

Analysis of Anatomy Information of T2 Weighted TSE Sequences between Fatsat and Dixon on Examination Mri Lumbar Case HNP of Axial Plane

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ABSTRACT

Background: Fat suppression is a method used to suppress fat signal. Result of fat suppression are seen hypointense. Fatsat and dixon are fat suppression methods. Fat suppression in MRI Lumbar of HNP case in each literature uses different methods. According to Manann (2018), axial lumbar MRI examination uses fatsat T2W, whereas according to Wadhwa (2016) uses dixon T2W. This research to knowing the differences anatomy information and better fat suppression methods on anatomy information T2 weighted TSE sequences between fatsat and dixon MRI lumbar examination HNP case of axial plane.

Methods: This research type is quantitative experimental. This research was conducted at the Radiology Installation of the RSUD Dr. Soedono Madiun in 10 patients. The data obtained were 100 images assessed by radiologists in the vertebral body, nerve root, epidural fat, annulus fibrosus and disc bulging. The results of the study were analyzed using SPSS Wilcoxon statistical test.

Result: The results showed that each anatomy has a p -value < 0.05 and in the overall anatomy p -value is 0.032 (p -value < 0.05) which indicates H_0 is rejected and H_a is accepted which means there is a difference in information (assessment of each anatomy and overall anatomy) information TSE sequences between fatsat and dixon lumbar MRI HNP cases of axial plane. Based on the mean rank value each anatomy, fatsat more clearly reveals the anatomy of nerve root and epidural fat, whereas dixon more clearly shows the vertebral corpus, annulus fibrosus and disc bulging. Based on the overall anatomy the mean rank fatsat value is 21.25, while dixon is 28.33.

Conclusions: there is a difference in anatomical image information of T2 Weighted TSE sequences Between fatsat and dixon on examination MRI lumbar case HNP of axial plane. T2 TSE dixon fat suppression is better than T2 TSE fatsat at anatomy information on TSE sequences lumbar MRI HNP cases of axial plane because it has a higher mean rank value.

Keywords: Fat Suppression, Fatsat, Dixon, Lumbar, HNP

INTRODUCTION

Lumbar is a part of the vertebrae that has a center of pressure and support for the body's weight, so that the lumbar is more susceptible to damage in the vertebrae (intervertebral discs) (Ramani, 2014). One pathology that occurs in intervertebral discs is the hernia nucleus pulposus (HNP). HNP is the bulging of the intervertebral disc towards the lateral and / or posterior direction which will cause sensitization of the nerve roots and the spinal cord (Fitriyani, 2017).

MRI is the Gold standard HNP examination (Wilmink, JT, 2010). Lumbar MRI of Axial plane is used to see the effect of HNP bulging on the surrounding tissue, such as compression on the nerve root and on the spinal cord (Chawalparit, et al., 2006). Fatsat and dixon are fat suppression technique based on the selection of chemical shifts, fat sat by suppressing fat

signals, while in Dixon by separating between fat and water signals, both fat suppression techniques can be applied in all sequences. Dixon has a longer time scanning compared to Fatsat, because Dixon requires applying two TE (Wu et al. 2012). The resulting image between the two fat suppression methods is different, Fatsat produces one image, this is fat suppression image, while Dixon can produce 4 images, there are water image, fat image, in phase image (SIP) and out phase image (SOP) (Guerini et al., 2015).

Based on the SOP (Standard Operational Procedure) Lumbar MRI examination at Dr. Soedono Madiun Hospital uses the sequence T1 TSE, T2 TSE and T2 TSE Dixon. SOP at Hasan Sadikin Bandung Hospital and National Brain Center Hospital also use Dixon T2 TSE, while SOP at Premier Bintaro Hospital and Moewardi Hospital use TSE Fatsat T2.

