Oshada; Jurnal Kesehatan
https://nawalaeducation.com/index.php/O/index
Volume 2 Nomor 6, December 2025
e-ISSN : 3047-017X
DOI : https://doi.org/10.62872/sxxnth96

Variations in 0° and 8° Caudal Angulation in Lumbosacral Joint Lateral Projection Examinations with Clinical Low Back Pain to Show More Informative Anatomy in the Radiology Department of Pariaman Regional General Hospital

Santa Mareta[1]*, Oktavia Puspita Sari[2], Nerifa Dewilza[3], Livia Ade Nansih[4], Nadhifa Shofikha Giani[5]
Universitas Baiturrahmah Padang, Indonesia [1,2,3,4,5]

e-mail: * santamareta@fv.unbrah.ac.id

Inputed : November 09, 2025
Revised : November 28, 2025
Accepted: December 11, 2025
Published : December 20, 2025

ABSTRACT

This quantitative experimental study, conducted at the Radiology Department of Pariaman Regional General Hospital, compared the diagnostic quality of lateral lumbosacral radiographs using 0° and 8° caudal beam angles. With a sample of three female patients assessed by five radiology specialists, results analyzed via the Wilcoxon test showed the 8° caudal projection (score: 3.87) was superior to the 0° angle (score: 3.07). The 8° angle provided a more optimal image, characterized by a well-opened intervertebral disc space and clear visualization of the spinous process without sacral overlap, making it more informative for clinical evaluation. In contrast, the 0° angle, while offering a clearer vertebral body outline, resulted in a less open disc and superimposed spinous process. The findings suggest that an 8° caudal beam angle enhances visualization of key anatomical structures in lateral lumbosacral radiography.
Keywords: Radiography, Lumbosacral joint, 0° and 8° caudal angles

INTRODUCTION

X-rays are electromagnetic waves similar to radio waves, heat, light, and ultraviolet rays. X-rays have varying wavelengths and are invisible. Due to their very short wavelength, X-rays are different from other electromagnetic rays. The wavelength of visible light is only 1/10,000. With such a short wavelength, X-rays can penetrate objects. One of the benefits of X-rays is their use in radiology (Rasad, 2015).

The use of radiology must be balanced with special research on the safety aspects of the surrounding community (Trikasjono, T., Hanifasari, K., & Suhendro, 2015). The spine (Columna vertebralis) is a flexible structure formed by a number of bones called vertebrae.

The columna vertebralis consists of a number of vertebrae connected by discus intervertebralis and several ligaments. The columna vertebrae is divided into 7 vertebrae cervical bones, 12 vertebrae thoracal bones, 5 vertebrae

lumbalis bones, sacrum, and vertebrae coccygeus. The lumbosacral is a bone structure formed by several bones, namely the lumbar and sacral bones, which are called the lumbosacral joint. The lumbosacral angle is the angle formed by a parallel line on the superior surface of the sacrum and an axis perpendicular line (Pearce, 2013).

Low back pain (LBP) is a significant global health problem. According to (Hartvigsen, J., Hancock, M. J., Kongsted, A., Louw, Q., Ferreira, M. L., Genevay, S., & Woolf, 2018), LBP is the leading cause of disability worldwide and requires serious attention. The global prevalence of LBP shows a consistent increase, with an estimated 619 million people living with this condition in 2020 (Wu, A., March, L., Zheng, X., Huang, J., Wang, X., Zhao, J., & Hoy, 2020). LBP can be specific or non-specific. Specific LBP is pain caused by a specific disease or structural problem in the spine or when the pain radiates from another part of the body.

Non-specific LBP occurs when a specific disease or structural reason to explain the pain cannot be identified. LBP is non-specific in about 90% of cases (Maher, C., Underwood, M., & Buchbinder, 2017). LBP is often associated with a loss of work productivity, resulting in a significant economic burden on individuals and society (Organization, 2023).

LBP in Indonesia is a real health problem. LBP is the second most common disease in humans after influenza. The exact number of LBP sufferers in Indonesia is unknown, but it is estimated that LBP sufferers in Indonesia vary between 7.6% and 37% of the total population (Lailani, 2013). According to data from the Directorate General of Health Services of the Ministry of Health of the Republic of Indonesia, the prevalence of LBP in Indonesia is 18% (RI., 2018).

