



Original Article

Accuracy of the kissing sign on lumbar spine MRI in cases of axillary disc herniation and the surgical correlation: an Indian multi-center study[☆]



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ABSTRACT

Objectives: Magnetic resonance imaging has proven to be a valuable tool in the assessment of disc abnormalities. Two types of disc extrusion can be described according to the direction of herniated disc material: shoulder type and axillary type. Axillary disc herniation is described when the extruded disc fragment lies in the recess between the lateral border of cauda equina and medial to the nerve roots, while in the shoulder type the disc lies lateral to the nerve roots. It is very important to describe the type of disc herniation, as the surgical approach differs in each type. To the best of the authors' knowledge, no definite signs have been described in literature to date. This study aimed to address the accuracy of the kissing sign on MRI for the diagnosis of axillary disc herniation.

Methods: The MRIs of 72 patients undergoing spinal surgery were prospectively evaluated for axillary disc herniation by a senior radiologist and experienced spinal surgeon using the kissing sign on MRI. The kissing sign was considered positive when the herniated disc material was in direct contact with the lamina and/or ligamentum flavum on axial images. Subsequently, all surgeries were performed by two independent surgeons and the actual type of disc herniation was documented. The accuracy of the results was statistically assessed.

Results: The kissing sign on MRI was found to be 66.66% sensitive, 92.59% specific, and 76.38% accurate in detecting axillary disc herniation with significant correlation with the surgical findings.

Conclusion: The type of disc herniation is an important parameter for patient selection in different surgical approaches. The kissing sign on MRI can be considered as an important tool for diagnosing axillary disc herniation due to its high specificity and accuracy.

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[☆] Study conducted at Dr. B. L. Kapur Hospital, New Delhi; and Apollo Hospitals International Limited, Gandhinagar, India.

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Precisão do sinal do beijo na RM da coluna lombar em casos de hérnia do disco axial e a correlação cirúrgica: um estudo multicêntrico indiano

R E S U M O

Palavras-chave:

Deslocamento do disco
intervertebral
Ressonância magnética
Coluna/cirurgia

Objetivos: A ressonância magnética provou ser uma ferramenta valiosa na avaliação das anormalidades do disco. Dois tipos de extrusão de disco podem ser descritos de acordo com a direção do disco herniado: lateral e axilar. A hérnia de disco axilar é definida quando o fragmento do disco extruso encontra-se no recesso entre a borda lateral da cauda equina e medial às raízes do nervo, enquanto na hérnia lateral o disco posiciona-se lateralmente às raízes do nervo. A descrição do tipo de hérnia de disco é extremamente importante, pois a abordagem cirúrgica difere em cada tipo. Tanto quanto é do conhecimento dos autores, nenhum sinal definido foi descrito na literatura até o momento. Este estudo teve como objetivo abordar a precisão do sinal do beijo na RM no diagnóstico de herniação de disco axilar.

Métodos: As RM de 72 pacientes submetidos à cirurgia da coluna vertebral foram avaliadas prospectivamente em relação à presença de hérnia de disco axilar por um radiologista sênior e cirurgião da coluna experiente usando o sinal do beijo na RM. O sinal do beijo foi considerado positivo quando o material do disco herniado estava em contato direto com a lâmina e/ou ligamento amarelo em imagens axiais. Posteriormente, todas as cirurgias foram realizadas por dois cirurgiões independentes e o tipo real de hérnia de disco foi documentado. A precisão dos resultados foi avaliada estatisticamente.

Resultados: O sinal do beijo na RM apresentou 66,66% de sensibilidade, 92,59% de especificidade e 76,38% de precisão na detecção de hérnia de disco axilar com correlação significativa com os achados cirúrgicos.

Conclusão: O tipo de hérnia de disco é um parâmetro importante para a seleção de pacientes em diferentes abordagens cirúrgicas. O sinal do beijo na RM pode ser considerado uma ferramenta importante para o diagnóstico de hérnia de disco axilar devido à sua alta especificidade e precisão.

