

# The Anatomical Image Information Difference MRI Vertebrae cervical Sagittal In Sequence Short Tau Inversion Recovery (STIR) With Pre Saturation Variation

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**Abstract.** Pre saturation is one of the methods used to reduce artifacts. pre saturation can be applied to any sequence where the number and location can be adjusted as needed. The aim of this research is to know the difference of MRI anatomical image of vertebrae cervical sagittal on sequence of short tau inversion recovery (STIR) with pre saturation variation. This study used MRI Phillips 3 T. Data were collected from 2 patients and 8 volunteers with 3 variations of pre saturation (anterior, anterior – superior, and anterior - inferior) with 30 images obtained. The MRI image was qualitatively assessed by two radiology specialists by filling out the questionnaire provided in the form of Spinal Cord anatomy, Cerebrospinal Fluid, Corpus Vertebrae, Invertebral Discus and Processus Spinosus. The Result on Friedman's different test results, for the highest mean rank is pre-saturation variation in anterior - inferior with mean rank value 2.39. For the second pre-saturation variations in anterior - superior with mean value of 1.90. And in the last order that is on pre saturation in anterior with mean value equal to 1.71. on Wilcoxon different test showed the level of significance on variations of pre saturation Anterior and Anterior - Superior with value 0.340. In the variation of pre saturation Anterior and Anterior - Inferior showed a significant difference in two variations with p value <0,001. For variations of pre saturation Anterior - superior and Anterior - Inferior significance level valued 0.003.

## 1. Introduction

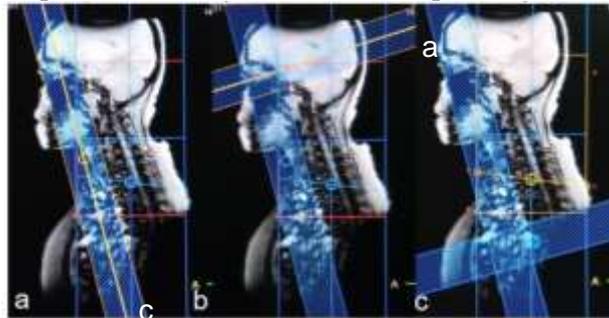
In cervical vertebrae, we often encounter various pathologist associated with soft tissue where the CT Scan modalities cannot be seen clearly; therefore, Magnetic Resonance Imaging (MRI) modalities are used to view the pathology. An MRI cervical vertebrae are often found artifacts, especially in the Short Tau Inversion Recovery sequence (STIR) [1]. The long use of Time Repetition (TR) is one of the contributors to the increase of artifacts, because long TR will cause the addition of scanning time, and these results in the addition of artifacts caused by movement around the cervical vertebrae and one way to reduce the artifact are to use pulse pre saturation. The workings of pre saturation are by removing signals from nuclei that produce artifacts with the Radiofrequency (RF) 90° application on the selected network before the sequence pulse begins. One solution to reducing artifacts of swallowing is to put pre saturation next to the throat with anatomical records examined not cut off [2]. According to [3] to reduce artifacts from Cerebrospinal Fluid (CSF) movements in cervical sagittal MRI with STIR sequence, pre-

saturation use is placed anterior and superior from the cervical vertebral curve and according to [2] to reduce artifacts due to CSF and pulsation, pre saturation is placed in the superior and inferior cervical vertebrae.

In the Radiology Installation of one of the MRI Phillips MRI in the MRI vertebrae cervical section of the sagittal section of the STIR sequence, the use of pre saturation has several variations, first placed only anterior to the cervical vertebral curve and secondly anterior to the right and left cervical vertebrae. The purpose of this study is to see if there is a difference in the anatomical image and to know the proper pre saturation placement in order to display the best image on MRI Vertebrae cervical.

## 2. Method

This research uses quantitative research with experimental approach. The data were collected at the Radiology Installation of dr. Saiful Anwar Malang Hospital using Phillips 3 Tesla MRI aircraft with samples of 2 patients and 8 volunteers. Then each participant performed a cervical vertebrae MRI examination with a STIR sequence with anterior, anterior - superior and anterior - inferior pre variation



**Figure 1.** Scout Placement variations of pre saturation (a) anterior; (b) anterior - superior; (c) anterior - inferior

**Table 1.** Parameter MRI of cervical vertebrae with pre saturation variation

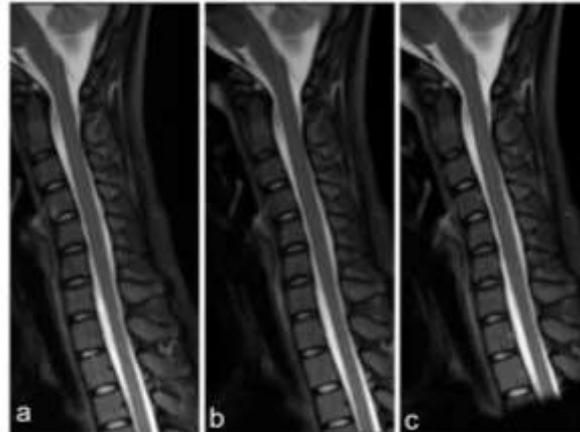
Parameter	Value
TR	3400 ms
TE	60 ms
TI	210 ms
FOV	150 x 216x 57 mm
<i>Slice Thickness</i>	4 mm
<i>Matrix</i>	188 x 194
NEX	2

