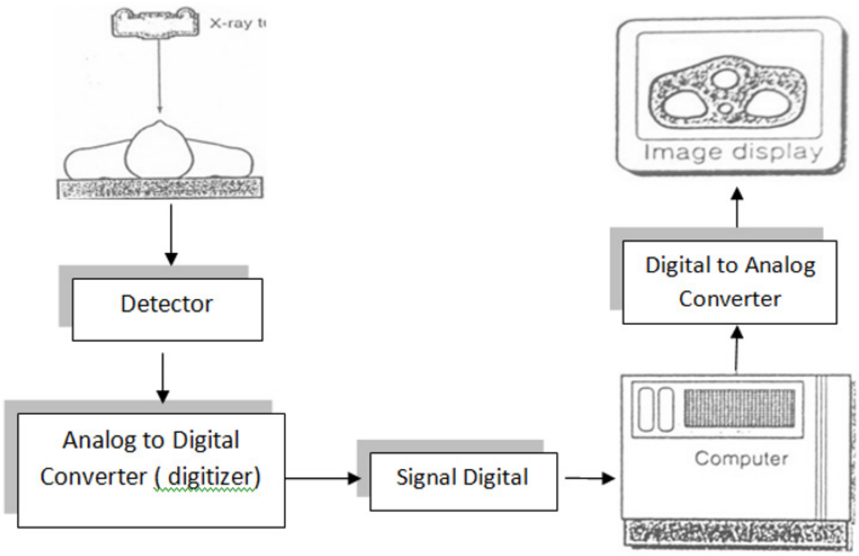

Figure 1: Working System of MSCT

Parameter Computed Tomography (CT-Scan)

According to Bontrager (2018), the quality of the image produced by MSCT is an important factor in displaying a good image, thus allowing the clinical aspects of the image to be used to make a diagnosis. When using Multislice CT, there are several parameters that must be considered to control optimal image output. Multislice CT parameters are as follows:

Range

Range is the result of combining a number of slice thicknesses. Range is used to produce different slice thicknesses in one examination area.

Slice Thickness

Slice Thickness is the thickness of the cut or slice of the object being examined, also expressed in millimeters (mm).

Exposure Factor

Exposure factors are factors that influence tube voltage (kV), tube current (mA) and time (s). The amount of tube voltage can be selected automatically for each inspection

Field of View (FOV)

FOV is the diameter of the image to be reconstructed between 200-300mm

Gantry Tilt

Gantry tilt is the formation of an angle between the vertical plane and the gantry (X-ray tube with sectors). The angle range is between -30° to +30°. Gantry angles function for diagnostic purposes in each case.

Matrix Reconstruction

Matrix reconstruction is a series of rows and columns of picture elements (pixels) in the image reconstruction process. Generally the matrix used is 512 x 512 in size.

Reconstruction Algorithms/ Kernel Filters

Reconstruction Algorithms are mathematical procedures used in reconstructing images. The appearance and characteristics of the Computed Tomography image depend on the strength of the algorithm chosen.

Window Width

Window width refers to the computed tomography (CT) values converted to gray levels for display on a

TV monitor. After the image is processed through matrix reconstruction and algorithms, the results will be converted into a numerical value called the CT Number. This CT number is measured in Hounsfield Units (HU), where bone has a HU value of around +1000 to +3000 and air has a HU value of around -1000. Tissue or other substances have different HU values depending on their density. As a result, bones will appear as white and air will appear as black on the monitor. Tissue and other substances will be displayed as different levels of gray called Gray Scale. However, if iodine is used as a contrast medium, blood that initially appears as gray levels may appear as white (7). A narrower window width can increase greater detail in anatomical image quality, for example the use of a narrow window width (70 HU) in head MSCT examinations in cases of non-hemorrhagic stroke.
According to Seeram (2022), the correct use of window width is 400HU - 2000HU to cover different tissues, for example tissue in parts of the body, namely the abdomen, using a window width of 350 HU to 600 HU in order to differentiate fat, fluid and muscle.
According to Buzug 2008, to show the condition of the bones using a window width of 1500HU and to show soft tissue using a window width of 350HU, visible on abdominal examination. Differences in spine density can only be seen in the bone window because the window width is wide, but cannot show soft tissue. Soft tissues such as the liver and kidneys can be differentiated quite well in a narrow window width with a value of +225HU, whereas according to R. Bruening et.al the Ct Scan examination to show the kidneys uses a window width of 420 to get maximum results on the kidney organs.

Window Levels
Window level is the middle value of the window used for image display. This value can be selected and depends on the weakening characteristics of the structure of the object being examined. Window level determines the density of the image to be produced (7). Using the correct window level will produce good anatomical image quality, which is indicated by clear boundaries between different tissues. When examining a Thorax CT scan for lung window conditions, using a window level of -450 is better in displaying anatomical image quality.

a) Computed Tomography (CT-Scan) Image Quality

b) According to Nagel, the factors that influence image quality are spatial resolution, contrast resolution, noise and artifacts.

Spatial Resolution
Spatial Resolution is to distinguish small objects with different densities from the same background.

