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The Role of Short TAU Iversion Recovery (STIR) Sequence in Lumbar MRI Examinations at Andalas University Hospital

Wahdini Hanifah[1], Nerifa Dewilza[2], Sagita Yudha[3], Chairun Nisa[4], Faiz Arkananta[5]
Prodi Radiologi Fakultas Vokasi Universitas Baiturrahmah Padang, Indonesia[1,2,3,4,5]
e-mail*: wahdinihanifah@fv.unbrah.ac.id

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ABSTRACT

Magnetic Resonance Imaging (MRI) is a non-invasive diagnostic imaging modality that excels in displaying details of the body's soft tissues, including the lumbar spine area. One important sequence in a lumbar MRI examination is the Short Tau Inversion Recovery (STIR) which functions to suppress fat signals to increase the contrast between normal and pathological tissue. This study aims to determine the management of lumbar MRI examinations and analyze the role of the STIR sequence in detecting abnormalities in patients with clinical Low Back Pain (LBP) and Herniated Nucleus Pulposus (HNP). This study used a descriptive method with a qualitative approach at Andalas University Hospital in August 2025, Research Informants numbered 4 people, consisting of 2 radiographers, 1 Radiology doctor, and 1 head of the room. Data collection was carried out through in-depth interviews, observation, and documentation, then analyzed using source triangulation techniques and presented in tabular form. The results show that the STIR sequence is routinely used in sagittal and coronal sections. STIR plays a crucial role in homogenously suppressing fat signals, enhancing tissue contrast, and detecting edema, inflammation, and abnormalities in the spinal cord more clearly than other sequences such as T1, T2, and Fatsat. Although STIR has the drawback of a low Signal-to-Noise Ratio (SNR) and longer scan times, the overall image quality is considered optimal and very helpful in establishing radiological diagnoses. Therefore, the STIR sequence plays a crucial role in lumbar MRI examinations, especially in cases involving bone marrow and soft spinal tissue.

Keywords: *Lumbar Magnetic Resonance Imaging (MRI), Short Tau Inversion Recovery (STIR), Low Back Pain (LBP), Hernia Nukleus Pulposus (HNP)*

INTRODUCTION

Magnetic Resonance Imaging (MRI) is an advanced tool in the field of medicine that combines computer technology, high magnetic fields (0.064-7.0

Tesla), and radio waves to produce cross-sectional images of the human body. MRI examination has advantages over other diagnostic imaging modalities because it uses non-ionizing radiation, is non-invasive, and produces high resolution on soft tissues and allows imaging from various angles in all fields (transverse, sagittal, coronal, and even oblique) so that the results are more detailed and clear (Vargas et al., 2021)(Mirfauddin et al., 2025)

There are many MRI examinations on the human body, such as in the head there are Brain MRI, SPN MRI, Orbital MRI. On the chest MRI Chest, on the abdominal part of the abdominal MRI Abdomen. Then in the body apparatus there is an MRI of the upper extremity, MRI of the lower extremity, an MRI of the pelvis, on the spine there is an MRI of the whole spine for the entire spine, then there are three MRI Spine, namely Cervical MRI, Thoracic MRI, and Lumbar MRI. (Westbrook & Talbot, 2019)(Hasbi, Jamal, et al., 2025)

Lumbar MRI examination aims to detect abnormalities in soft tissues, such as muscles, ligaments, and intervertebral discs of the sagittal, coronal, and axial pieces. (Nurcahyo et al., n.d.)The sagittal cut displays abnormal anatomy of spondylolisthesis, subluxation and connection of the intervertebral disc to the adjacent vertebral body and spinal canal (Sebayang et al., 2024). (Hasbi, Setiawan, et al., 2025).

Pathological or clinical conditions that are often experienced in lumbar MRI examinations include LBP and HNP (Samudra et al., 2025). Low Back Pain (LBP) is pain felt in the lower back area, it can be in the form of local pain or accompanied by radicular pain and or both caused by irritation or radical compression in one or 3 lumbosacral radiations which can be accompanied by motor weakness, sensory disturbances and decreased physiological reflexes (Aprisandi & Silaban, 2023). Nucleus Pulposus Hernia (HNP) is a condition in which the nucleus pulposus made of gel-shaped material in the spinal cord comes out of the annulus fibrosus or the part that protects it, this condition causes a protrusion into the spinal canal so that it causes pain to radiate to the lower limb caused by pressure on the spinal nerve. (Astuti, 2024).

