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SCIATICA: DIAGNOSTIC CONSIDERATIONS

CIÁTICA: CONSIDERAÇÕES SOBRE O DIAGNÓSTICO

CIÁTICA: CONSIDERACIONES DIAGNÓSTICAS

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ABSTRACT

This study investigates the relevance of computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnosis of root compressions of bony or calcified origin, considering the challenges imposed by the multifactorial etiology of sciatica. The research also reviews advances in understanding the discogenic and non-discogenic causes of the condition, in addition to discussing the limitations of the clinical evaluation of dermatomes, often marked by overlaps and anatomical variability. The analysis of a clinical case involving a 59-year-old patient with left-sided lumbosciatic pain allowed a precise correlation between clinical and radiological findings, highlighting the importance of an integrated diagnostic approach. Computed tomography revealed the presence of a calcified juxtafacet cyst and marginal osteophytes, both directly contributing to root compression. In contrast, MRI was limited in fully elucidating the etiology. Surgical treatment, performed via transforaminal endoscopic approach, resulted in complete symptom relief, significant functional improvement, and early return to daily activities. The findings of this study reinforce the complementary role of imaging techniques in the diagnosis of sciatica and suggest a more careful evaluation of dermatomes in the clinical setting. The adoption of multimodal approaches contributes to greater diagnostic accuracy and therapeutic efficacy, promoting better clinical outcomes for patients affected by radicular syndromes. ***Level of Evidence III; Review Article.***

Keywords: Sciatic Nerve; Pain; Tomography, X-Ray Computed; Magnetic Resonance Spectroscopy; Minimally Invasive Surgical Procedures.

RESUMO

Este estudo investiga a relevância da tomografia computadorizada (TC) e da ressonância magnética (RM) no diagnóstico de compressões radiculares de origem óssea ou calcificada, considerando os desafios impostos pela etiologia multifatorial da ciática. A pesquisa também revisa os avanços no entendimento das causas discogênicas e não discogênicas da condição, além de discutir as limitações da avaliação clínica dos dermátomos, frequentemente marcados por sobreposições e variabilidade anatômica. A análise de um caso clínico envolvendo uma paciente de 59 anos com quadro de lombociatalgia à esquerda permitiu uma correlação precisa entre os achados clínicos e radiológicos, evidenciando a importância de uma abordagem diagnóstica integrada. A tomografia computadorizada revelou a presença de um cisto parafacetário calcificado e osteófitos marginais, ambos contribuindo diretamente para a compressão radicular. Em contrapartida, a RM mostrou-se limitada na elucidação completa da etiologia. O tratamento cirúrgico, realizado por via endoscópica transforaminal, resultou em alívio completo dos sintomas, melhora funcional significativa e retorno precoce às atividades cotidianas. Os achados deste estudo reforçam o papel complementar das técnicas de imagem no diagnóstico da ciática e propõem uma avaliação mais criteriosa dos dermátomos no contexto clínico. A adoção de abordagens multimodais contribui para maior precisão diagnóstica e eficácia terapêutica, promovendo melhores desfechos clínicos para pacientes acometidos por síndromes radiculares. ***Nível de Evidência III; Artigo de Revisão.***

Descritores: Nervo Isquiático; Dor; Tomografia Computadorizada por Raios X; Espectroscopia de Ressonância Magnética; Procedimentos Cirúrgicos Minimamente Invasivos.

RESUMEN

Este estudio investiga la relevancia de la tomografía computarizada (TC) y la resonancia magnética (RM) en el diagnóstico de la compresión radicular de origen óseo o calcificado, considerando los desafíos que plantea la etiología multifactorial de la ciática. La investigación también revisa los avances en la comprensión de las causas discogénicas y no discogénicas de la afección, y analiza las limitaciones de la evaluación clínica de los dermatomas, que a menudo se caracterizan por la superposición y la variabilidad anatómica. El análisis de un caso clínico de un paciente de 59 años con dolor lumbociático izquierdo permitió una correlación precisa entre los hallazgos clínicos y radiológicos, destacando la importancia de un enfoque diagnóstico integrado. La tomografía computarizada reveló la presencia de un quiste parafacetario calcificado y osteofitos marginales, ambos contribuyendo directamente a la compresión radicular. Por el contrario, la resonancia magnética fue limitada para esclarecer completamente la etiología. El tratamiento quirúrgico, realizado mediante abordaje endoscópico transforaminal, resultó en un alivio completo de los síntomas, una mejora funcional significativa y una reincorporación temprana