Low back pain can be caused by infection, degenerative conditions, neoplasms, trauma, congenital disorders, metabolic diseases, and autoimmunity. Of these various etiologies, the most common cause of low back pain is mechanical causes such as trauma to the vertebrae, discs, or surrounding soft tissues. The second most common cause is degenerative processes such as osteoarthritis and osteoporosis. One of the radiographic examinations of the spine is the lumbosacral joint examination. In general, the lumbosacral joint radiographic examination. On the right and left lateral projections with a 5^{o} caudal beam direction for men and an 8^{o} caudal beam direction for women (Long, B. W., Rollins, J. H., & Smith, 2019) and on the right and left lateral projections with a 0°, 5°, 10°, and 15°, it is stated that most respondents indicated that the 0° angle was in the unclear category (Utami, 2011). Meanwhile, the author's experience during fieldwork practice at two hospitals, namely Andalas University Hospital in Padang and Padang Pariaman Hospital, for lateral lumbosacral projection examinations using a 0° beam direction. Then, when the author conducted observations at Pariaman Regional General Hospital, the author also found that in lumbosacral joint lateral projection examinations, a 0° beam angle was also used 8° for both male and female patients. The number of patient visits to the radiology department of Pariaman

Regional General Hospital for lumbosacral joint examinations over a period of one month was 35 patients, consisting of 5 males and 30 females, with a male to female ratio of 6:1.

Based on this description, a gap is identified between the established radiographic technique guidelines (5° for men, 8° for women) and the common practice observed in some hospitals (using 0° for all patients). Furthermore, there is a discrepancy between the guideline-recommended angles and research suggesting that a 0° angle may result in unclear images. This inconsistency in practice and the lack of clarity on the optimal angle for achieving the most informative anatomical image in clinical settings for Low Back Pain diagnosis creates a clear need for further investigation.

The purpose of this study was to analyze and determine which caudal X-ray angle (0^o or 8^o) produced more informative anatomical images in lateral projection radiography of the lumbosacral joint for cases of low back pain.

METHOD

Quantitative experimental. Although it has the characteristics of a controlled intervention, namely a comparison of exposure at angles of 0° and 8°, and numerical measurement of results, the limited sample size of three people means that this research cannot yet be considered a full-scale study. This small sample served to test the feasibility of the entire research protocol, from patient positioning techniques and exposure parameters (70 kVp and 40 mAs) to the comparison procedure itself, before implementation in a broader study. In addition, the initial data from the three subjects provided an initial estimate or trend regarding differences in image quality, where the average expert assessment score could be used to calculate the effect size to determine the adequate sample size for the main study. This stage also serves as an instrument validation test, namely the assessment questionnaire, to ensure that the evaluation criteria such as the clarity of the vertebral corpus and the openness of the intervertebral disc can be understood and applied consistently by the assessors, who are radiology specialists.

This study used conventional radiography equipment from Philips Diagnost 65 with a high frequency generator. Image recording was performed using a computed radiography (CR) system with a 35 x 43 cm (14 x 17 inch) imaging plate cassette. Patients were positioned in the lateral decubitus position (lying on their side) on the examination table. The side of the body to be examined was brought close to the cassette. The limbs were bent at the knee and hip joints to stabilize the position, and a support pad was placed between the knees to maintain spinal alignment. Each patient underwent two exposures with variations in angle of 0^o and 8^o caudal, with the Central Point at L5-S1. Exposure factors were controlled consistently for both angles, using parameters of 70 kVp and 40 mAs. The Focus Film Distance (FFD) was set at 100 cm.

Lead aprons were used on patients to protect unexposed organs. Data collection was performed using a questionnaire. Data obtained from the questionnaire was then processed using the SPSS computer program. Bivariate

analysis was used for data analysis. After performing a normality test, the data was found to be non-normally distributed and the Wilcoxson statistical test was used.

RESULT AND DISCUSSION

After conducting research on three patients using the lateral projection technique of the lumbosacral joint in women with an angle of 0° and 8° towards the caudal, the results of the radiographic examination are shown in the image below.

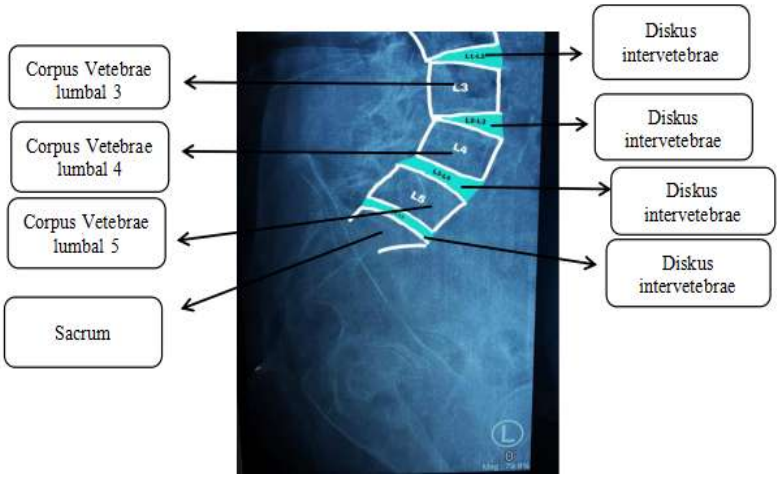

Figure 1. Radiographic results of the lumbosacral joint lateral projection with a 0^0 caudal ray direction in patient 1.