In the Lumbar MRI examination there is no special preparation before the examination, the patient is given an explanation of the various positions and procedures of the examination to be carried out. Routine lumbar MRI examination using T1 SE/TSE sagittal, T2 SE/TSE sagittal, T2 SE/TSE axial, SE/TSE T1 axial, T2 SE/TSE Coronal, Short Tau Inversion Recovery (STIR) (Westbrook & Talbot, 2019). Lumbar MRI examination can show a picture of fat that appears hyperintense which can interfere with the pathological picture of the lumbar, so it is necessary to carry out fat suppression techniques in fat suppression. Some of these techniques include fat saturation, Short Tau Inversion Recovery (STIR), Spatial Inversion Recovery (SPIR) and the Dixon Technique. (Astuti, 2024)(Nizar & Katili, 2019)

Based on the discussion above, there is a sequence that is routinely used, namely STIR, which is part of the Inversion recovery technique. Inversion recovery is a variation of the spin echo sequence. In this sequence, there are four pulses used, starting with a 180-degree inversion pulse, followed by a 90-degree

excitation pulse, and then a 180-degree rephasing pulse. A 180-degree inversion pulse is used to press on certain tissues so that it will appear as a dark area on the image. The fat suppression technique in the fat suppression technique is used to make fat appear as a dark area on the image. This technique is very useful in accurately identifying pathologies, facilitating the diagnosis process (Fikra et al., 2023)

STIR sequences allow for clearer visualization of Myelo, intervertebral discs, as well as stenosis in the conus medularis in LBP cases, thus facilitating the elucidation and compression of the tissues around the spine. the role of the sagittal STIR sequence to suppress fat in the cerebral spinal fluid, conus medullaris and myelum in the spinal cord (Wilhelm et al., 2025) (Sebayang et al., 2024).

In lumbar MRI examinations, which are often found with clinical LBP and HNP, the examination is carried out using STIR sequence (Samudra et al., 2025). STIR sequences are routinely used because STIR sequences are very useful in accurately identifying pathologies, and can detect fluids such as edema, myelo, and vertebral discs (Patriat et al., 2023). Sequence STIR suppresses or suppresses fat so that fat will be darker in color and fluid will be lighter, Sequence STIR is routinely used because it is superior to other fat suppression techniques in MRI at Andalas University Hospital such as fatsaturation. (Agrilian et al., 2023)

This study aims to determine the management of lumbar MRI examinations and analyze the role of STIR sequence in detecting abnormalities in patients with clinical Low Back Pain (LBP) and Hernia Nucleus Pulposus (HNP) at Andalas University Hospital.

METHODS

The type of research conducted is a descriptive study through a qualitative approach. This research was conducted at the Radiology Installation of Andalas University Hospital Padang in August 2025. The population in this study is 2 Radiographers, 1 Radiology Doctor, 1 Head of Room at the Radiology Installation of Andalas Padang University Hospital, and as a sample in this study is a Lumbar MRI Examination at the Radiology Installation of Andalas Padang University Hospital. Data collection was carried out by in-depth interviews, observations, and documentation studies. Then the data is processed using the source triangulation technique and presented in the form of a table. After that, conclusions and suggestions were drawn.

RESULT AND DISCUSSION

Table 1. Triangulation Source

No	Aspects Studied	Informan	Interview Results	Conclusion
1	Experience using STIR	Radiographers 1 & 2	Have extensive experience; STIR is used	STIR is effective and routinely