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a las actividades cotidianas. Los hallazgos de este estudio refuerzan el papel complementario de las técnicas de imagen en el diagnóstico de la ciática y sugieren una evaluación más cuidadosa de los dermatomas en el ámbito clínico. La adopción de abordajes multimodales contribuye a una mayor precisión diagnóstica y eficacia terapéutica, promoviendo mejores resultados clínicos para los pacientes con síndromes radiculares. ***Nivel de Evidencia III; Artículo de Revisión.***

Descriptores: Nervio Ciático; Dolor; Tomografía Computarizada por Rayos X; Espectroscopía de Resonancia Magnética; Procedimientos Quirúrgicos Mínimamente Invasivos.

INTRODUCTION

The term "sciatica" has deep historical roots and literally means "relative to the hip". This condition was already described in ancient manuscripts by Greek, Roman, Arab, Jewish and Persian doctors, evidencing its long history as a diagnostic challenge. Currently, its annual incidence varies between 1% and 5%, while the average prevalence revolves around 18%, and can oscillate from 1.6% to 43%, depending on the studied population. It is estimated that between 5% and 10% of patients with lumbar pain have symptoms of sciatica. It is important to note that sciatica is a symptom, not a disease itself, and can be of discogenic origin (in about 85% of cases), non-discogenic (10%) or extra-spinal (5%), generally related to the vertebral segment[1].

In-depth knowledge of the etiology of sciatica is essential for an accurate diagnosis and for the formulation of effective therapeutic strategies. Diagnostic difficulties are largely due to the variability of the anatomical sites responsible for symptoms, as well as changes in clinical characteristics as the pathological process becomes chronic. Among the most common causes of sciatic pain is lumbar disc hernia, which poses a challenge for both diagnosis and treatment, and can result in inadequate therapeutic approaches or clinical failures[1].

Thus, the evaluation of patients with sciatica should follow the fundamental principles of medical semiology, including a detailed history, thorough physical examination, careful neurological evaluation and the conduct of relevant complementary examinations. This integrated approach is essential to ensure an accurate diagnosis and the definition of an appropriate treatment, aligned with the etiology and complexity of the clinical picture.

The aim of this study is to explore the definition of sciatica, its differential diagnosis and the main clinical difficulties, especially in the evaluation of the symptoms distributed along the dermatomes and in the interpretation of imaging exams. It is also sought to illustrate the relevance of computed tomography and magnetic resonance imaging in the diagnosis of root compressions, supplementing the analysis with the presentation of a clinical case.

REVISION

Sciatica

Although sciatica has been identified and described for many centuries, there is still a lack of consensus on its definition, both among health professionals and patients. Among the main definitions presented are:

- " Pain along the path of the sciatic nerve or its branches, especially in the leg, caused by compression, inflammation or reflex mechanisms; widely: pain in the lumbar region, buttocks, hips or adjacent parts"[2].
- " Pain along the path of the sciatic nerve, usually neuritis. It is accompanied by paresthesia of the thigh and leg, sensitivity along the course of the nerve and, sometimes, atrophy of the calf muscle"[3].
- "Pain radiated from the buttock to the thigh, pantyhose and occasionally the foot. Although it is in the distribution of the sciatic nerve, sciatica is rarely caused by a disease of that nerve. The pain felt in the back and lateral face of thigh, leg and foot is often caused by degeneration or displacement of the intervertebral disc, which compresses and irritates the lower lumbar nerve root or upper sacral nerve root"[4].

Sciatica is characterized by pain or paresthesia due to inflammation of nerve roots originating in the spinal cord, specifically between the levels L4 and S3, which make up the sciatic nerve. These roots emerge in the region of the lateral recess and follow the intervertebral foramen[5,6,7]. The most common causes are associated with degenerative changes in the spine, such as disc hernia, foraminal stenosis and lateral recess. Among the main structural findings, disc blurings, hypertrophy of the joint facets, marginal osteophytes, hypertrophy of the yellow ligament and juxtafacet cysts are highlighted[5,8,9,10].

Radiated pain along the lower limb is often attributed to sciatica, although it may actually correspond to other clinical conditions, such as femoral neuralgia or cruralgia, which reinforces the need for accurate diagnostic assessment. The absence of a universally accepted definition for sciatica contributes to this confusion, and several etiological classifications have been proposed[1], varying according to different criteria: topographic location (in relation to the spine, central nervous system or the sciatic nerve itself), specific population (such as in paediatric, elderly or pregnant patients, whose clinical manifestations may differ significantly), pathological categories (including infectious, congenital, inflammatory, neoplastic, iatrogenic, among others) and functional etiology (such as discogenous causes, non-discogenous intra-spine and extra-spine, each with distinct implications for diagnosis and treatment).

