Journal of the Asociación Argentina de Ortopedia y Traumatología

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AAOT 1936–2026. 90 Years to Commemorate Our Achievements and Plan for the Future

Dr. Daniel E. Vaineras
President of the AAOT

It is an immense honor to assume the presidency of our Association, a role that entails great responsibility.

From the very first day I began working within our Association, I did so with deep satisfaction and enthusiasm. I have always felt that attending the AAOT was like going to a club where we gathered to work for the common good and learn from one another, exchanging knowledge and experience in both clinical practice and academic teaching within our specialty.

Nearly 35 years have passed, and I still feel the same way every time I participate in the various activities carried out by our institution.

My first involvement was as Editorial Secretary to Dr. Franklin Merlo, proofreading the galley proofs of the AAOT Journal. I know and deeply appreciate the tremendous work performed by everyone who serves on the Editorial Committee of this Journal, which makes it an honor for me to write this editorial today.

Our Association was founded in 1936; therefore, in 2026, it will celebrate 90 years of existence. It will truly be a year to celebrate, to honor the accomplishments of our predecessors, and to reflect on our future.

The AAOT develops extensive educational activities and serves as a benchmark for Latin America and beyond. It does so through its Committees, such as the Medical Education Committee, the Certifications and Service Accreditation Committee, and the Surgical Skills Center, which continues to grow year after year with its outstanding hands-on courses.

We will continue along this path, encouraging and investing in the continuous education of our members. Likewise, we will continue striving to extend our educational offerings beyond our borders, building upon previous collaborative experiences with Uruguay.

We are also committed to maintaining the prudent and responsible financial management of our members' funds established by recent Executive Committees.

We will continue reorganizing the work of the various Committees to avoid overlapping activities, optimize resources, and promote remote activities whenever feasible.

We will maintain strong support for the Agremiación Argentina de Ortopedia y Traumatología (*Argentine Guild of Orthopedics and Traumatology*), which has carried out important work since its founding in advocating for fair professional fees consistent with training and responsibility, while also working in collaboration with regional associations — always keeping the patient as the central priority of our profession.

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We believe this represents the future of the AAOT and will also contribute to maintaining financial balance. We invite you to learn more about its activities and benefits.

In 2026, the following activities will take place:

- Eight regular scientific sessions, inviting societies from the different subspecialties, during which candidates for Full Membership — the highest membership category, granting access to leadership roles within the Association — will present their work. We will continue encouraging young physicians to pursue this distinction and actively participate in AAOT activities.
- Six extraordinary scientific sessions to be held across the country (Paraná, Córdoba, Junín, Tucumán, and Rosario), as well as one session within the framework of the Patagonian Congress, which will take place in the city of Esquel.

This year, we have formed a strong leadership team composed of members from various subspecialties and regions of the country (Mar del Plata, Junín, Córdoba, Concepción del Uruguay, Tucumán, Corrientes, Comodoro Rivadavia, and Santa Fe), reaffirming our commitment to a truly federal AAOT.

I invite you all to join us in this endeavor. Ours will be an AAOT with open doors.

I promise to dedicate my full effort to this responsibility.

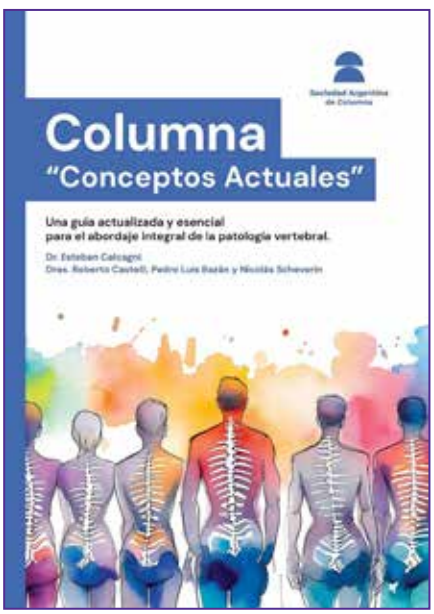
I hope that, at the end of my term, I will be able to say that our work has contributed positively to the continued growth of our Association.

The Essential Task of Educating

Dr. Esteban Calcagni
President of SAPCV 2025

Through the joint efforts of the Editorial Committee of the AAOT Journal and the Executive Board of the SAPCV 2025, we would like to express our gratitude for the opportunity to present an issue exclusively dedicated to spinal pathology in such a prestigious scientific publication.

As one of the final activities of the academic year, and marking the conclusion of the Biannual Course of the Sociedad Argentina de Patología de la Columna Vertebral (*Argentine Society of Spinal Pathology*), its director, Dr. Pedro Bazán, proposed the development of a module devoted exclusively to Scientific Activity, with the aim of fostering awareness of the need for improvement in this area. Within this framework, the following topics were addressed in depth: spinal research and research methodology, taught by Dr. Lidia Loterzo, one of the editors of this journal; a lecture on spinal research in Argentina, delivered by Prof. Dr. Aníbal Sarotto and Dr. Bersusky, highlighting the importance of publishing and clearly outlining the direct benefits and the academic standing that publication confers on scientific societies such as ours.



One of the main goals of our working group is to encourage all members of our Society to engage in the publication of scientific work derived from their daily clinical practice with patients.

As particularly encouraging news related to the benefits of publishing, we are pleased to announce the release of the book *Columna, Conceptos Actuales*. Although this represents a different format for presenting scientific work, we wish to share this achievement of the SAPCV with our readers. The authors are members of the teaching staff of the Biannual Course.

Once again, we would like to express our sincere appreciation for this exclusive issue of the AAOT Journal and to its Executive Editor, Dr. Ernesto Bersusky.

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Case Presentation

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Case Resolution on page 73.