For image information, data were performed by assessing questionnaires by respondents on anatomical image information (Spinal Cord, Cerebrospinal Fluid, Corpus Vertebrae, Invertebral Discus, and Processus spinosus). Next is anatomical assessment using ordinal data that is value 3 for "very clear" image information, 2 for "clear" image information, and 1 for "unclear" image information.

To see the level of conformity or the perception agreement of both respondents, the test was performed by Cohen's Kappa test. After getting the agreement, then selected one of the respondents. Because the data obtained is nonparametric ordinal with paired variable more than two, the difference test used is Friedman test to know which pre-saturation variation is better and the Wilcoxon test to know the difference between variation of pre saturation placement.

## 3. Results

This study used three variations of pre saturation on MRI image vertebrae cervical sagittal pieces. The variations of pre saturation used in this study were anterior, anterior - superior and anterior - inferior.



**Figure 2.** Image results of MRI vertebrae cervical sagittal pieces with STIR sequence on pre aation variation (a) anterior; (b) anterior - superior; (c) anterior – inferior

The results of the MRI Vertebrae cervical examination were further read out by a radiologist. After that using SPSS 25 data is tested Cohen's Kappa to know the similarity perception as follows:

**Table 2.** Cohen's Kappa test results

<i>Pre saturation</i>	Cohen's Kappa	Agreement
	R1*R2	
Anterior	0,787	Good
Anterior – Superior	0,937	Excellent
Anterior – Inferior	0,780	Good

From table 2 can be donated Both respondents have a speed of perception ( $K > 0.61$ ). After that selected data results from one of the respondents to do next credit. Every respondent can be used for more than five years, but the first respondent chosen to be the respondent on the grounds that the first respondent is a consultant radiology specialist physician in the field of musculoskeletal. After selecting one of the respondents, then the next test Friedman different as follows.

**Table 3.** Friedman different test results

<i>Pre saturation</i>	<i>Mean rank</i>	<i>P Value</i>
Anterior	1,71	
Anterior – Superior	1,90	< 0,001
Anterior – Inferior	2,39	

From table 3 it can be concluded from the mean rank value that the best pre saturation variation is in the anterior - inferior variation with the mean value of 2.39 and the worst is the anterior variation with the mean rank of 1.71. Based on the results of Friedman's different tests on pre-saturation variation the overall organ obtained p-value of  $< 0.001$  or  $p < 0.05$  is  $H_0$  is rejected and  $H_a$  accepted which means there is a different with each variation of pre saturation on MRI vertebrae cervical. After Friedman's different test then the next is a different test using Wilcoxon to see the difference between variations of pre saturation as follows:

**Table 4.** Different Wilcoxon test results

<i>Pre saturation</i>	<i>P value</i>	<i>Keterangan</i>
Anterior dan Anterior – Superior	0,340	Undifference
Anterior dan Anterior – Inferior	< 0,001	Difference
Anterior – Superior dan Anterior – Inferior	0,003	Difference

In the Wilcoxon difference test results obtained p-value <0.05 for anterior and anterior - inferior pre saturation variation; anterior - superior and anterior - inferior meaning that there is a difference in both variations of the anatomical image information. For anterior and anterior - superior pre saturation variations obtained p value 0.340 which means there is no difference in the variation. After testing on each variation, then next is to test different variations of pre saturation on each organ as follows:

**Table 5.** Friedman's different test results on each organ

Friedman Test	Pre saturation	Mean rank	P Value
Spinal Cord	Anterior	1,45	0,007 Difference
	Anterior – Superior	1,90	
	Anterior – Inferior	2,65	
Cerebrospinal Fluid	Anterior	2,20	0,010 Difference
	Anterior – Superior	1,45	
	Anterior – Inferior	2,35	
Corpus Vertebrae	Anterior	1,55	0,009 Difference
	Anterior – Superior	2,65	
	Anterior – Inferior	1,80	
Discus Intervertebralis	Anterior	2,10	0,023 Difference
	Anterior – Superior	1,40	
	Anterior – Inferior	2,50	
Processus Spinosus	Anterior	1,25	0,002 Difference
	Anterior – Superior	2,10	
	Anterior – Inferior	2,65	

On the mean rank of each organ the highest mean value is Spinal Cord organ with pre saturation variation in anterior-inferior with mean rank value of 2.65 and P value 0.007, Cerebrospinal Fluid with pre saturation variation in anterior-inferior with value mean rank of 2,35 P value 0,010, Corpus Vertebrae with pre saturation variation in anterior-superior with mean rank value 2,65 P value 0,009, Discus Intervertebralis with pre saturation variation anterior-inferior with mean rank value equal to 2,50 P value 0,023 and Processus Spinosus with pre saturation variation in anterior-inferior with mean rank value 2,65 P value 0,002. For the lowest mean rank is on Processus Spinosus with a value of 1.25 with anterior saturation variation.