The highest percentage of "sciatica" is caused by diseases of the intervertebral disc (85%), and is referred to as discogenic ciatic. About 10% of sciatica are caused by non-discogenic vertebral pathological changes, while 5% are of extravertebral origin[1].

Sciatic nerve

The sciatic nerve originates from the ventricular roots of the lumbar spine, covering levels from L4 to S3, and incorporates anterior and posterior fibers of the lombosacral plex. This plexus is formed by the union of the lombosacral trunk (L4–L5) with the sacral spinal nerves (S1–S4), forming a complex neural network known as sacral plexus.

Recognized as the largest and longest nerve in the human body, the sciatic nerve travels an extensive path from its origin in the lumbar region to its bifurcation in the popliteal fossa, where it divides into the tibial and fibular nerves common. Among the main branches derived from the sacral plexus, stand out: the upper gluteal nerve, the lower gluteal nerve, the sciatic nerve, the posterior skin nerve of the thigh and the pudendum nerve.

Functionally, the sciatic nerve is responsible for controlling the posterior musculature of the knee and leg, as well as driving the sensitivity of the posterior region of the thigh, the lower part of the leg and the foot.

Clinical framework and diagnosis

Detailed history and thorough clinical examination are essential for the accurate diagnosis of sciatica, as well as for the identification of its etiology and definition of the appropriate treatment. It is essential to distinguish the painful symptoms of neurogenic origin from those of non-neurogenic nature, in addition to distinguishing the root signs, which are the most prevalent, from the symptoms related to the nervous plexus or the peripheral nerves.

In addition, the analysis of the characteristics of pain, including type, location, irradiation pattern, relief and aggravation factors, presence of sphincterial alterations and clinical history, contributes significantly to the diagnostic guidance. Among the physical tests, the lower limb raise test (*Straight Leg Raise Test*) remains the most widely used in the assessment of ciatology, being highly sensitive to detect root impairment[5,11,12].

Complementary examinations play a key role in confirming the diagnosis, providing crucial information, such as the location of the affected level, the type of compression and the evaluation of the lateral recess, which guide the indication and planning of surgical treatment. The examination of the dermatomes, an integral part of the clinical evaluation, allows to identify the compromised nerve root based on the distribution of symptoms, such as pain and sensitivity changes. However, the interpretation of this information is still subject to controversy in the literature.

Dermatomes

Dermatomes are widely used in clinical evaluation, especially in the identification of the affected nerve root. However, its historical origin and limited correlation with intraoperative findings are little discussed. The initial description was made by Sir Charles Sherrington in the 19th century, with studies in *rhesus* monkeys that identified areas of skin sensitivity after dorsal root sections[13]. In the 1930s, Otfrid Foerster mapped human dermatomes through rhizotomies, associating nerve roots with specific sensory territories[14]. Subsequently, Keegan and Garrett, in the late 1940s, correlated clinical symptoms of radical compression with the distribution of dermatomes, deepening their understanding of disc lesions[15].

Despite these advances, the original mapping was based on skin sensitivity tests, while today dermatomes are often used to locate root pain, which can generate inaccurate interpretations. Recent studies point to limitations in this approach, due to the overlap between dermatomes and individual variations.

Taylor et al. (2013)[16] demonstrated that, even in patients with radiological confirmation of L5 or S1 impairment, the skin identification of pain in the lower limbs did not allow precise distinction of the affected root. Furman and Johnson (2019)[17], when inducing pain through injections, observed wide variability in pain patterns among individuals. Only cases of S1 lesions corresponded to traditional dermatomes; in two-thirds of patients, the pain did not follow the classical distribution.

Lee et al. (2008)[18] proposed an evidence-based map of dermatomes, revealing that L4 inert the medial part of the leg, without involving the thigh or knee, and that L5 does not present a continuous trajectory. S1 retains a broad distribution, compatible with previous descriptions. In addition, the complex network of interconnections between nerve roots can generate anatomical and functional variations, making direct correlation between symptoms and dermatomes difficult.

Image Examinations

Imaging examinations play an essential role in the identification and characterization of root compression. Currently, the most widely used methods in the evaluation of the spine include radiographs, computed tomography, myelography, magnetic resonance imaging, bone scintigraphy and PET scan (Positron Emission Tomography)[19,20].