Lower Limb Monoplegia

ABSTRACT
We report the case of a 68-year-old man with multiple cardiovascular and oncological comorbidities (active lung and prostate cancer) who developed rapidly progressive acute paraplegia following percutaneous bone biopsy, percutaneous fixation, and bipedicular kyphoplasty at L1. Although computed tomography ruled out mechanical causes and cement leakage, magnetic resonance imaging confirmed spinal cord ischemia extending from T9 to L4. This report analyzes the multifactorial etiology of the event, highlighting the interaction between paraneoplastic hypercoagulability and the surgical technique as key factors to be considered during preoperative planning.
Keywords: Spinal cord infarction; ischemic stroke; ischemia; kyphoplasty; paraplegia.
Level of Evidence: IV

Monoplejía de miembro inferior

RESUMEN
Se presenta el caso de un hombre de 68 años con múltiples comorbilidades oncológicas (cánceres de pulmón y de próstata en actividad) y cardiovasculares que desarrolló una paraplejía aguda rápidamente progresiva tras una biopsia ósea por punción, fijación percutánea y cifoplastia bipedicular en L1. A pesar de que, con la tomografía computarizada, se descartaron causas mecánicas o fuga de cemento, la resonancia magnética confirmó una isquemia medular desde T9 hasta L4. En este reporte, se analiza la etiología multifactorial del evento, y se destaca la interacción entre el estado de hipercoagulabilidad paraneoplásica y la técnica quirúrgica, como puntos clave por tener en cuenta en la planificación prequirúrgica.
Palabras clave: Infarto medular; accidente cerebrovascular; isquemia; cifoplastia, paraplejía.
Nivel de Evidencia: IV

INTRODUCTION

A 68-year-old man presented with several months of progressively worsening thoracolumbar pain, rated as 9 out of 10 on the visual analog scale, with no response to nonsteroidal anti-inflammatory drugs or opioid analgesics. His medical history included active lung and prostate cancer (without chemotherapy or radiotherapy), chronic pericardial effusion, and an episode of pulmonary thromboembolism in 2023.

To manage pain, a percutaneous surgical biopsy, percutaneous pedicle fixation from T12 to L2, and bipedicular kyphoplasty of the L1 vertebral body were performed. The patient was receiving rivaroxaban, which was suspended by the Hematology Service five days prior to the intervention.

The procedure was carried out according to the preoperative plan and without intraoperative adverse events. Upon awakening from anesthesia, the patient presented with monoplegia of the right lower limb, which progressed to paraplegia in less than 24 hours.

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FINDINGS AND INTERPRETATION OF IMAGING STUDIES

Preoperative images

Figure 1 shows preoperative magnetic resonance imaging of the lumbar spine, including midsagittal T1-, T2-, and STIR-weighted sequences, as well as an axial slice at the level of the L1 vertebral body. A lesion is observed compromising the vertebral body structure and predominantly involving the anterior column at the L1–L2 segment, without spinal canal involvement. The lesion appears hypointense on T1- and T2-weighted sequences and hyperintense on STIR images.

Figure 1. Preoperative magnetic resonance imaging of the lumbar spine demonstrating the lesion. Midsagittal T1-weighted (**A**), T2-weighted (**B**), and STIR (**C**) sequences. Axial slice (**D**).

Postoperative images

Postoperative computed tomography confirmed correct pedicle screw placement and absence of intracanal cement leakage (Figure 2). No signs of spinal canal compression were observed.