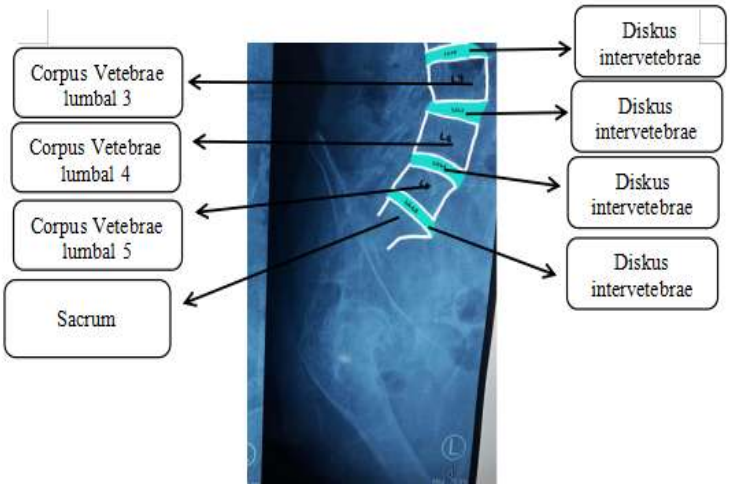

Figure 2. Radiographic results of the lumbosacral joint lateral projection with a beam direction of 8^0 caudal in patient 1.

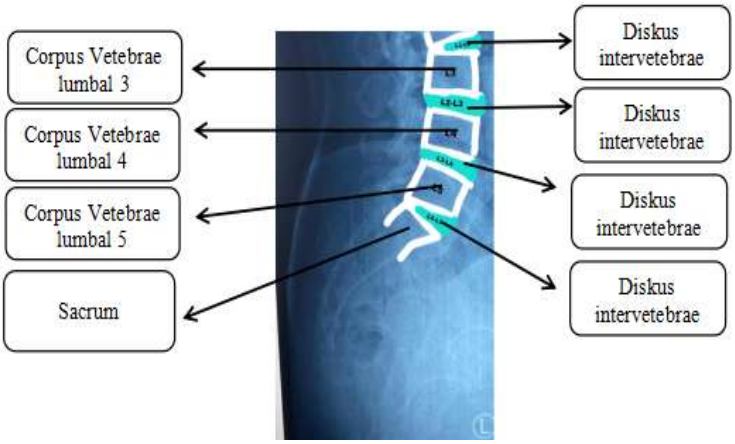

Figure 3. Radiographic image of the lumbosacral joint lateral projection 0̊ caudal Patient 2

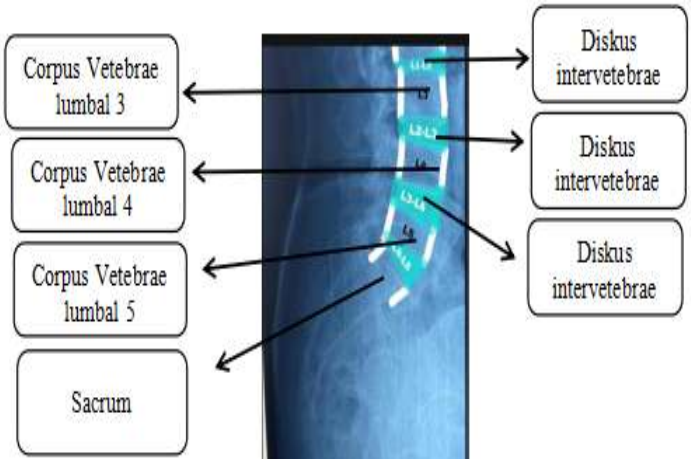

Figure 4. Radiographic image of the lumbosacral joint, lateral projection 80° caudal, Patient 2.