The simple radiographs, in the anteroposterior (AP) and profile projections, are used to evaluate the alignment of the spine, in addition to identifying degenerative changes and instabilities (dynamic radiographs). Among the complementary examinations, magnetic resonance imaging is highlighted, considered the gold standard in the evaluation of neural structures and intervertebral discs. Although computed tomography has been largely replaced by resonance imaging in sciatology research protocols, it still plays a relevant role, especially in the detailed analysis of bone structures and in cases with contraindication to resonance imaging[10,21,22].

Magnetic resonance imaging is the test of choice to evaluate radical compression by discoligmental structures, allowing detailed analysis of paravertebral muscles, intervertebral discs, vertebral canal, lateral recess, foramens and dural bag content. Based on radio frequency waves, without the use of ionizing radiation, the technique uses different sequences to distinguish tissues. Weighted images in T1, with hypersinal for fat, are ideal for evaluating fat-rich structures, such as the intervertebral foramen and bone marrow. The images in T2, which highlight water and fat, are more suitable for investigating intervertebral discs and inflammatory processes, accurately evidencing the relationship between anatomical and neural structures[23,24].

Radical compression by bone or calcificated structures is best detected by computed tomography (TC), considered the ideal test for bone evaluation. Based on the principles of radiography, CT uses photons that are absorbed by dense tissues, allowing to detail fractures, lytic lesions and degenerative arthropathies. These can cause sclerosis, osteophytes, reduced joint space and subchondral changes. CT is also effective in analyzing the degree of narrowing of the vertebral canal, lateral recess and intervertebral forums due to bone alterations[23]. With technological advances, computed tomography scanners have become capable of visualizing not only bony structures but also soft tissues, such as disc protrusion and ligamentum flavum hypertrophy[25].

CASE REPORT

This study was approved by the Research Ethics Committee of the Samaritan Hospital under protocol no. 3540420.5.0000.5487.

Female patient, 59 years old, with lumbociatalgia on the left. No comorbidities or relevant personal history. The pain was measured by the analogue visual scale (EVA), differentiating between lumbar pain and irradiated pain. The pain radiated to the left lower limb was graduated in 8/10, predominating in the gluteal region and the back face of the thigh. Lower back pain was also rated as 8/10. The leg lift test showed positive on the left.

In addition to the pain, the patient presented hypoesthesia in the lateral face of the left thigh, with no signs of motor deficit. The patellar reflexes were preserved bilaterally, with symmetry and amplitude within normal parameters. The functional evaluation, performed using the Oswestry Incapacity Index, indicated a score of 50%, characterizing the picture as of serious incapacity.

Imaging examinations were performed, including simple X-rays, MRI and computed tomography. The X-rays, obtained in orthostasis at the static (anteroposterior and profile) and dynamic positions (hyperflexion and hyper-extension profile), covered the lumbar region and the spine in a panoramic view (Figure 1). The main findings included degenerative changes with reduced height of the intervertebral disc in L4-L5. No signs of instability were observed, and the sagital and coronal alignment were within normality patterns.

Magnetic resonance imaging revealed degenerative changes in the L4-L5 level, with terminal plaque sclerosis, collapse of the intervertebral disc and diffuse and symmetrical disc blurring. Bilateral stenosis of the lateral recess was observed, with no other relevant findings for clinical correlation (Figure 2 and 3).

The computed tomography confirmed degenerative changes in the L4-L5 level and allowed the identification of specific findings that corroborate the clinical picture of sciatica on the left. In addition to the bilateral facetary hypertrophy in L4-L5, the presence of a calcificated parafacetary cyst was observed on the left. Marginal osteophytes were also identified in the upper terminal plate of L5, predominating

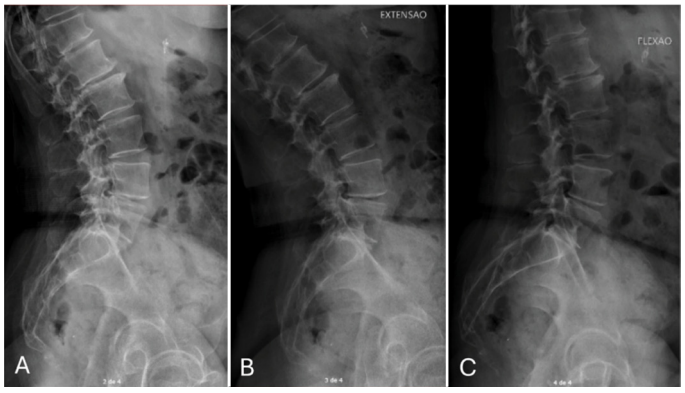

Figure 1. Radiographic profile images in static position (A), in hyperextension (B) and hyperflexion (C).

in the left post-lateral portion, contributing to the stenosis of the lateral recess and the ipsilateral intervertebral foramen (Figure 4).