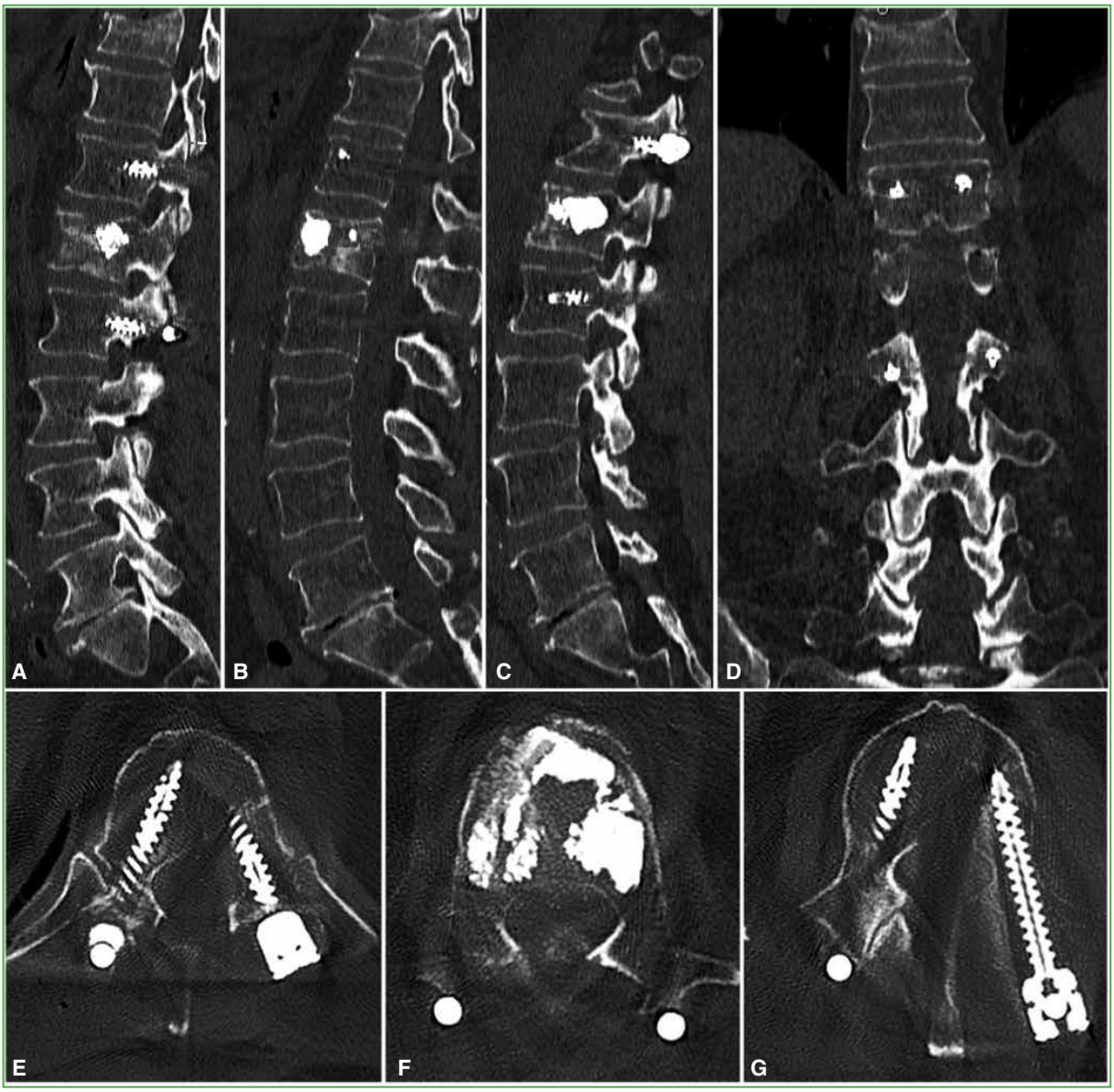

Figure 2. Immediate postoperative computed tomography of the thoracolumbar spine. Correct screw and cement positioning is observed. **A**. Left parasagittal section. **B**. Medial sagittal section. **C**. Right parasagittal section. **D**. Coronal reconstruction. **E**. Axial section at the upper instrumentation level. **F**. Axial section at the augmentation level. **G**. Axial section at the lower instrumentation level.

Conflict of interest: The authors declare no conflicts of interest.

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Pyogenic Spinal Infections Without Disc Involvement in Childhood

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ABSTRACT

Introduction: Pyogenic spinal infections in children include spondylodiscitis, spondylitis, facet joint septic arthritis, paraspinal and perivertebral abscesses, meningitis, myelitis, and their associations. *Staphylococcus aureus* is the most common causative microorganism. **Objective:** To determine the prevalence of spinal bone infections and pyogenic perivertebral abscesses in children and to evaluate the usefulness of Ju's algorithm. **Materials and Methods:** Nine children without comorbidities presenting with pyogenic spinal infection and preserved disc integrity were included. **Results:** A higher frequency was observed in children older than eight years. The most prevalent clinical triad was pain, fever, and antalgic postures. Ju's algorithm proved to be reliable. One case of facet joint septic arthritis, four cases of spondylitis, and eight perivertebral abscesses were identified, five associated with bone infection. On CT, bone lesions showed a lytic or mottled appearance, while MRI demonstrated typical infectious patterns. Bone specimens obtained by percutaneous and transoral biopsy confirmed acute osteomyelitis. *S. aureus* was isolated in seven of nine patients. Antibiotic therapy was effective; however, six children required surgery: five for abscess drainage and one for a pedicle subtraction osteotomy due to residual kyphosis. **Conclusions:** Spinal infection with preserved disc integrity was prevalent in late childhood and adolescence. Its association with abscess formation and *S. aureus* infection was significant. We recommend the application of Ju's algorithm and, in cases of negative blood cultures, performing bone biopsy for bacteriological identification and histopathological confirmation, surgical drainage of soft tissue abscesses, and targeted antibiotic therapy.

Keywords: Children; spinal infection; pyogenic abscesses; *Staphylococcus aureus*.
Level of Evidence: IV

Infecciones espinales piógenas sin afectación discal en la infancia

RESUMEN

Introducción: Las infecciones espinales piógenas en la infancia incluyen entidades, como espondilodiscitis, espondilitis, infección facetaria, abscesos para y perivertebrales, meningitis, mielitis y sus asociaciones. *Staphylococcus aureus* es el microorganismo habitual. **Objetivos:** Determinar la prevalencia de infecciones óseas espinales y abscesos piógenos perirraquídeos, y evaluar la utilidad del algoritmo de Ju. **Materiales y Métodos:** Se incluyó a 9 niños con infección espinal piógena e indemnidad discal, sin comorbilidades. **Resultados:** La frecuencia fue mayor en niños >8 años. La tríada prevalente incluyó dolor, fiebre y posturas antiálgicas. Se demostró que el algoritmo de Ju es confiable. Se detectaron una artritis facetaria, 4 espondilitis y 8 abscesos perivertebrales, 5 asociados a una infección ósea. En la tomografía computarizada, las lesiones óseas tenían un aspecto lítico o atigrado. La resonancia magnética mostró el patrón típico de infección. Los especímenes óseos, obtenidos por punción percutánea y transoral, fueron informados como osteomielitis aguda. En 7 de 9 pacientes, se aisló *S. aureus*. La antibioticoterapia fue eficaz para curar la enfermedad. Sin embargo, 6 niños requirieron cirugía: 5 para drenar abscesos y uno para una osteotomía de sustracción pedicular en una cifosis secuelar. **Conclusiones:** La infección vertebral con disco indemne fue prevalente en la segunda infancia y la adolescencia. La asociación con abscesos fue significativa, así como la identificación de *S. aureus*. Recomendamos la aplicación del algoritmo de Ju y, ante hemocultivos negativos, la biopsia ósea para la determinación bacteriológica y la certeza histopatológica, el drenaje quirúrgico de los abscesos de partes blandas y la antibioticoterapia específica.