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Introduction

Magnetic resonance imaging (MRI) has been an indispensable tool for the spine surgeon. Its value in assessing normal spinal anatomy, features of degenerative spine, and in diagnosing herniated spinal discs has been well documented.¹ Accordingly, MRI is used for assessing type of disc herniation recommended by the combined task forces of the North American Spine Society, the American Society of Spine Radiology and the American Society of Neuroradiology.²⁻⁴ Fig. 1 shows the normal anatomy of spine with corresponding schematic diagram. Any disc material extending beyond the vertebral bodies is considered a herniated disc. This is described further as 'disc bulge', 'protrusion', 'extrusion' and 'sequestration'.²⁻⁴ Extruded disc can also be classified into shoulder type and axillary type according to the direction of herniated disc⁵ (Fig. 2). This nomenclature is not included in standard nomenclature that is used commonly in radiology.²⁻⁴

Axillary disc herniation is a type of disc extrusion, which affects both exiting and descending nerve roots. The extruded material travels posteriorly into the axilla between the nerve roots laterally and thecal sac medially.⁶ In shoulder type of disc extrusion, the extruded disc material lie lateral or ventral to nerve root on axial images. As the surgical approach

to the disc herniation is different according to the direction of the disc material, nomenclature and the identification of this disc herniation is almost important.⁵⁻⁷ As per our best of knowledge, there is no definite sign has been describe for the diagnosis of axillary disc herniation.

Material and methods

The institutional ethical committee of both institutes approved the study.

The MR images of seventy-two consecutive patients meeting the following criteria were included in this study:

- (1) The MRI was performed using a 1.5 T superconductive unit (Siemens Magnetom) in two different hospitals, Dr. B. L. Kapur Hospital, New Delhi and Apollo Hospitals International Limited, Gandhinagar, Gujarat.
- (2) Both T1 and T2 axial images were available and were of high quality.
- (3) Cases of disc extrusion were included.

The age of the patients ranged from 31 to 75 years and averaged 47 years. There were 33 males and 39 females.

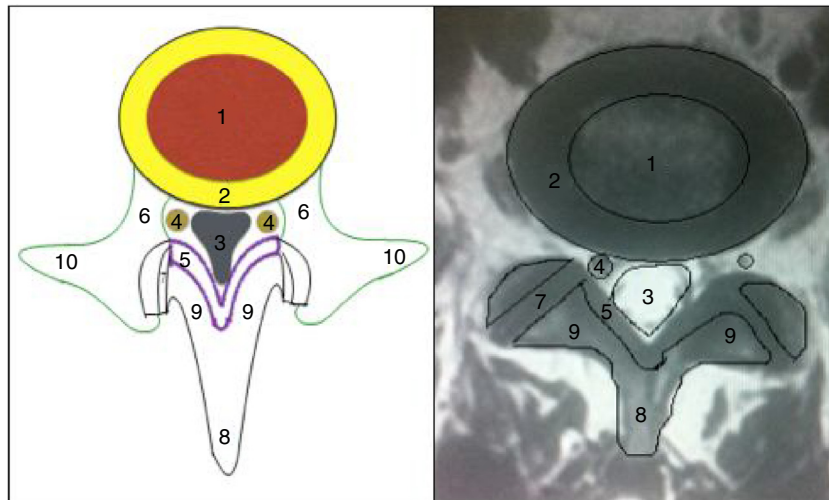


Fig. 1 – Schematic and axial T2W MR image showing normal anatomy at intervertebral disc level. 1, disc nucleus; 2, disc annulus; 3, Thecal sac; 4, Nerve roots; 5, Ligamentum flavum; 6, Pedicle; 7, Facet joint; 8, Spinous process; 9, Lamina; 10, Transverse process.

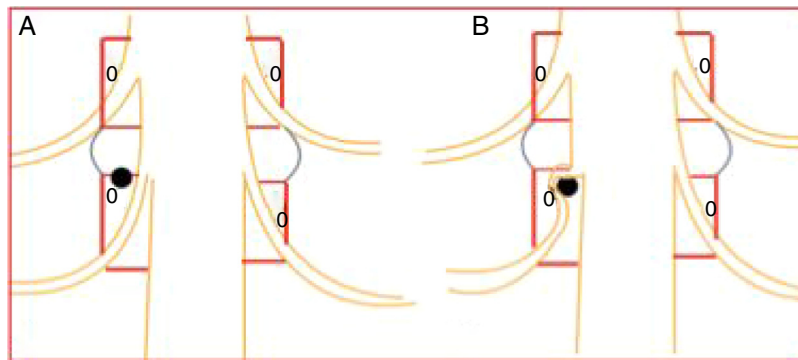


Fig. 2 – Schematic diagram showing type of extrusion disc herniation; Shoulder type (A) and Axillary type (B).

All surgeries were performed within a one-year time interval.

The MR images of seventy-two patients were read independently and blinded to all clinical and surgical information by two readers; a senior radiologist specializing in spine MRI and an experienced spine surgeon.

The readers independently classified the herniations using “Kissing sign” on axial MRI images as follows:

- (1) Axillary disc herniation: Direct contact of herniated disc material with lamina and/or ligamentum flavum on axial images-Kissing sign (Fig. 3).
- (2) Shoulder disc herniation: The herniated disc material lateral (Fig. 4) or ventral (Fig. 5) to nerve root on axial images.