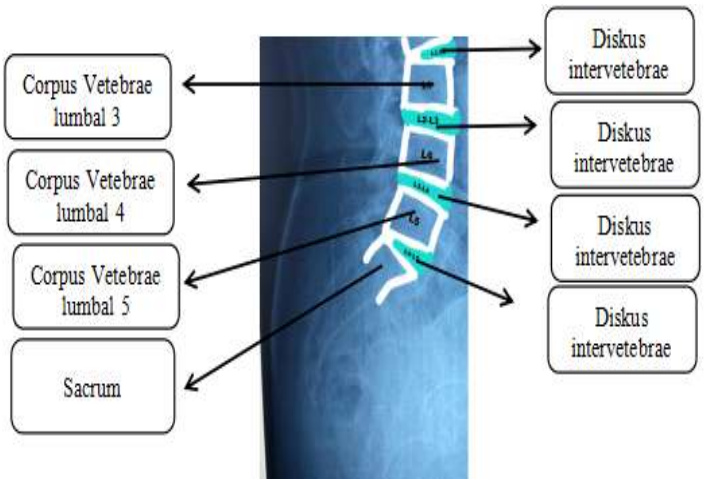

Figure 5. Radiographic image of the lumbosacral joint lateral projection 0̊ patient 3

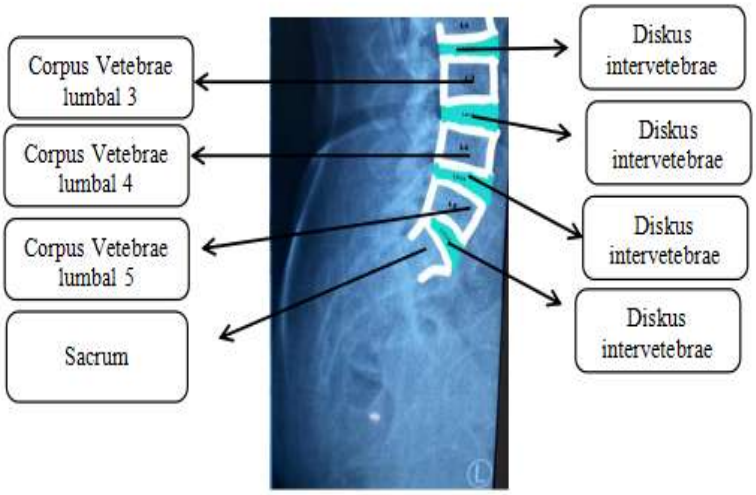

Figure 6. Radiographic image of the lumbosacral joint lateral projection 8° caudal of patient 3.

The results of the respondents' assessment of question 1 on the examination of the lumbosacral joint lateral projection with a 0° caudal angle for the L5-S1 vertebral body image are clear, where the anatomy of the L5-S1 vertebral body appears distinct. For an 8° caudal angulation for the radiographic image of the L5-S1 vertebral body, the anatomy is clearly visible. There is a difference between the two results, where the 0° caudal angulation shows more clearly that there is no elongation. In question 2, in the examination of the lumbosacral joint, lateral projection with 0° caudal angulation for the L5-S1 vertebral disc image is clear, where the anatomy of the vertebral disc is visible. For 8° caudal angulation for the L5-S1 vertebral disc radiograph image, it is very clear, where the anatomy of the L5-S1 vertebral disc is more widely visible. In question 3, in the examination of the lumbosacral joint lateral projection with 0° caudal angulation for the image of the L5-S1 spinous process, it is clear that the anatomical image of the L5-S1 spinous process is slightly superimposed with the sacrum. For 8° caudal angulation for the radiographic image of the L5-S1 vertebral disc, it is very clear that the vertebral disc is more open.

Statistical test results for Questions 1, 2, and 3

Table 1. Statistical test results for questions

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
P1	15	2.73	.458	2	3
P2	15	2.73	.458	2	3
P3	15	2.80	.676	2	4
R1	15	3.53	.834	2	5
R2	15	3.87	.743	3	5
R3	15	3.87	.834	3	5

In question 1 of the examination of the lumbosacral joint lateral projection with a 0° caudal angle, the L5-S1 vertebral body is clearly visible, where the anatomy of the L5-S1 vertebral body appears distinct with an average value (in the descriptive statistics test) of 2.73. For an 8° caudal angle, the radiographic image of the L5-S1 vertebral body is clear, with the anatomy appearing distinct and an average value (in the descriptive statistics test) of 3.53. The results of both show a difference, with the 0° caudal angle appearing more distinct.

In question 2, in the examination of the lumbosacral joint lateral projection with a 0° caudal angle for the L5-S1 vertebral disc image, the anatomy of the vertebral disc is clearly visible with an average value (in the descriptive statistics test) of 2.73. For an 8° caudal angle, the radiographic image of the L5-S1 intervertebral disc is very clear, where the anatomical image of the L5-S1 intervertebral disc is more open with an average value (in the descriptive statistics test) of 3.87. In question 3 of the examination of the lumbosacral joint lateral projection with a 0° caudal angle for the image of the L5-S1 spinous process, the anatomical image of the L5-S1 spinous process is slightly superimposed on the sacrum with an average value (in the descriptive statistics test) of 2.80. For an 8° caudal angle, the radiographic image of the L5-S1 vertebral disc is very clear, where the intervertebral disc is more open with an average value (in descriptive statistics) of 3.87. Comparison of Angulation Variations in the 0° Caudal and 8° Caudal Directions in the Examination of the

Lumbosacral Joint Lateral Projection with Clinical Low Back Pain (LBP). Based on the results of the study, which compared lateral projection radiographs of the lumbosacral joint at 0° and 8° caudal angles, through questionnaires obtained from five respondents, namely radiology specialists, the results varied. In the lateral projection examination of the lumbosacral joint at a 0° caudal angle, the results were compared with three questions on each questionnaire sheet. The first question was about the radiographic image of the L5-S1 vertebral body, the second question was about the radiographic image of the L5-S1 intervertebral disc, and the third question was about the radiographic image of the L5-S1 spinous process.