Palabras clave: Niños; infección espinal; abscesos piógenos; *Staphylococcus aureus*.
Nivel de Evidencia: IV

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INTRODUCTION

Pyogenic spinal infections in childhood are uncommon. Spondylodiscitis predominates; however, other entities may occur, including spondylitis, facet joint infection, meningitis, myelitis, abscesses concomitant with bone infection, and primary perivertebral septic collections.[1] Regardless of the presentation, the inoculum enters via the hematogenous route (Figure 1).[2]

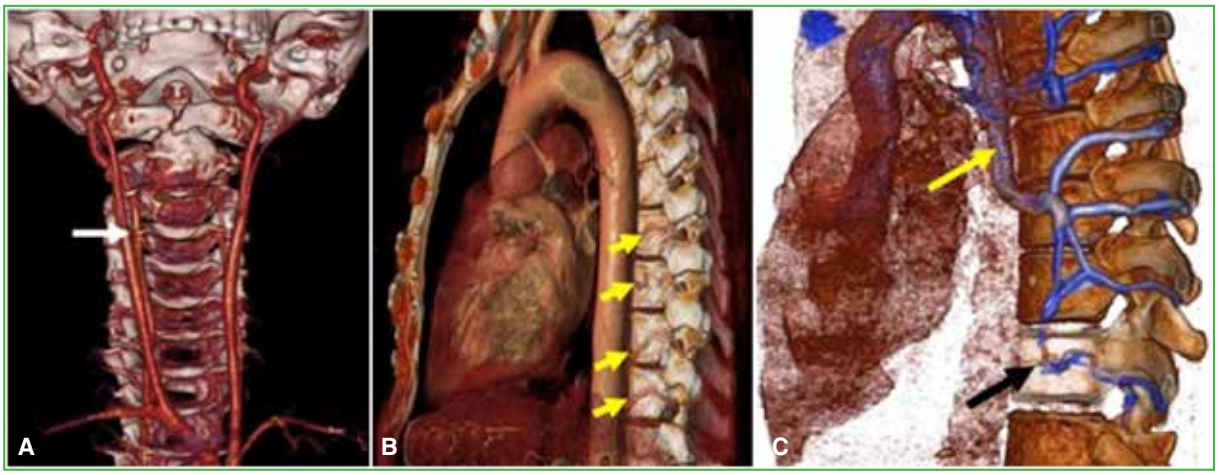

Figure 1. Spinal computed angiography. **A**. Vascular supply of the cervical spine, which depends primarily on the vertebral arteries. **B**. Segmental arteries arising from the aorta that supply the equator of the vertebral body (yellow arrows). **C**. Venous drainage of the thoracic spine into the azygos vein (yellow arrow). The black arrow indicates an intercostal arteriovenous bundle. (Images taken from *Libro de Cátedra*, O. A. Romano and C. A. Fernández, SEDICI 2023; reproduced with permission).

In recent decades, the epidemic of methicillin-resistant *Staphylococcus aureus* (MRSA) has substantially altered the spectrum, prevalence, and prognosis of skeletal infections.[3,4] The Pan American Health Organization has reported alternative etiologies according to age stratification (Table 1).[5]

In prior studies, spinal osteomyelitis accounts for 1% to 2% of all bone infections.[6]

The objectives of this study were to determine the prevalence of spondylitis and pyogenic paraspinal abscesses in children and to assess the usefulness of Ju's algorithm.

Table 1. Most common microorganisms in osteoarticular infections in childhood and adolescence according to the Pan American Health Organization[5]

Age	Common microorganisms
<1 month	*S. aureus*, Gram-negative bacilli, streptococci, *Neisseria gonorrhoeae*, *Treponema pallidum*
1-3 months	*S. aureus*, Gram-negative bacilli, *Haemophilus*
From 3 months to 5 years	*S. aureus*, streptococci, *Haemophilus*, *Kingella kingae* (gram-negative)
>5 to 18 years	*S. aureus*, streptococci, *Neisseria meningitidis*, *Kingella kingae*

MATERIALS AND METHODS

A descriptive, retrospective observational case series was conducted at a multidisciplinary pediatric referral institution in the Province of Buenos Aires, covering the period from October 2004 to December 2023.

Inclusion criteria were: children up to 15 years of age with a primary pyogenic infection of the spine, without disc involvement or comorbidities, who met two or more of the following requirements: 1) Clinical presentation: spinal pain, refusal to walk or limping, limited range of motion, abnormal postures, and febrile syndrome. 2) Biological pattern of infection: decreased hematocrit or hemoglobin concentration; increased C-reactive protein (CRP) or erythrocyte sedimentation rate (ESR). 3) Bacteriological confirmation: identification of the organism on blood culture or aspiration specimen; histopathological confirmation; or any combination of these variables. 4) Imaging findings suggestive of infection. Exclusion criteria were: children with systemic disease, surgical site infection, tuberculosis, and incomplete medical records. We applied the predictive algorithm for *S. aureus* osteomyelitis described by Ju et al., which includes the following factors: leukocytosis >12,000 cells/mm³, hematocrit <34%, temperature >38°C, and CRP ≥13 mg/L, with the following expected probability of diagnosis: no factors = 0%, one = 1%, two = 10%, three = 45%, and four = 92%.[4]

In addition to demographic data, we recorded time to presentation/evolution and follow-up, infection location, biological and histopathological parameters, imaging studies, and antibiotic therapy. The classification of bone infection as acute or chronic was based on histopathological confirmation, not on duration of symptoms.

Statistical Analysis

The nonparametric Wilcoxon rank test and Pearson's correlation coefficient were used (SPSS 17®). A p value ≤0.05 was considered statistically significant.