These readings were then compared with the intra-operative findings. All surgeries performed by two independent surgeons and the disc herniations were classified intra-operatively into shoulder and axillary type (Table 1). The surgeons were blinded to the MRI readings.

Statistical breakdown of the MRI readings into four groups (true and false positives and true and false negatives) allowed assessment of sensitivity, specificity, and accuracy using

standard calculations as well as ROC (Receiver Operating Characteristic) graphic evaluation. The comparison between MRI diagnosis and surgical outcome was done using Pearson Correlation Test using Statistical Package for the Social Sciences (SPSS) version 17.0 [Correlation is significant at the 0.01 level (2-tailed)].

Observation and result

Out of 100 patients who had undergone MRI, 72 patients were included in the study according to the inclusion criteria. On the basis of “Kissing sign” for axillary disc herniation, 32 patients were classified as axillary disc herniation and 40 patients as shoulder disc herniation. These patients underwent surgery and intra-operative pathology of axillary disc herniation was documented in 45 patients and shoulder disc herniation in 27 patients. On the basis of “Kissing sign”, 15 were false negative and 30 were true positive for of axillary disc herniation. There were 2 false positive and 25 true negative diagnoses (Table 2). Overall, sensitivity was 66.66%, specificity 92.6%, with accuracy of 76.38% for “Kissing sign” in detecting axillary disc herniation. The positive predictive value was 93.75% and the negative predictive value was 62.5%. The true

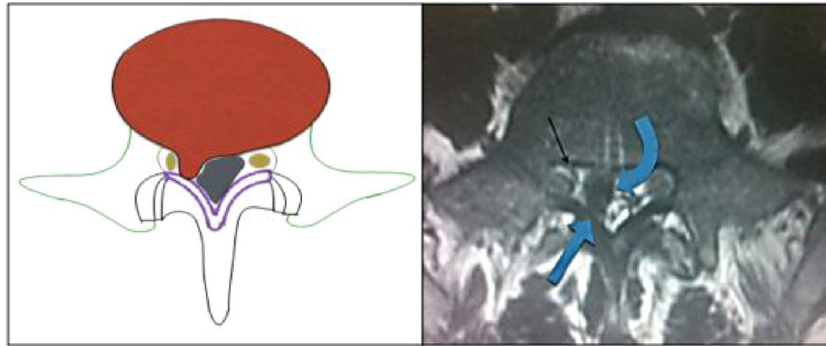


Fig. 3 – Schematic diagram and MR axial T2W images showing axillary disc herniation: The extruded disc material causing compression over thecal sac medially and lateral displacement of nerve roots (black arrow). The extruded disc material (curved blue arrow) is in direct contact with ligamentum flavum (straight blue arrow), a pathognomonic feature for diagnosis of axillary disc herniation – “Kissing sign”.

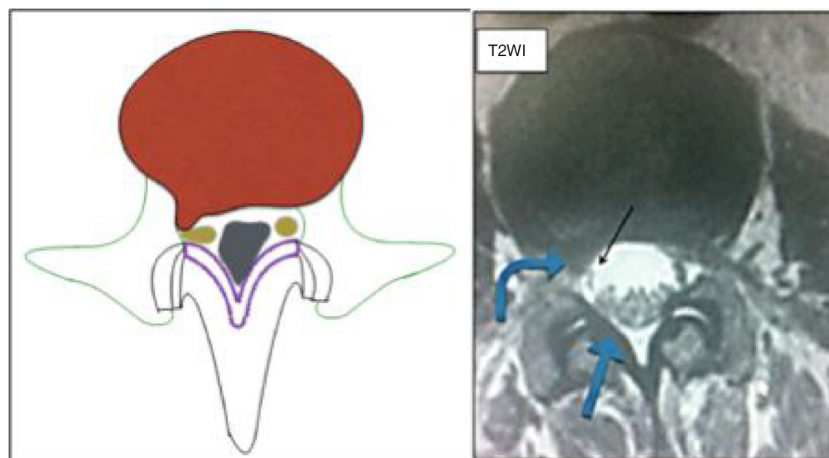


Fig. 4 – Schematic diagram and MR axial T2W images showing shoulder type of disc herniation with disc material (curved blue arrow) lateral to nerve roots (black arrow). In this case disc material is not touching the ligamentum flavum (straight blue arrow) directly.