Based on a journal written by Sirvancy, et al (2009) using Fatsat/STIR, in a journal written by Wadhwa, et al (2016) using Dixon, SOP of Dr. Soedono Madiun and Hasan Sadikin Hospital Bandung used Dixon, SOP at Premier Bintaro Hospital and Dr. Moewardi uses T2 Fatsat. In a journal written by Wu Jing, et al. (2012) mentioning that fat suppression is recommended for Lumbar MRI examination, there are Fatsat and Dixon. The aim of this study was to determine the technique of Fatsat and Dixon fat suppression which was more informative in revealing anatomical information on lumbar MRI of HNP cases in axial plane.

METHODS

This type of research is quantitative research with an experimental approach. Data retrieval was carried out in March-

April 2019 in Radiology Installation of RSUD dr. Soedono Madiun. The subjects of this study were two radiologist.

The population of this study was all patients Lumbar MRI examinations at the RSUD dr. Soedono Madiun. The sample is

10 samples, calculated using the Lameshow formula, (Notoadmodjo, 2010).

Data analysis using Wilcoxon statistical test. Wilcoxon test to find out whether there is a difference in anatomic information between T2 TSE fatsat and Dixon T2 TSE and to

Note:

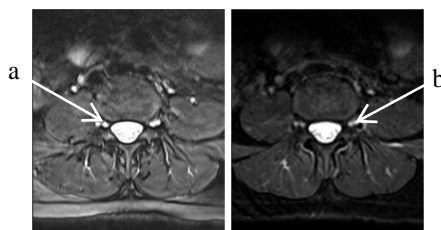


Image 2 Nerve root of fatsat and Dixon find a better fat suppression method between T2 TSE fatsat and Dixon T2 TSE.

RESULTS AND DISCUSSION

This study was conducted on 10 patients who indicated HNP to find out the differences in T2 weighted Lumbar MRI anatomic information on the TSE sequence between fatsat and Dixon in axial HNP cases as follows:

1. Sample Characteristics.

Based on gender the sample characteristics were male and female. Presented in table 1 as follows:

Table 1 Characteristics of Samples by Gender			
a.	Gender	total	Percentage (%)
	Male	6	60%
	Female	4	40%
	Total	10	100%

b. Nerve root of fatsat

c. Nerve root of Dixon

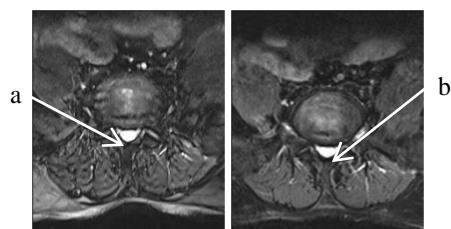


Image 3 Epidural fat of fatsat and Dixon

Note :

a. Epidural fat of fatsat

b. Epidural fat of Dixon **Table 2 Characteristics Samples by age**

Usia	Tota	Precentage
	1	(%)
40-50 years old	1	10%
51-60 years old	5	50%
61-70 years old	4	40%
Jumlah	10	100%

2. Parameter Characteristics

The parameters used in this study are as follows:

Table 3 ParametersSequence

Parameter	Fatsat	Dixon
TR	3500	3500
TE	78	82
<i>Slice Thicknes</i>	4	4
FOV	260	260
<i>Flip Angle</i>	150	150
<i>Bandwith</i>	254	337
<i>Matrix</i>	224x320	205x256
NEX	1	1

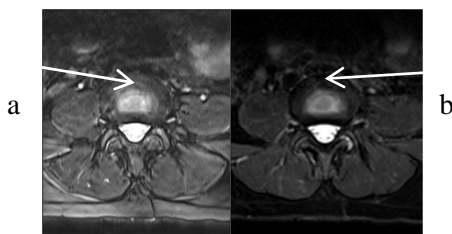


Image 4 annulus fibrosus of fatsat and dixon

Note:

- annulus fibrosus offatsat
- annulus fibrosus ofdixon

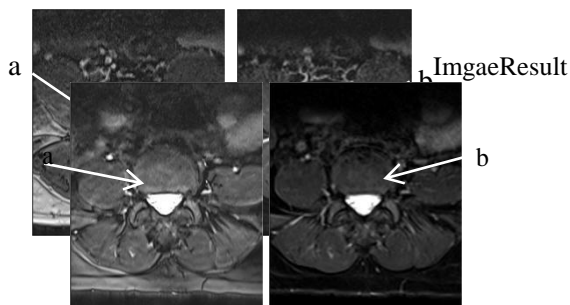


Image 5 Disc bulging of fatsat and dixon

Note:

- Disc bulging* offatsat
- Disc bulging* ofdixon

Image 1 Corpus Vertebrae of fatsat and dixon

Note:

a. *Corpus vertebrae* of fatsat b. *Corpus vertebrae* of dixon

3. Differences in Information on T2 Weighting Anatomy TSE Sequence between Fatsat and Dixon Lumbar MRI Examination in Axial HNPCases

Table 4 Differential Information Test Results for Anatomy of T2 Lumbar MRI TSE Sequence between Fatsat and Dixon in HNP

Cases of Axial Plane in Each Anatomy			
Anatomy	Sekuen	ρ -value	Note
<i>Corpus vertebrae</i>	Fatsat Dixon	0,004	There is a different
<i>Nerve root</i>	Fatsat Dixon	0,004	There is a different
<i>Epidural fat</i>	Fatsat Dixon	0,002	There is a different
<i>Annulus fibrosus</i>	Fatsat Dixon	0,004	There is a different
<i>Disc bulging</i>	Fatsat Dixon	0,004	There is a different

Based on the Wilcoxon test in Table 4, it is known that the p -value in each anatomy is <0.05 , which means there is a difference in information about the vertebral anatomy, nerve root, epidural fat, annulus fibrosus and bulging disc between T2 TSE fatsat and T2 TSE dixon MRI examination lumbar of axial plane HNP case. This is because each anatomy has different constituent components which can influence the clarity of the anatomy, including:

- Bone (*Corpus vertebrae*) is composed of 10% water, 30% organic matter (Protein) and 60% inorganic (Feng, 2009), component of bone has no fat content, so if applied using the fat suppression method, there is no suppression, MRI images of the bone remain hypointense (slightly containing water).
- The root nerve is surrounded by fat (Autio, 2006). So that the strength of fat suppression to see the nerve root greatly influences the clarity of its anatomy.
- Epidural fat is composed of adipose tissue (fat cells) (Walker et al., 2018). T2 weighted MRI features in epidural fat appear to be intermediates, application of epidural fat fat suppression will reduce epidural fat intensity (Westbrook, 2011). So that the strength of the fat suppression method can affect the clarity of the anatomy produced.
- Annulus fibrosus is composed of hyaline cartilages containing 85% of water and the nucleus pulposus is mostly composed of a gel containing 70% water (Baldit, 2018). Nucleus Pulposus hernia (HNP) is the release of the nucleus pulposus from the annulus fibrosus which can cause bulging or tearing of the annulus fibrosus (Muttakin, 2008). So that the bulging disc contains a lot of water in it, then when the fat suppression is applied to the annulus pulposus and the disc bulging will appear hyperintense. Intervertebral discs (annulus fibrosus and nucleus pulposus) position in front of the nerve (ventral root and dorsal root), these nerves are protected by fat, so the application of fat suppression to the annulus pulposus and disc bulging can affect the clarity of the anatomy.

Table 5 Information Differential Test Results forAnatomy of T2 Lumbar MRI TSE Sequence between Fatsatand

Dixon in HNP Cases Overall Axial Pieces Anatomi		
Fat Suppression methods	ρ -value	Not e
FatsatDixon	0,032	There is a different

Based on the Wilcoxon test in Table 5 it is known that the ρ -value in the overall anatomy is 0.032 ($\rho < 0.05$), which means there is a different anatomy information between T2 TSE fatsat and T2 TSE dixon lumbar MRI examination axial plane of HNP. This is because the application of fat suppression to each anatomy will greatly affect, the components of each anatomy have different water and fat content, so the more anatomy containing fat will be more affected, the stronger the fat suppression, the more anatomic he saw, so the strength of fat suppression greatly influenced the clarity of anatomy (Guerini et al., 2014).