Contrast Resolution
Contrast resolution is to differentiate organs with very small differences in density which are influenced by object size, exposure factors, slice thickness, and reconstruction algorithms/kernel filters.

Noise
Noise is the fluctuation (standard deviation) of the attenuation value in a homogeneous tissue or material.

METHODOLOGY
This research is quantitative research with an experimental approach. The resulting data is on an ordinal scale, so a descriptive test is carried out to group the data followed by a kappa test to assess the reliability of the respondents. From the respondents' results, the statistical test used is the Friedman test, if the p value is <0.05 then Ho is rejected and Ha is accepted, meaning that there is an influence of window width variations on the MSCT Stonegrafi anatomical image information.

RESULTS AND DISCUSSION
Based on data obtained from MSCT Stonegraphy patients at the Radiology Installation at Sanjiwani Hospital, Gianyar, the examination was carried out using the Siemens Somatom Definition AS 64 Slice MSCT tool using varying window width values, namely 250, 300, 350, 400. Data from this study were obtained from 15 patients as a research sample, so that 60 image results were obtained. From the slices obtained, the slice that most clearly shows the kidneys, ureters, urinary bladder and pathology in one image is selected. Then the assessment of anatomical information is obtained by giving an assessment score of 1 to 3.

Table 1: Results of Kappa test.

	Value	Approximate Significance
Measure of Agreement Kappa	.881	.000
N of Valid Cases	15	

Table 1 shows that the kappa test above means that the level of reliability between the two respondents is strong, (strong agreement) namely 0.881.
Analysis of window width variations in anatomical image information during the MSCT Stonegraphy examination at the Radiology Installation at Sanjiwani Hospital, Gianyar.
Data was obtained from 2 questionnaires that were distributed to radiologists. Because the data is ordinal in nature, the data is then processed using the Friedman Test, where the results are obtained according to Table 2.
Based on Table 2, the results of the Friedman test regarding window width variations in the MSCT Stonegraphy examination of anatomical image information shows a p value of 0.000 (p value <0.05) which means that Ho is rejected and Ha is accepted.

Table 2: Results of Friedman test.

N	p value	Results
Window width variation analysis of MSCT Stonegraphy anatomical image information	0.000	P value <0.05 Ho Rejected Ha Accepted

The results of this research are related to research conducted by Muhammad Izzudin *et al.* (2020) which shows the results of Asymo. Sig is smaller than 0.05 (p value <0.05), which means there is a difference in changes in window width variations, which can also be interpreted as meaning that changes in window width have an effect on image information.

According to Buzug (2008), to show the condition of the bones using a window width of 1500HU and to show soft tissue using a window width of 350HU, visible on abdominal examination. Differences in spine density can only be seen in the bone window because the window width is wide, but cannot show soft tissue. Soft tissues such as liver and kidneys can be differentiated quite well in a narrow window width with a value of +225HU.

The results of this research are also supported by the results of the author's observations while conducting research at the Radiology Installation at Sanjiwani Hospital, Gianyar, namely, on the radiologist's advice, the radiographer changed the window width conditions to between 250 and above to obtain optimal image results according to the needs for diagnosing patients.

The Most Optimal Window Width Value to Obtain Good Anatomical Image Information During the MSCT Stonegraphy Examination at the Radiology Installation at Sanjiwani Hospital of Gianyar Regency

Data was obtained from a questionnaire distributed to two radiologists as respondents to determine the most optimal window width value to obtain good image information. Then the data is input using statistics according to the questionnaire data that has been selected.

Table 3: Mean Rank.

Mean Rank			
R1_250	7.17	R1_250	7.23
R2_300	4.10	R2_300	4.47
R3_350	3.57	R3_350	3.13
R4_400	2.93	R4_400	3.40

Based on Table 3, the mean rank results regarding the optimal window width value show that the window width value of 250 has the largest mean rank value, namely 7.17 and 7.23.

The results obtained can be interpreted as meaning that this research can make the window width value of 250 the optimal variation to show a good anatomical image in the MSCT Stonegraphy examination. Apart from being based on statistical test results, based on direct observation by the two respondents, namely radiology specialists, they stated that a window width value of 250 could show clear anatomy of the urinary tract.

The results of this research are also supported by other similar research conducted by Izzudin *et al.* (2020) regarding analysis of window width variations on MSCT Stonegraphy anatomical image information showing that the optimal window width value for showing the anatomy of the urinary tract is 300. According to Buzug (2008), Differences in spine density can only be seen in the bone window because the window width is wide, but cannot show soft tissue. Soft tissues such as liver and kidneys can be differentiated quite well in a narrow window width with a value of +225HU.

CONCLUSIONS

The results of the research show that there is a significant influence of window width variations on the anatomical image information of MSCT Stonegrafi. The most optimal variation in window width values for obtaining anatomical image information shows a mean rank of 7.23 with a window width value of 250. This value is able to display the anatomy of the urinary tract clearly and clearly. The window width selection for the MSCT Stonegraphy examination is recommended to use a window width of 250. Each hospital has a different window width value in order to obtain optimal results for confirming the diagnosis. Future research can further vary the window width in the MSCT Stonegraphy examination, and so that each anatomy is assessed.

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