In question 1 of the lateral projection lumbosacral joint examination, the X-ray angle plays an important role in clarifying the anatomical image of the L5-S1 vertebral body. Based on the research data, it was found that at a caudal angle of 0°, the radiographic image of the anatomy of the L5-S1 vertebral body was quite clear with an average value of 2.73 and a standard deviation (SD) of 0.458. However, when an 8° caudal angulation was performed, there was an increase in image clarity with an average value of 3.53 and a standard deviation of 0.353, indicating more consistent and definitive results. These findings support Ballinger's theory (Long, B. W., Rollins, J. H., & Smith, 2019) in Merrill's Atlas of Radiographic Positioning and Procedures, which states that an 8° caudal angle on the lateral projection helps visualize the intervertebral disc and reduces superimposition between bone structures, especially in the L5-S1 area.

Ballinger suggests an angulation of approximately 5^{o}–8^{o} caudal, adjusted according to the patient's morphology (male or female).

These results are also in line with the findings of Utami (Utami, 2011), who studied variations in beam angles in lateral projections of the lumbosacral vertebrae and found that angles of 8^{o} to 15^{o} caudal provided more optimal anatomical images compared to 0^{o} angles, which respondents categorized as unclear. Anatomically, the L5-S1 intervertebral disc structure is located obliquely forward (anterior) to the frontal plane of the body. Therefore, caudal beam angulation is very helpful in opening the disc space and displaying the superior and inferior edges of the vertebral corpus more clearly.

A 0° caudal angle produces a clear image of the L5-S1 vertebral corpus without elongation (average value of 2.73). However, an 8° caudal angle produces a higher value (3.53) despite a slight elongation. Anatomically, the vertebral body is a solid bone structure that does not require special projection to be visualized. Slight elongation at an 8° angle occurs because the beam direction is no longer perpendicular to the long axis of the vertebral body.

However, this does not significantly reduce the anatomical clarity value according to the respondents' assessment.

This finding reinforces the statement in Merrill's Atlas (Long et al., 2019) that although caudal angulation is intended to open the disc, small angle adjustments (5°-8°) do not drastically interfere with the visuality of the vertebral body. A study by (Geijer, M., & Jonsson, 2016) also supports that angle variations within the 5-10° range do not significantly affect the clinical assessment of the vertebral body, and a study by (Widyaningrum, T. S., Suhariningsih, I., & Nurhayati, 2018a) also concluded that angles up to 10° still provide a diagnostic image of the vertebral body. The clarity of the vertebral body is important for assessing compression fractures, lytic or blastic lesions, and degenerative abnormalities such as osteophytes (Daffner, R. H., & Dalinka, 2014). These results indicate that although a 0° angle is technically more "perfect" for the vertebral body, the use of an 8° angle does not sacrifice critical clinical information from this structure, so it can be adopted without fear of losing important details.

Regarding question 2 about the image of the L5-S1 intervertebral disc. The results of the study indicate that X-ray angulation affects the clarity of visualization of the L5–S1 intervertebral disc in lumbosacral lateral projection examinations. At a caudal angle of 0°, the disc image appears quite clear with an average value of 2.73 and a standard deviation (SD) of 0.458. However, when the angle was changed to 8° caudal, the clarity of the image increased significantly with an average value of 3.87 and SD of 0.743, indicating that the disc space appeared wider and its superior and inferior edges were more distinct.

The disc appears wider at an angle of 8°. Anatomically, the lumbosacral joint (L5-S1) has an inclination or angle, where the superior surface of the sacrum faces anteriorly and inferiorly (Been, E., & Kalichman, 2014). When the beam is directed perpendicularly (0°), it is parallel to the disc, causing the

shadows of the upper and lower vertebral bodies to overlap, making the disc space appear narrower or closed. An 8° caudal angulation aligns the beam direction with the anatomical inclination of this joint, allowing the beam to pass through the disc space more parallel, resulting in a more open and clear "gap" in the joint.