RESULTS

Eleven medical records met the aforementioned criteria. Two were excluded due to the lack of imaging documentation. The sample represented 81% of the cases admitted during the study period. The cohort included nine patients with a mean age of 9.6 years (range, 3 months–15 years), with a male-to-female ratio of 6:3. The mean prodromal period was 6 days (range, 48 hours–5 months). Mean follow-up for bone infections was 1.8 years (range, 12–36 months), whereas for primary abscesses without skeletal involvement, the mean follow-up was 9 months (range, 6–18 months).

The predominant clinical presentation included pain, febrile syndrome, limited range of motion, and antalgic postures. No patient developed neurological deterioration. Blood cultures were negative except in two cases, and all patients had a Ju index of 92%, except for one patient ($p < 0.002$) (Table 2).

Table 2. Ju parameters (underlined)

Case	Leukocytosis	CRP	Hematocrit-Hemoglobin	ESR	Fever	MRSA	MSSA	Pathological anatomy	Ju parameters
1	X	X	X	X	X	X		AHO	92
2	X	X		X	X		X	AHO	92
3								AHO	0
4	X	X	X	X				AHO	92
5	X	X	X	X	X		X	AHO	92
6	X	X	X	X	X	X		Abscess	92
7	X	X	X	X	X	X		Abscess	92
8	X	X		X	X	X		Abscess	92
9	-	X	X	X	X		X	Abscess	92

Inferential statistics were used to analyze the variables with Wilcoxon's nonparametric rank tests and Pearson's correlation coefficient. For bone infection and abscesses, all were significant in view of the final definitive diagnosis (bacteriological or histological), $p < 0.002$.
CRP = C-reactive protein; ESR = erythrocyte sedimentation rate; MRSA = methicillin-resistant *Staphylococcus aureus*; MSSA = methicillin-sensitive *Staphylococcus aureus*; AHO = acute hematogenous osteomyelitis.

Eight abscesses were identified in nine patients (p = 0.005): three were associated with spondylitis and one with facet joint arthritis; the remaining four were primary abscesses (Figure 2).

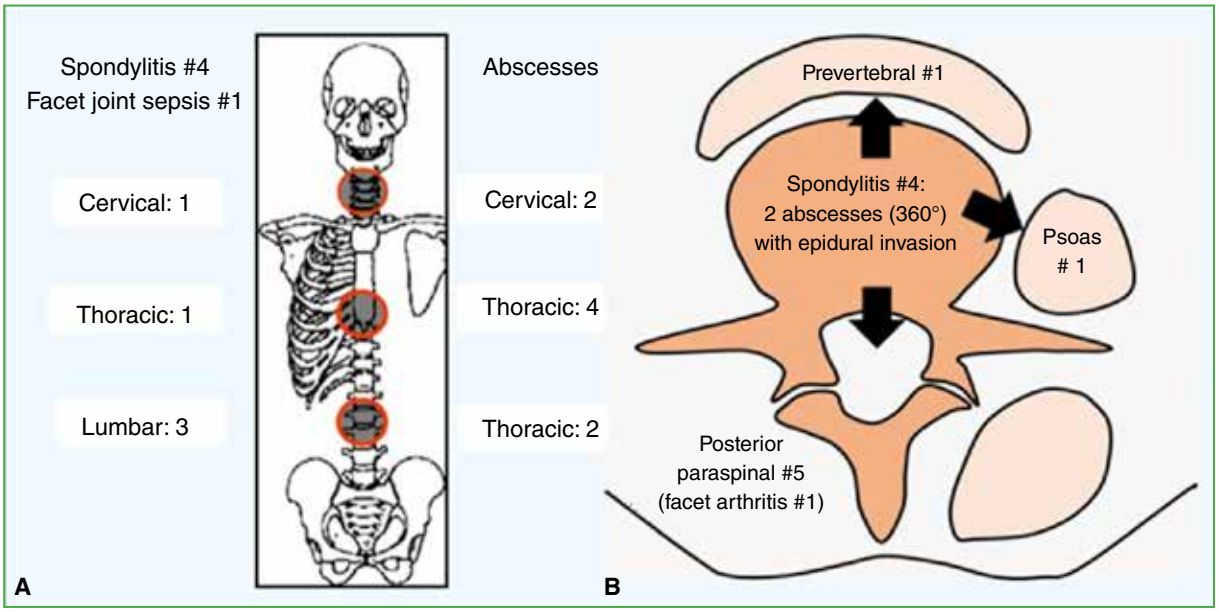

Figure 2. A. Topographic anatomical distribution of bone infections and spinal abscesses. **B**. Axial plane distribution. Note the presence of eight abscesses: two somatic with epidural extension, one prevertebral, one psoas, and four posterior paraspinal abscesses.

Abscesses associated with spondylitis resolved with antibiotic treatment, whereas the remaining abscesses required surgical drainage, including those in two children whose diagnosis in the emergency department was made exclusively by ultrasound. *Staphylococcus aureus* was isolated in seven patients (p = 0.001), including four cases of MRSA and three of MSSA (Figures 3-6).

Figure 3. 13-year-old boy with back pain and febrile syndrome. Elevated acute-phase reactants, fluid collection involving the multifidus muscles and the T9–T10 facet joints. Surgical drainage and lavage were performed. Methicillin-sensitive *Staphylococcus aureus* was isolated, and histopathology was consistent with acute osteomyelitis. **A and B**. Magnetic resonance imaging of the thoracic spine, sagittal and axial sections. The abscess described is evident.