Endoscopic transforaminal root decompression was performed at the level L4-L5 on the left. The procedure included extensive foraminoplasty with extraforaminal approach of the joint facets, extending to the anatomical limit of the lateral recess. Subsequently, the resection of marginal osteophytes of the upper plateau of L5 was carried out. There was no need for direct intervention on the intervertebral disc. The descending (L5) and emerging (L4) nerve roots were visualized free, with no signs of residual compression.

The patient evolved without intraoperative or postoperative intercourse. Reported complete resolution of the left lower limb sciatology and partial improvement of the previously described hypoesthesia. He was discharged five hours after the procedure, showing a bilateral negative limb elevation test. Pain, previously graded as 8/10 on the visual analogue scale (VAS), was reduced to 0/10 in both the lumbar region and the lower limb. The Oswestry Disability Index functional assessment indicated a score of 8%, which is compatible with minimum disability.

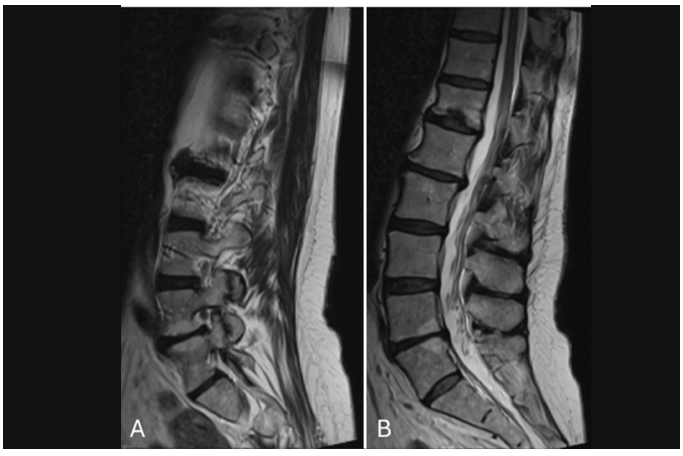

Figure 2. Magnetic resonance imaging, sagittal cutting, showing degenerative changes in L4-L5 level, with sclerosis in the terminal plaques and collapse of the intervertebral disc (A, B).

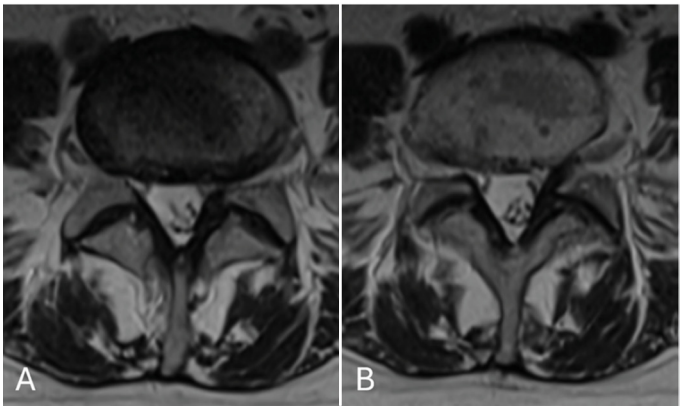

Figure 3. L4-L5 level magnetic resonance imaging showing bilateral lateral recess stenosis (A,B).

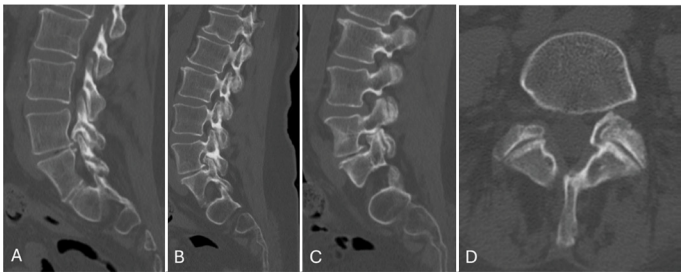

Figure 4. Computerized tomography showing vertebral degeneration at L4-L5, osteophytes (A, B) and calcificated parafacetary cyst (B, C). D: Axial cut of computed tomography demonstrating marginal osteophytes in the vertebral body of L5, located predominantly in the left portion, contributing to the stenosis of the lateral recess and the ipsilateral intervertebral foramen.