4. Better fat suppression method for revealing T2-weighted TSE anatomic information between fatsat and dixon lumbar MRI in axial HNP cases

Table 5 Results of mean rank Wilcoxon Information Test Per Anatomy at T2 Weighting TSE Lumbar MRI SequencesHNP

Axial CutCases		
Kriteria	Fa t	Mean rank
<i>Corpus vertebrae</i>	Suppression	
	Fatsa	0.0
	t	0
	Dixo	5.5
<i>Nerve root</i>	n	0
	Fatsat	5.5
	Dixon	0
		0.0
<i>Epidural fat</i>		0
	Fatsat	5.5
	Dixon	0
		0.0
<i>Annulus fibrosus</i>		0
	Fatsat	0.0
	Dixon	0
		5.5
<i>Disc bulging</i>		0
	Fatsat	0.00
	Dixon	5.50

Based on the Wilcoxon test in table 5, the fat suppression fat method is better at revealing anatomical information on epidural fat and nerve root. Epidural fat is composed by adipose tissue (fat cells) (Walker et al., 2018), so that when applied a strong fat suppression method it will be increasingly invisible. Nerve root is an anatomical part that has a diameter of 1.46 mm and is surrounded by fat (Liu, Yongtau, et al., 2015), because dixon

has a small anatomic weakness and is surrounded by fat, so that the results of anatomical clarity are more clearly seen in fatsat. According to the results of a study by Guerini, et al. (2014), dixon is a fat suppression method that is less sensitive to small anatomy in size surrounded by fat. Nerve anatomy and epidural fat are more clearly displayed in the fat suppression method which has weak strength.

suppression method which has weak strength. Based on the Wilcoxon test in table 5, the method of dixon fat suppression is better in revealing anatomical information on the corpus vertebrae, annulus fibrosus and disc bulging. The component of bone (corpus vertebrae) consists of 10% water, 30% organic matter (Protein) and 60% inorganic substances (Feng, 2009), because the component of bone does not consist of fat, when applied fat suppression there is no suppressed fat. Annulus fibrosus and 80% bulging disc are composed of water which will appear hyperintense when applied to T2 weighting, the position of the annulus fibrosus and the bulging disc is in front of the nerve root, the nerve root is protected by fat, so the application of the fat suppression method will suppress the surrounding fat signals nerve root that can affect the anatomic intensity of the surrounding tissue. This is in accordance with the results of a study by Guerini et al. (2015), dixon is able to clearly reveal vertebral body anatomy, dixon fat suppression method is stronger for suppressing fat compared to other fat suppression methods, the stronger the fat suppression method is used, the more clear picture of the anatomy.

Table 6 Results of mean rank Wilcoxon test Overall Information Anatomy at T2 Weighting TSE Sequence of Lumbar MRI HNP Axia Cut Case

<u>FatSupression</u>	<u>MeanRank</u>
Fatsat	21,25
Dixon	28,33

Based on the Wilcoxon test in table 6, dixon has a higher mean rank value, which means that dixon is better at revealing anatomical information between T2 weighting of TSE sequences of lumbar MRI in axial cut HNP cases. This is consistent with the results of the study of Guerini, et al. (2014), the water and fat content in each anatomy is different, the application of dixon to the anatomy that contains lots of fat will further reduce its intensity, because dixon's ability to suppress fat is very strong (Guerini, 2014).

CONCLUSION

There are differences in T2-weighted anatomic information on TSE sequences between fatsat and dixon lumbar MRI examination axial-cut HNP cases in each anatomy and overall anatomy with p -value < 0.05.

The dixon fat suppression method produces better anatomical information on the anatomy of the corpus vertebra, annulus fibrosus and disc bulging, whereas in fatsat it is better to produce anatomic information on nerve root and epidural fat. In the overall anatomy, the method of dixon fat suppression is better than fatsat (mean rank: 21.25) in revealing T2-weighted

T2 anatomic information on lumbar MRI examination in axial cut HNP cases.

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