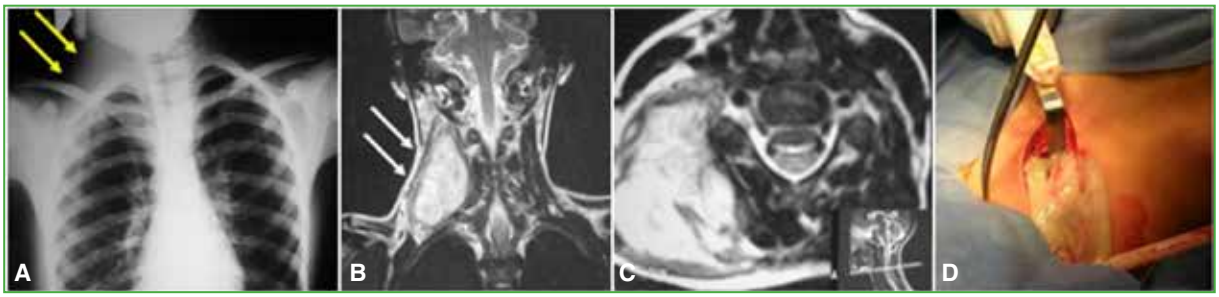

Figure 4. 13-year-old boy with laterocollis, pain, and acute febrile syndrome. **A**. Anteroposterior radiograph of the chest and shoulders. Yellow arrows indicate soft tissue swelling in the cervical region. **B and C**. Magnetic resonance imaging of the neck and supraclavicular region, coronal and axial T2-weighted sequences, showing a large primary abscess. **D**. Intraoperative image demonstrating purulent drainage. Isolated pathogen: methicillin-resistant *Staphylococcus aureus*.

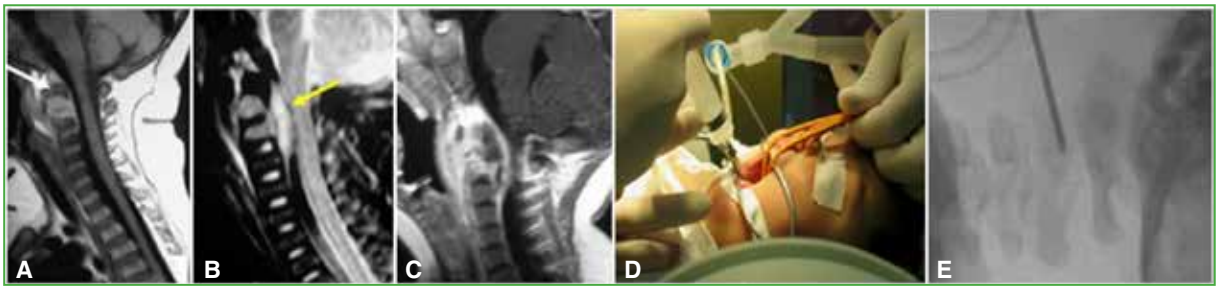

Figure 5. 3-month-old infant with febrile syndrome, episodes of inconsolable crying, opisthotonos, and laterocollis of one month's duration. **A**. Magnetic resonance imaging of the skull base and cervical spine, sagittal T1-weighted sequence. C2 spondylitis (white arrow); note preservation of the C2–C3 disc. **B**. Same study, T2-weighted sequence. Perivertebral abscess with epidural extension anterior to the tectorial membrane (dark interface) (yellow arrow). Extension of the abscess toward the skull base below the clivus. **C**. Same study, T1-weighted sequence with gadolinium contrast, showing marked peripheral enhancement. **D**. Transoral biopsy puncture. **E**. Image intensifier view confirming correct placement of the Jamshidi needle. Methicillin-sensitive *Staphylococcus aureus* was isolated. Histopathological confirmation of acute osteomyelitis. Excellent response to antibiotic therapy, rest, and cervical immobilization with a brace. (Images taken from *Libro de Cátedra*, O. A. Romano and C. A. Fernández, SEDICI 2023; reproduced with permission).

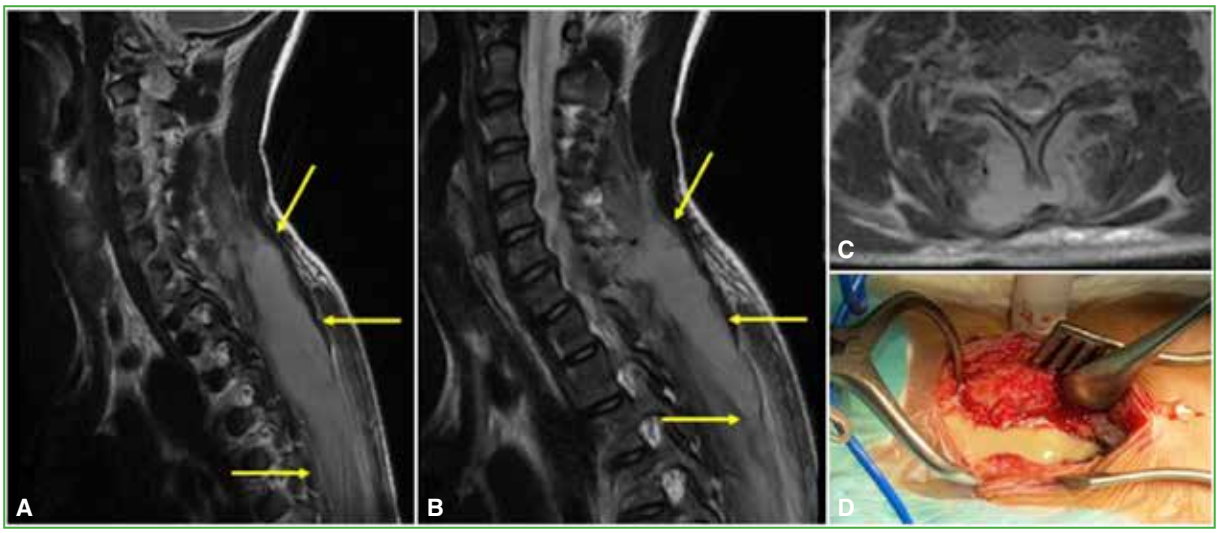

Figure 6. 14-year-old boy with fever and back pain, with elevated acute-phase reactants. **A and B**. Magnetic resonance imaging of the cervicothoracic spine, sagittal sections. Fluid collection extending from C6 to T4 (yellow arrows). **C**. Magnetic resonance imaging of the cervicothoracic spine, axial section. Posterior paraspinal abscess. **D**. Intraoperative image of posterior surgical approach showing evacuation of purulent material.