This finding is consistent with the principle of lateral radiography, which explains that the caudal beam angle helps align the beam direction with the inclination of the lumbosacral joint. This is supported by Merrill's Atlas of Radiographic Positioning and Procedures (Long, B. W., Rollins, J. H., & Smith, 2019), which recommends a 5°–8° caudal angulation in male patients, as the L5–S1 joint has a downward sloping orientation from anterior to posterior. Without the appropriate angle, the beam may hit overlapping structures and cause the disc space to appear partially closed. Research by Utami (Utami, 2011) also supports these findings. In her study, variations in beam angulation (0°, 5°, 10°, 15° caudal) on lateral projections showed that angles of 8° to 15° produced a more open view of the intervertebral disc. Clinically, optimal visualization of the intervertebral disc is crucial for diagnosing degenerative conditions such as disc space narrowing, which correlates with LBP (Kanayama, M., Togawa, D., Takahashi, I., Terai, T., & Hashimoto, 2010) and evaluating herniated nucleus pulposus (Kreiner, D. S., Hwang, S. W., Easa, J. E., Resnick, D. K., Baisden, J. L., Bess, S., & Toton, 2014).

Overlapping images at a 0° angle can lead to overdiagnosis of disc narrowing or failure to detect mild narrowing. Thus, the use of an 8° caudal angle improves diagnostic accuracy for disc pathology, which is a common cause of LBP. The 0° angle often produces suboptimal images due to superimposition of the posterior vertebral structures. Radiologically, the L5–S1 intervertebral disc is one of the most difficult areas to visualize optimally on lateral projections due to its depth within the body and the orientation of the joint angle. Therefore, adjusting the beam angle is crucial to ensure that the joint space is clearly visible, especially in the evaluation of herniated nucleus pulposus (HNP) cases or the assessment of other degenerative abnormalities.

Optimal visualization of the intervertebral disc is key in diagnosing degenerative conditions such as disc space narrowing and herniated nucleus pulposus (HNP). Overlapping images at a 0° angle can lead to overdiagnosis of disc narrowing or failure to detect mild narrowing. Thus, the use of an 8° caudal angle improves diagnostic accuracy for disc pathology, which is a common cause of LBP.

In question 3 of the lumbosacral joint lateral projection examination, the clarity of visualization of the L5–S1 spinous processes is also an important indicator in the evaluation of the lower spine structure. Based on the results of this study, at a 0° caudal angle, the image of the L5–S1 spinous process was quite clear but showed partial superposition with the sacrum, with an average value of 2.80 and a standard deviation (SD) of 0.676. Meanwhile, at an 8° caudal angle, although the focus of the study was on the vertebral disc, the clarity of the posterior structure, including the spinous process, also increased along with

the opening of the L5–S1 disc, as shown by a mean value of 3.87 and an SD of 0.834. The spinous process is a posterior structure that, in a lateral position, is parallel to the sacral body.

Without angulation, the image of the L5 spinous process would overlap with the image of the sacrum behind it. The 8° caudal angulation changes the direction of the projection, thereby "lifting" the image of the L5 spinous process out of superposition with the sacrum, making it appear more separate and clear. This finding is consistent with research (Gunn, M. J., Brosso, A., & O'Connell, 2015) reporting that an 8° caudal angle significantly reduces the superimposition of posterior structures. According to (Manaster, B. J., May, D. A., & Disler, 2014) in Musculoskeletal Imaging, the importance of adjusting the beam angle to avoid overlap of the sacrum with posterior elements, particularly the spinous processes and laminae, is emphasized. They emphasize that lateral projections not adjusted to the anatomical angle of the joint will produce suboptimal images and risk failing to identify abnormalities such as compression fractures, spina bifida occulta, or degenerative changes.

Research by Widyaningrum et al. (Widyaningrum, T. S., Suhariningsih, I., & Nurhayati, 2018) on the evaluation of beam angles in lumbar examinations also found that an angulation of 8°–10° produced the most optimal visualization of the spinous process and intervertebral foramen, with a higher level of radiological interpretation accuracy compared to angles of 0° or >15°.

At a caudal angle of 0°, the L5-S1 spinous process showed superposition with the sacrum (average value of 2.80). This superposition was significantly reduced at a caudal angle of 8° (average value of 3.87).

The spinous process is a posterior structure that, in the lateral position, is parallel to the sacral body. Without angulation, the shadow of the L5 spinous process overlaps with the shadow of the sacrum behind it. An 8° caudal angulation changes the direction of the projection, thereby "lifting" the shadow of the L5 spinous process out of superposition with the sacrum, making it appear more distinct and clear.

The clarity of the spinous process and other posterior structures is crucial in evaluating patients with suspected spondylolysis (fracture of the pars interarticularis, athletes) and spondylolisthesis (vertebral slippage). Superimposition at 0° may conceal defects or subtle fractures in this area. Therefore, the use of an 8° caudal angle provides important additional diagnostic value, especially in young LBP patients with traumatic or repetitive stress etiology.