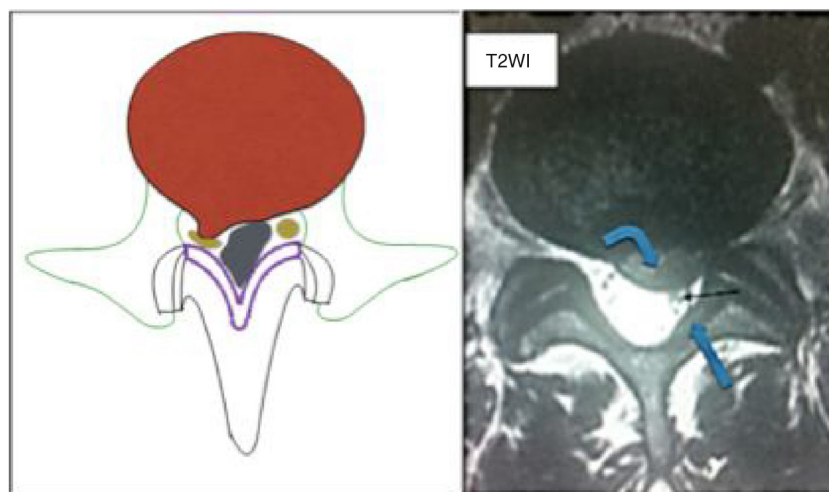


Fig. 5 – Schematic diagram and MR axial T2W images showing shoulder type of disc herniation with disc material (curved blue arrow) lies ventral to nerve roots (black arrow). In this case disc material is not touching the ligamentum flavum (straight blue arrow) directly.

Table 1 – Institute wise MRI and surgical data.

	Axillary disc herniation	Shoulder disc herniation	Total
Group 1 ^a	28	15	43
Group 2 ^b	17	12	29
	45	27	72

^a MRI and surgery done in Dr. B. L. Kapur Hospital, New Delhi, India.
^b MRI and Surgery done in Apollo Hospitals International Limited, Gandhinagar, India.

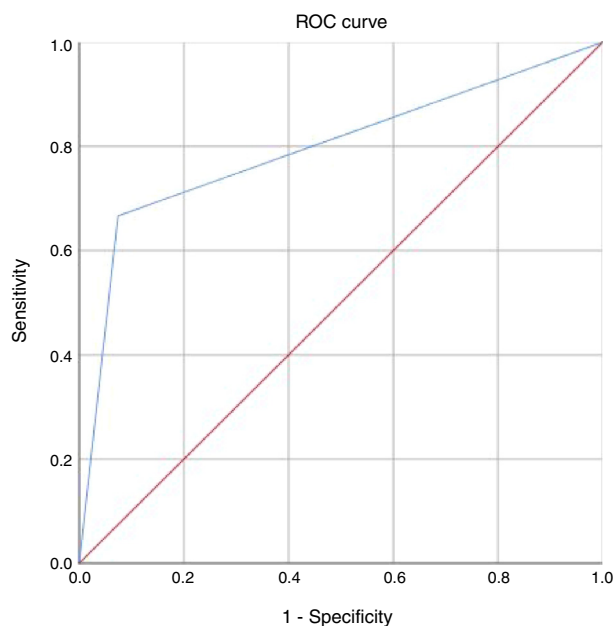
Table 2 – A 2 × 2 contingency table of “Kissing sign” for axillary disc herniation.

	Surgery outcome		Total
	Axillary disc herniation	Shoulder disc herniation	
“Kissing sign” on MRI			
Axillary disc herniation	30	2	32
Shoulder disc herniation	15	25	40
Total	45	27	72

positive rates were 0.66 and false positive rate was 0.07. The ROC graph is depicted in Fig. 6. The inter-observer agreement was .90 with a Kappa of .796 at 95% confidence. Outlying cases were resolved by consensus between the two readers. The study shows significant correlation between the “Kissing sign” on MRI and surgical outcome for the axillary disc herniation (Table 3).

Discussion

Any disc material extending beyond the vertebral bodies is considered a herniated disc, which is described further as ‘disc bulge’, ‘protrusion’, ‘extrusion’ and ‘sequestration’.² The term

**Fig. 6 – The ROC graph for MRI detection of axillary disc herniation.****Table 3 – Correlation between “kissing sign” and surgical outcome.**

	Test	Outcome
Test		
Pearson correlation	1	.577 ^a
Sig. (2-tailed)		.000
n	72	72
Outcome		
Pearson correlation	.577 ^a	
Sig. (2-tailed)	.000	
n	72	72

^a Correlation is significant at the 0.01 level (2-tailed).