On computed tomography, bone lesions exhibited a lytic or mottled appearance, with asymmetric distribution and poorly defined margins. One patient developed angular kyphosis due to wedging of T11, which required delayed pedicle subtraction osteotomy (Figure 7).

Figure 7. 12-year-old girl with febrile syndrome, back pain, and functional limitation. Frankel grade E. Methicillin-resistant *Staphylococcus aureus* isolated from blood culture and bone biopsy. **A and B**. Computed tomography, axial slice at the T11 vertebra. Eccentric lytic, mottled-appearing lesion at T11 and a circumferential (360°) perivertebral abscess. **C**. Magnetic resonance imaging of the thoracic spine, coronal view. Abscess with preserved intervertebral disc integrity and an hourglass-shaped vertebral body. **D and E**. Same study, sagittal T2- and T1-weighted sequences. Angular kyphosis of 30° secondary to wedge collapse of the vertebral body.

Magnetic resonance imaging showed hypointense signal on T1-weighted sequences and hyperintense signal on T2-weighted and STIR sequences, with gadolinium enhancement. In patients with bone involvement and negative blood cultures, image-guided needle biopsies were performed: three percutaneous transpedicular biopsies, one transfacet biopsy, and one transoral biopsy. In two cases, no pathogen was identified; in two cases, *S. aureus* was isolated (1 MRSA and 2 MSSA). All specimens submitted for histopathological analysis were classified as acute osteomyelitis (Figures 8 and 9). According to protocol, all specimens were evaluated for tuberculosis (Figure 10).

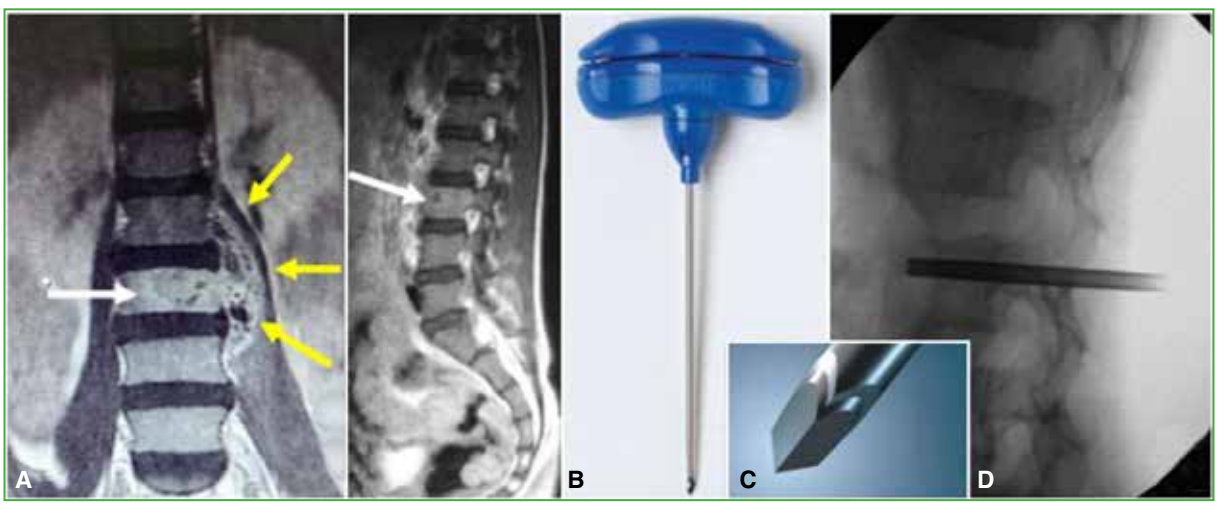

Figure 8. 10-year-old boy with low back pain and febrile syndrome. **A**. Magnetic resonance imaging of the lumbar spine, coronal and sagittal T1-weighted images. L3 spondylitis (white arrows) and a concomitant abscess of the left psoas muscle (yellow arrows). **B and C**. Jamshidi needle and its trocar. **D**. Percutaneous transpedicular biopsy performed under fluoroscopic guidance.