Based on these theories and findings, it can be concluded that an 8° caudal beam angle improves the accuracy and quality of radiographs in visualizing the L5–S1 spinous processes, reduces sacral structure overlap, and enables more reliable clinical evaluation, especially in cases of chronic low back pain, trauma, or suspected spondylolysis and spondylolisthesis.Then, to answer the comparison of variations in beam angle 0° caudal and 8° caudal, which is more informative in the lateral projection of the lumbosacral joint examination with clinical low back pain (LBP). Based on the results of SPSS processing using

the Wilcoxon test in question 1, the lateral projection of the lumbosacral joint with an angle of 0° obtained an Asymp. Sig value of 0.013 < 0.05. In question 2, the lateral projection of the lumbosacral joint with an angle of 0° obtained an Asymp. Sig value of 0.003 < 0.05. Question 3 on the lateral projection of the lumbosacral joint with an angle of 0° obtained an Asymp. Sig value of 0.002 < 0.05. Based on the above results, it can be concluded that there is a difference between the lateral projection of the lumbosacral joint with variations in angle of 0° and 8° caudal.

The results of this study indicate that the lateral projection of the lumbosacral joint with an 8° caudal angle is more informative for the clinical diagnosis of low back pain using an 8° beam direction because the lateral projection of the lumbosacral joint with an 8° caudal beam direction obtained an average weight mean score of 3. 77 and can provide more informative anatomical information on the lateral projection of the lumbosacral joint in clinical low back pain, as seen from the questionnaire data filled out by the respondents.

The most informative angle for showing the lateral projection of the lumbosacral joint with a 0° and 8° caudal beam direction is the 8° caudal beam direction. This is considered good to use because the L5-S1 vertebral body is clearly visible, the L5-S1 vertebral disc is very clear, and the spinous process is very clear. while in the 0° caudal beam direction, the L5-S1 vertebral body is very clear, the L5-S1 vertebral disc is clearly visible, and the L5-S1 spinous process is less clearly visible. thus, the 8° caudal angle is highly informative for visualizing the lumbar intervertebral disc and spinous process because the intervertebral disc is open and the spinous process is visible without superposition. However, for visualizing the anatomy of the vertebral body, the 0° caudal beam angle is preferable because there is no elongation, and this finding aligns with the study by Utami (2011) which states that the results of the 0° angle are less clear because the intervertebral discs are less open and the spinous processes overlap with the sacrum. However, the advantage of the 0° angle is that it is better able to visualize the anatomy of the vertebral body.

In the radiographic examination of the L5-S1 lumbosacral joint lateral projection with an 8° caudal beam direction, the beam direction provided very clear radiographic anatomical information and was sufficient to establish a diagnosis. The information obtained was for the entire L5-S1 lumbosacral joint. According to the author, the results of this study show that the lateral projection examination procedure of the lumbosacral joint with an 8° caudal beam direction has different uses and is applied in the diagnosis of low back pain because this beam direction can produce more informative images and can confirm the diagnosis in these patients. Meanwhile, other lumbosacral joint beam angles may not clearly show this area in the anatomical information. The lateral projection radiographic examination of the lumbosacral joint with an 8° caudal beam angle is better for visualizing the intervertebral disc because it is open, and the spinous process does not overlap with the sacrum, making it sufficiently effective for clinical low back pain (LBP).

Thus, the results of this study reinforce the theoretical approach that an 8° caudal beam angle provides a clearer image of posterior structures such as the spinous processes, while also opening up the vertebral disc space more widely and improving the accuracy and quality of radiographs in visualizing the L5–S1 spinous processes, reducing sacral structure overlap, and enabling more reliable clinical evaluation, especially in cases of chronic low back pain, trauma, or suspected spondylolysis and spondylolisthesis.

CONCLUSION

Based on the results of the study, it can be concluded that lateral projection with a 8° caudal beam direction shows superior results overall. At this angle, the image of the L5-S1 vertebral body remains clear, while the other two key structures, namely the L5-S1 intervertebral disc and the spinous process, are visualized with excellent clarity. Conversely, although the projection with a 0° caudal beam direction produces a very clear image of the vertebral body, the image quality is limited because the intervertebral disc is only clearly visible and, more crucially, the spinous process appears less clear due to superposition with the sacrum. Furthermore, examination of the lumbosacral joint lateral projection with an 8° caudal beam angle proved to be more informative in establishing a diagnosis of low back pain (LBP).