	sequences on Lumbar MRI		to suppress fat signals and accentuate fluids and edema.	used to assess soft tissue and spinal disorders.
2	Lumbar MRI procedures and protocols	Radiographer 1 & 2, Head of Room	There is no special preparation; the position of the patient supine head-first; sagittal, coronal, axial pieces; main sequences T1, T2, STIR, and Myelo.	The STIR protocol is a standard part of the lumbar MRI examination.
3	STIR technical settings (TR, TE, TI, Slice Thickness)	Radiographers 1 & 2	TR: 3528–4328 ms; TE: 14–40 ms; TI: 140–150 ms; Slice thickness: 3 mm; Scan time ±4 minutes.	The parameters are adjusted according to the tool's preset.
4	Advantages of STIR over other sequences	Radiolog	STIR excels at detecting fluid, edema, and inflammation; suppresses fat signals more homogeneously than Fatsat.	STIR is more sensitive to fluids and is ideal for assessing pathological lesions.
5	Limitations of using STIR	Radiographer 1 & 2, Head of Room	Low SNR, high noise, and motion artifacts due to relatively long scan times.	The limitations can be overcome with increased NSA and patient education.
6	The role of STIR in the clinical diagnosis of LBP and HNP	Radiolog	STIR is essential for bone marrow disorders (fractures, spondylitis, metastasis); not too necessary for pure HNP.	STIR is important in pathological cases involving bone marrow.
7	Evaluasi dan kualitas citra STIR di RS Unand	Radiologist, Head of Room	The results of the images are considered optimal, but sometimes artifacts appear in certain patients.	Image quality is good, but it still needs tool optimization to minimize artifacts.
8	STIR facility support and usage policies	Head of Room	STIR includes routine protocols; There has been no equipment upgrade, but periodic evaluations are carried out with technicians.	STIR is implemented regularly and supported by radiology installation policies.

Discussion

Head coil and body coil to ensure optimal magnetic field coverage. The examination was carried out using the whole spine protocol, but focused on the

lumbar area with a centering point (CP) in the middle of the lumbar vertebra. The pieces used include sagittal, coronal, and axial, while the sequences applied include: T1 and T2 Sagittal, T1 and T2 Coronal, T1 and T2 Axial, STIR Sagittal and Coronal, 3D Myelo.

According to (Sebayang et al., 2024; Westbrook & Talbot, 2019), lumbar MRI examination does not require any special preparation, before the examination the patient is asked to urinate to empty the bladder, then the radiographer explains the examination procedure, and ensures the patient is not wearing metal objects, then the patient fills out the consent inform, after which the patient.

1. Management of Lumbar MRI Examination

Based on the results of interviews with two radiographers, the head of the radiology installation room, and the results of direct observation, the management of the lumbar MRI examination was asked to change the patient's clothes. The patient was positioned supine feet first and using a spinal coil, the examination was carried out using lumbar protocol, using sagittal, coronal, axial, and sequence pieces used T1 and T2 sagital, T1 coronal, T2 axial, and STIR sagittal.

From the results of the research, the examination stages are in accordance with the Standard Operating Procedure (SOP) guidelines that apply at the Radiology Installation of Andalas University Hospital. But there is a difference with the theory. According to the theory of the patient being positioned supine feet first and using a spinal coil, the examination was carried out using the lumbar protocol, using sagittal, coronal, axial, and sequence pieces used T1 and T2 sagittal, T1 coronal, T2 axial, and STIR sagittal. Meanwhile, at Andalas University Hospital, the lumbar MRI examination protocol uses the whole spine protocol and uses the head coil and coil spine with the position of the patient head first using sagittal, coronal, axial, and sequence pieces used T1 and T2 sagittal, T1 coronal, T2 axial, and STIR and additional T2 coronal, T1 axial, coronal STIR, 3D myelo sequences. The results of triangulation of data sources showed a match between interviews, observations, and hospital documents. This means that the implementation of lumbar MRI examination has been carried out with a standard, safe, and in accordance with clinical radiology standards.

2. Peranan Sequence STIR

Based on interviews with radiographers, radiologists, and room heads, STIR sequences have an important and irreplaceable role in lumbar MRI examinations, especially for detecting soft tissue and spinal abnormalities involving edema, inflammation, fractures, spondylitis, and bone metastases. For the STIR sequence parameters are adjusted to the tool preset (Sahr Ek Tsoon; Sneag, Darryl B., 2021).

Radiographers 1 and 2 have extensive experience in using STIR sequences, STIR is effective and routinely used to assess soft tissue and spinal abnormalities by suppressing fat signals and highlighting fluid and edema. According to radiologists, STIR sequences have advantages over other sequences, STIR is more fluid sensitive, edema, and compresses fats more homogeneously than Fatsat. The limitations of STIR according to radiographers and heads of STIR rooms have low SNR, high noise, artifacts due to patient movement, limitations can be overcome by increasing NSA and patient education. The role of STIR in the clinical diagnosis of LBP and HNP according to STIR radiologists is very important for bone marrow disorders (fractures, spondylitis, metastasis); STIR is not really necessary for pure HNP. This is supported by research that shows that STIR is superior in displaying bone marrow (Zadig et al., 2023) The quality of STIR images according to radiologists is considered optimal, but sometimes artifacts in certain patients, for this reason the head of the room always consults a technician to optimize the use of STIR if there is a tool artifact. (Nuha & Prasetya, 2022)