#### 4. Discussion

Anatomical Image Difference MRI Vertebrae Cervical Sagital Cuts In Short Tau Inversion Recovery (STIR) Sequences With Pre Saturation Variation Pre saturation is placed over an area that produces an artifact that will obscure the signal by reducing the artifact. In general on MRI examination, pre saturation is placed in the superior and inferior of the FOV so it can saturate the cause of artifact signals from the flow of blood from the aorta and vena cava [2].

The location of different pre saturation will produce different image because each location of pre saturation will produce signals on certain organs that are given pre saturation. According to [2] putting pre saturation on the side (anterior) of the throat will reduce the swallowing artifacts by noting the area to be examined uncovered and if placing pre saturation at the superior and inferior will reduce the flow

of cerebrospinal fluid and pulsatile flow. Meanwhile, according to [3], by putting pre saturation in anterior and superior is expected to reduce artifacts due to cerebrospinal fluid.

Subjectively the MRI vertebrae cervical image shows a difference in image imagery between the anterior-inferior pre saturation variation which is considered better than the anterior-superior pre saturation variation, although in the corpus there is a few disturbing artifacts.

So based on explanation and statistical test results proved that the use of pre saturation location variation in MRI cervical vertebrae Short Tau Inversion Recovery (STIR) sequences with sagittal fragments resulted in different anatomical images.

Appropriate pre saturation placement to display good anatomical MRI vertebrae cervical image on sagittal. The results of the vertebrae cervical MRI image as a whole show the anterior-inferior pre saturation variation resulting in the best image. In the dr.Saiful Anwar Malang and generally hospitals use anterior saturation variation and in this study the variation shows the worst image among other images.

The image on the spinal cord shows the clearest picture seen from the spinal cord's line on the anterior-inferior pre saturation variation. In the cerebrospinal fluid sections, anterior-inferior pre saturation variations show the best picture of the comparison of artifacts from other variations. The best part of the vertebrae corpus is shown in the anterior-superior pre-saturation variation, the indication being that the corpus is seen most clearly among other pre-saturation variations. In the intervertebral disc, the clearest picture is shown in anterior-inferior pre saturation variations that have firm limits on each discus. In the spinous process, the best feature is in the anterior-inferior pre saturation variation seen from the margin on the spinous process. While the image of a bad blade is the spinous process with anterior saturation variation, seen from the blurry image of the spinous process. This is because compared to other pre saturation variations, images of anterior saturation variations can only saturate the swallowing movement, while other variations can saturate more in the superior or inferior parts of the body.

This is consistent with [4], study which states that pre-saturation variations in the cervical vertebrae placed on the anterior-superior portion are higher in CNR than in the anterior portion alone.

Motion artifacts from respiration, heart movement, patient movement, CSF flow and blood can cause ghosting artifacts. Such artifacts can be derived by immobilizing patients, cardiac / respiratory gating, pre saturation or drugs that can slow down peristalsis [5].

The pre-saturation variation in the anterior - inferior is capable of displaying the best anatomical image information from other pre saturation variations. The author agrees with the book westbrook [2] which states that pre-saturation is placed anteriorly to saturate the swallowing movement, and with the addition of pre saturation in the inferior MRI images to the cervical vertebrae may increase its clarity. This is because inferior pre saturation can saturate cerebrospinal fluid, pulsating (flow of blood flow) and movement of breathing. To reduce the interference then radiographer should communicate how to breathe good (not take a breath and remove it deeply) so that the resulting image can be maximized.

The disadvantage of using pre saturation is the increase in the amount of time at which the pre saturation pulse is added to the sequence pulse, but it does not increase the facsimile time [6]. Pre saturation also increases the amount of RF received by the patient that causes an increase in the Specific Absorption Rate (SAR). The use of a gradient pre can also reduce the number of slices obtained and therefore should be used appropriately [2]

So based on the explanations and results of the above SPSS, the use of anterior-inferior preordial variation is considered capable of displaying better image information than other variations so that the diagnosis can be properly enforced. But also must be considered when using pre saturation because there are some losses.

## 5. Conclusion

Based on the results of research and discussion it can be concluded that on different test Wilcoxon there is a significant difference between anterior and anterior-inferior pre saturation variation; anterior-superior and anterior-inferior. While the anterior and anterior-superior pre-occupation did not show any significant difference.

In Friedman's different test, pre-saturation variation in the anterior-inferior produces the best anatomical image information from other variations. It is seen from the highest mean rank of Spinal Cord, Cerebrospinal Fluid, Discus Intervertebralis and Processus Spinosus.

## References

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