This advantage is mainly due to its superior ability to optimally display the anatomy of the intervertebral disc and spinous process compared to the 0° beam angle. Visualization of these two structures is critical for diagnosing common causes of LBP, such as herniated nucleus pulposus, spondylolisthesis, or other degenerative abnormalities, making the 8° caudal technique a more significant choice for accurate diagnosis.

The weakness of this study is that it cannot be generalized to a broader population. The conclusion serves as preliminary evidence indicating the need for further research with a larger and more representative sample.

REFERENCES

Been, E., & Kalichman, L. (2014). Lumbar lordosis. *The Spine Journal*, *14 (1)*, 87-97.

Daffner, R. H., & Dalinka, M. K. (2014). Radiologic evaluation of the low back pain. *Radiologic Clinics*, *52 (5)*, 1075-1094.

Geijer, M., & Jonsson, B. (2016). A comparison of two radiographic positioning methods for radiography of the lumbar spine. *Radiography, 22 (2)*, 140-144.

Gunn, M. J., Brosso, A., & O'Connell, C. D. (2015). The effect of tube angulation on diagnostic accuracy in lumbar spine radiography. *Journal of Medical Imaging and Radiation Sciences*, *46 (3)*, S14–S15.

Hartvigsen, J., Hancock, M. J., Kongsted, A., Louw, Q., Ferreira, M. L., Genevay, S., & Woolf, A. (2018). What low back pain is and why we need to pay attention. *The Lancet*, 2356–2367.

Kanayama, M., Togawa, D., Takahashi, I., Terai, T., & Hashimoto, T. (2010). Cross-sectional magnetic resonance imaging study of lumbar disc degeneration in 200 healthy individuals. *Journal of Neurosurgery: Spine*, *11 (5)*, 501-507.

Kreiner, D. S., Hwang, S. W., Easa, J. E., Resnick, D. K., Baisden, J. L., Bess, S., & Toton,

J. F. (2014). An evidence-based clinical guideline for the diagnosis and treatment of lumbar disc herniation with radiculopathy. *The Spine Journal*, *1 (1)*, 1–15.

Lailani, M. T. (2013). Hubungan antara peningkatan indeks massa tubuh dengan kejadian nyeri punggung bawah pada pasien rawat jalan di Poliklinik Saraf RSUD Dr. Soedarso Pontianak. *Jurnal Mahasiswa PSPD FK Universitas Tanjungpura, 1(1)*, 1–15.

Long, B. W., Rollins, J. H., & Smith, B. J. (2019). *Merrill's Atlas of Radiographic Positioning and Procedures* (14th ed.). Mosby.

Maher, C., Underwood, M., & Buchbinder, R. (2017). Non-specific low back pain. *The Lancet Global Health*, 736–747.

Manaster, B. J., May, D. A., & Disler, D. G. (2014). Musculoskeletal Imaging: The Requisites. *Elsevier Health Sciences*, *4th*.

Organization, W. H. (2023). *Low back pain: A major global public health issue (WHO bulletin).* https://www.who.int/news/item/26-07-2023-low-back-pain-a-major-global-public-health-issue

Pearce, E. C. (2013). *Anatomi dan Fisiologi untuk Paramedis* (33rd ed.). Gramedia Pustaka Utama.

Rasad. (2015). *Dasar-dasar Radiologi* (7th ed.). EGC.

RI., K. (2018). *edoman manajemen nyeri punggung bawah (Low Back Pain/LBP) di pelayanan kesehatan primer*.

Trikasjono, T., Hanifasari, K., & Suhendro, B. (2015). Analisis paparan radiasi lingkungan ruang radiologi di rumah sakit dengan program Delphi. *Jurnal Teknologi Elektro*, *6(3)*, 158. https://doi.org/10.22441/jte.v6i3.803

Utami, D. (2011). Pengaruh variasi penyudutan arah sinar pada pemeriksaan vertebra lumbosacral joint proyeksi lateral terhadap kriteria anatomi radiograf. *JURNAL UWHS*.

Widyaningrum, T. S., Suhariningsih, I., & Nurhayati, S. (2018a). Evaluasi Sudut Arah Sinar Terhadap Hasil Radiografi Proyeksi Lateral Lumbal. *Jurnal Radiologi Indonesia*, *7 (1)*, 15–21.

Widyaningrum, T. S., Suhariningsih, I., & Nurhayati, S. (2018b). Evaluasi Sudut Arah Sinar Terhadap Hasil Radiografi Proyeksi Lateral Lumbal. *Jurnal Radiologi Indonesia*, *7 (1)*, 15–21. https://journal.uwhs.ac.id/index.php/jitk/article/view/364

Wu, A., March, L., Zheng, X., Huang, J., Wang, X., Zhao, J., & Hoy, D. (2020). Global low back pain prevalence and years lived with disability. *Annals of Translational Medicine*, *8 (6)*, 299.