The radiographer explained that STIR is used to suppress fat signals and accentuate fluid or edema, so that anatomical structures such as the corpus vertebrae, intervertebral disc, spinal cord, and CSF (cerebrospinal fluid) are more clearly visible. Technically, STIR is superior to fatsaturation because it does not depend on the homogeneity of the magnetic field (Westbrook, 2019). The parameters used at Andalas University Hospital are TR: 3528–4328 ms, TE: 14–40 ms, TI: 140–150 ms, Slice Thickness: 3 mm, Scan time: ±4 minutes.

Radiologists confirm that STIR is very sensitive to fluids, so it is very effective in identifying abnormalities in the bone marrow, such as compression fractures, spondylitis, primary and metastatic tumors, and myelopathy. However, for pure HNP cases, the use of STIR is not always necessary because the T2-weighted image is already able to display disc abnormalities well. (Agrilian et al., 2023) (Hulmansyah & Bisra, 2025)

From the results of the study, STIR images at Andalas University Hospital showed a high contrast between fat and fluid tissue. Pathological areas such as edema or inflammation appear more hyperintense, supporting the clinical findings of patients with LBP or spondylitis.

The head of the room stated that the quality of STIR images at Andalas University Hospital was optimal, although sometimes artifacts were still found due to patient movements. This happens due to the relatively long inspection time and high noise resulting in a low SNR (Signal-to-Noise Ratio) value. Radiographers address this by increasing NSA values to improve image quality without significantly extending the scan time. Therefore the scan time for STIR sequences is ±4 minutes.

According to research from (Sebayang et al., 2024) the STIR sequence allows for a clearer visualization of Myelo, intervertebral discs, as well as stenosis in the conus medularis in LBP cases, thus facilitating the identification of deceleration and stress in the tissues around the spine.

According to research from (Hikmah et al., 2023), the role of this sequence to see if there is any inflammation in the bone marrow will show abnormal signals. Edema can be seen in the bone marrow components, the main components are fat and water, if you use the coronal sequence of STIR, the picture is hypointense, but if there is clinical edema, there is fluid (water) pressed so that it looks white. According to (Westbrook & Talbot, 2019) In the lumbar MRI examination, the cut used in the STIR sequence is only sagittal, while at Andalas University Hospital the cut in the STIR sequence is sagittal and there is an addition, namely coronal.

Overall, the triangulation results from interviews, observations, and documents show that STIR plays a decisive role in detecting spinal soft tissue abnormalities, STIR makes a significant diagnostic contribution, especially in cases with bone marrow involvement, STIR is an important part of the lumbar MRI protocol at Andalas University Hospital because it provides accurate and high-quality results.

Thus, the role of STIR sequences in lumbar MRI examinations at Andalas University Hospital is the main sequence in detecting pathological changes in spinal tissue, especially those involving fluid, edema, and inflammation, as well as supporting radiologists in establishing an accurate diagnosis.

CONCLUSION

Management of lumbar MRI examination at Andalas University Hospital, Examination does not require special preparation such as fasting. The patient only needs to do an anamnesis related to LBP complaints, then change special clothes and remove all metal objects attached to the body. The patient is positioned supine head first, with a head coil and body coil. The examination uses the whole spine protocol, but focuses on the lumbar area with CP in the middle of the lumbar vertebrae. The pieces used are sagittal, coronal, and axial, and T1 and T2 Sagittal, T1 and T2 Coronal, T1 and T2 Axial, STIR Sagittal and Coronal, 3D Myelo. STIR sequence has a very important and irreplaceable role in lumbar MRI examinations at Andalas University Hospital. The STIR sequence functions to suppress fat signals and accentuate fluid or edema, so that anatomical structures such as the corpus vertebrae, intervertebral discs, spinal cord, and cerebrospinal fluid (CSF) can be seen more clearly. STIR has been shown to be very sensitive to fluid and edema, making it very effective in detecting compression fractures, spondylitis, bone metastases, as well as bone marrow abnormalities, infalamity or edema.

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