“bulge” described as an apparent generalized extension of disc material beyond the edges of the apophyses. Bulging occurs in greater than 50% of the disc circumference and extends usually less than 3 mm, beyond the edges of the apophyses.^{2,3} A disc is considered “protruded,” if the greatest plane, in any direction, between the edges of the disc material beyond the disc space is less than the distance between the edges of the base, when measured in the same plane. Protrusions may be “focal” (protrusion with a base less than 25% (90°) of the circumference of the disc) or “broad-based” (herniated disc material encompasses 25–50% of the circumference of the disc).²⁻⁴ The herniated disc is defined as an extruded disc, if the disc material, in at least one plane, any one distance between the edges of the disc material beyond the disc space is greater than the distance between the edges of the base measured in the same plane.²⁻⁴ Extruded disc material that has no continuity with the disc of origin is further characterized as “sequestered”.²⁻⁴ disc material that is displaced away from the site of extrusion, regardless of continuity, is considered as “migrated” disc.²⁻⁴

The extruded disc may be further classified according to the direction of herniated disc into shoulder and axillary type of disc herniation.⁵ Axillary disc herniations affect both exiting and descending nerve roots. It is commonly treated by inter laminar percutaneous endoscopic lumbar discectomy. There are two types of inter laminar approaches: shoulder type and axillary type, depending upon the type of disc herniation.⁸ So, it is important to differentiate these two types of disc herniation as the inappropriate approach to a specific disc herniation lead to failure of the procedure and necessitates the second attempt and other approach.⁹⁻¹¹

The present study described an important sign, which shows fairly good sensitivity but very good specificity with good accuracy in the diagnosis of axillary disc herniation on axial images of MRI.

In axillary disc herniation, the extruded material travels posterior and pushes the nerve roots laterally and thecal sac medially and thus come in direct contact with ligamentum flavum and/or lamina – “Kissing sign”. In shoulder type of disc herniation, the extruded disc material lies lateral to nerve root on axial images. The roots when pushed posteriorly by the extruded disc lie close to the ligamentum flavum and/or lamina but disc fragment never seen touching above two structures (Fig. 3). This sign relies upon disc material in

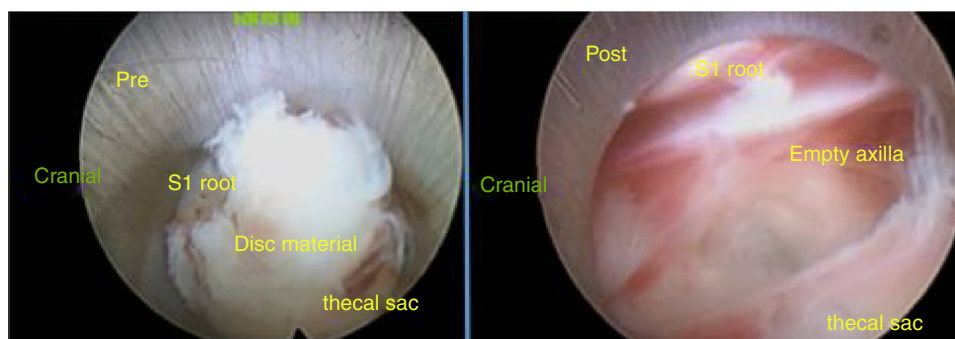


Fig. 7 – Intraoperative images of pre-removal of axillary disc herniation showing disc material in between the nerve roots and thecal sac, while after removal of disc material, the axilla is empty.

direct contact with lamina and/or ligamentum flavum on axial images.

The endoscopic surgery was done through inter-laminar approach for axillary disc herniation while trans-pedicular approach was used for shoulder disc herniation. A total 32 cases were diagnosed as axillary disc herniation on MRI axial images, out of which 30 cases were confirmed on surgery and only two cases were false positive. Sign was not able to diagnosed axillary disc herniation in 15 cases. The herniated disc material was easily removed by the inter-laminar approach (Fig. 7).

We found statistical correlation between “Kissing sign” and surgical outcome, thus pathognomic in the diagnosis of axillary disc herniation ($p=0.000$). Type of disc herniation according to its direction is an important aspect in deciding surgical approach; this sign can be useful for the evaluation of axillary disc herniation.

In summary, we have found “Kissing sign” to be 66.66% sensitive, 92.59% specific, and 76.38% accurate in detecting axillary disc. MRI alone may provide positive predictive value of 93.75% with negative predictive value of 62.5%.

Conclusion

The present study described an important sign – “Kissing sign” for the diagnosis of axillary disc herniation, which relies upon the disc material in direct contact with lamina and/or ligamentum flavum on axial images. Furthermore, the study showed a statistically significant correlation between the “Kissing sign” on MRI and surgical findings.

Conflicts of interest

The authors declare no conflicts of interest.

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