DISCUSSION

The description of human dermatomes by Sherrington and Foerster established the anatomical and functional foundations for the evaluation of the distribution of symptoms in sciatica. However, studies such as those of Taylor et al. (2013)[16] and Lee et al. (2008)[18] question the accuracy of classical dermatomes in the identification of the affected nerve root, highlighting that overlaps between sensory territories and individual variations can make direct clinical correlation difficult and compromise diagnostic accuracy.

In the case described, the pain located in the gluteal region and in the back face of the thigh has an anatomical correlation with the inervation of sacred roots, especially S1. The absence of discal hernia, associated with the findings of calcified parafacetary cyst and marginal osteophytes, highlights the relevance of considering non-discogenic etiologies in the evaluation of root pain. The integration between clinical data and radiological findings was decisive for the establishment of the diagnosis and the surgical planning. This multidisciplinary approach is consistent with the observations of Furman and Johnson (2019)[17], which emphasize the importance of the correlation between image and symptomatology for the precise identification of atypical root compressions. In this case, computed tomography proved superior to magnetic resonance imaging in the investigation of non-discogenic origin sciatica, allowing precise identification of bone structures of different etiologies that compromised the path of the same nerve root. Magnetic resonance imaging, although widely used, proved inconclusive and insufficient in this specific context, reinforcing the importance of choosing the appropriate imaging method according to the diagnostic hypothesis.

Although lumbar disc hernia is the most prevalent cause of sciatica, it is essential to recognize that other etiologies can generate similar symptoms, even in the absence of disc impairment. In this context, the diagnostic investigation of non-discogenic origin sciatica should be comprehensive and careful, using all available resources to ensure a precise diagnostic conclusion and guide a safe and effective treatment[10,22,26,27].

The choice of the most appropriate complementary examination in the evaluation of sciatica depends directly on the nature of the etiological agent involved. Computerized tomography stands out in the detection of bone alterations, thanks to its bio-physical profile focused on dense structures, being especially useful in cases of osteophytes, fractures or facetary sclerosis. In contrast, magnetic resonance imaging shows greater sensitivity to discoligmental and neural changes, and is the reference test in the investigation of disc hernias, blurings and radical compressions of non-bone origin[23].

A significant contribution from this study is to reinforce the importance of both imaging methods in the evaluation of sciatica, counteracting the common sense that magnetic resonance imaging, being considered the gold standard, would be sufficient as a single exam[22]. The findings show that computerized tomography, although often neglected, plays a fundamental role in the identification of bone alterations that may be directly related to root compression, especially in cases of non-discogenic etiology[28].

Although both magnetic resonance imaging and computed tomography are relevant in the assessment of sciatica, it is important to consider the safety profile of each method. Computerized tomography, because it involves exposure to high levels of ionizing radiation, should be used with discretion, preferably in a second stage of the investigation, when there is suspicion of bone etiologies not evidenced by other methods[29]. This behavior was exemplified in the clinical case, in which CT was decisive for the diagnosis, after an inconclusive resonance.

CONCLUSION

Sciatica has multiple etiologies, including non-discogenic causes, such as bone and joint changes, which can compromise the root pathway. Although magnetic resonance imaging is widely recognized as the gold standard exam for the evaluation of neural and discoligmental structures, its sensitivity is limited in cases of compression by bone elements. In this scenario, computed tomography assumes an essential complementary role, allowing for a more comprehensive and accurate investigation, especially in non-discal etiologies.

In addition, the questions about the reliability of classical dermatomes, their limitations in correlation with clinical findings and their relevance in differential diagnosis deserve to be highlighted. The individual variability and overlap between sensory territories reinforce the need for an integrated approach between clinical and imaging.

The search for a deeper understanding of the clinical-radiological contexts of sciatica directly contributes to the diagnostic and therapeutic improvement. It is expected that technological advances and the development of new research will enhance the accuracy of diagnostic methods, promoting a safer, more effective and personalized management of sciatica in its various presentations.

CONFLICT OF INTEREST

All authors declare no potential conflict of interest related to this article.

CONTRIBUTIONS OF THE AUTHORS

Each author contributed individually and significantly to the development of this article. MPD, FSE, KOT: conceptualization, research, writing – preparation of the initial draft; RRA, MBSB, RSV: data curation; SEL, JPMB: formal analysis, validation, writing – revision and editing.

DATA AVAILABILITY DECLARATION

The contents underlying the research are available in the manuscript.

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