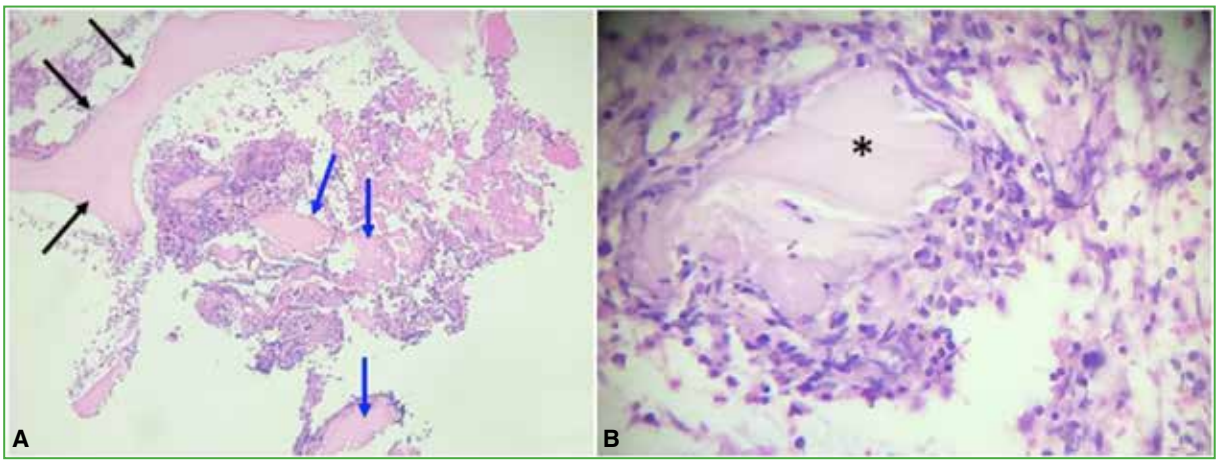

Figure 9. Bone specimen (hematoxylin–eosin stain), acute osteomyelitis. **A**. Centrally, islands of devitalized (acellular) bony trabeculae secondary to necrosis, surrounded by an intense polymorphonuclear inflammatory infiltrate (blue arrows); at the upper left margin, forming a C-shaped configuration, normal bone matrix is observed (black arrow). **B**. Higher-magnification image. Centrally, necrotic osteoid (black asterisk) with a marked peripheral leukocytic infiltrate.

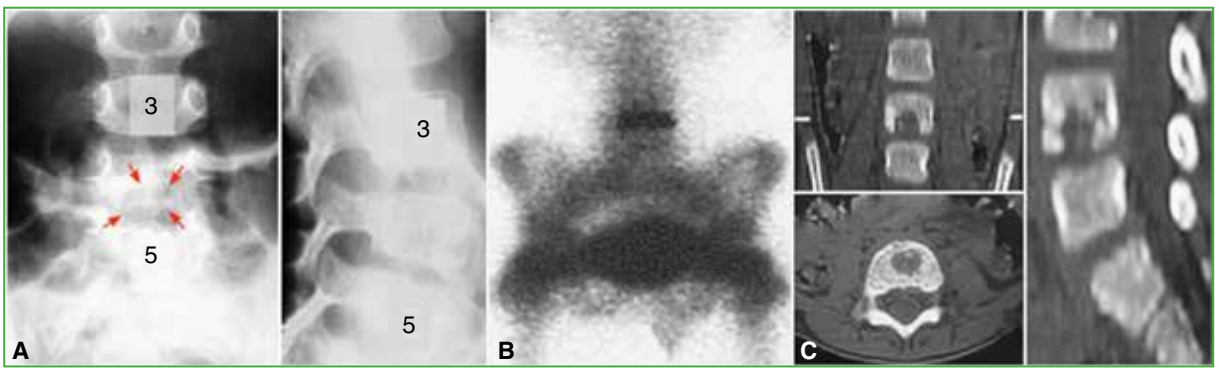

Figure 10. 5-year-old boy with insidious back pain and low-grade fever. Prolonged course. Family history suggestive of tuberculosis; PPD (+++). **A.** Computed tomography and radiograph of the lumbar region, coronal and sagittal views, respectively. Quiescent lacunar lesion in L4 (red arrows). **B.** Technetium-99m bone scintigraphy. Selective increased uptake in the L4 vertebral body. **C.** Computed tomography of the lumbar region, coronal, axial, and sagittal views. Lytic lesion with microcalcifications and preserved intervertebral disc integrity. Vertebral aspiration: frank caseous material. *Mycobacterium tuberculosis* was isolated. Medical treatment was initiated, with satisfactory clinical evolution.

Antibiotic therapy was guided by antibiogram results or administered empirically, according to local epidemiology. In general terms, the protocol included 2 to 3 weeks of intravenous antibiotics followed by 4 to 8 weeks of oral therapy. The most frequently administered antibiotics were clindamycin and vancomycin. Table 3 summarizes the most relevant variables. Overall, the cohort can be summarized into three main findings: (1) spondylitis, (2) facet joint arthritis, and (3) primary paraspinal abscesses or abscesses associated with the aforementioned bone infections.

Table 3. Differential diagnosis between nonspecific spondylitis and tuberculosis.

Characteristics of the infection	Pyogenic	Tuberculosis
Elective region	Thoracic or lumbar	Thoracic
Delay in diagnosis	+	+++
Clinical presentation	Eloquent	Overlapping
Biological data	+++	+
Pulmonary tuberculosis	No	Yes
Vertebral collapse CT/MRI >50%	+	+++
Bone fragments on CT	+	+++
Microcalcifications on CT scan	+	+++
Paraspinal abscess on MRI	+	+++
Length of abscess	+	+++
Mixed signal on T1-weighted gadolinium-enhanced MRI	+	+++
Mixed signal on T2-weighted MRI	+	+++
Peripheral enhancement on T1-weighted MRI with gadolinium	+	+++

CT = computed tomography; MRI = magnetic resonance imaging. Crosses indicate probability estimates: unlikely (+), highly likely (+++).

DISCUSSION

The vascular pattern appears to be the key differentiating factor in the pathogenesis of vertebral infection in children. In the first years of life, the metaphyseal vascular network facilitates bacterial inoculation, bone abscess formation, and disc involvement.[6] From the second stage of childhood onward, spinal blood supply, more prominent at the equator of the vertebral body, predisposes to osteomyelitis that spares the intervertebral disc.[2,7,8] Between the ages of 3 and 8 years, the prevalence of spondylodiscitis and spondylitis is similar, after which spondylitis becomes predominant. Reports on pyogenic spondylitis and facet joint arthritis in childhood are scarce.[6,8,9] In this study, five cases were identified over a 19-year period. The deleterious effect of *Staphylococcus aureus* is manifested by tissue necrosis, abscess formation, and recurrence.[10-14] The production of exotoxins, such as Panton–Valentine leukocidin, α-hemolysin, enterotoxins, and superantigens, may trigger a generalized inflammatory storm, leading to hemodynamic shock, multiple organ failure, and death.[11,12] According to the literature, deep abscesses, cellulitis, and furunculosis are caused by MRSA in 63% of cases and by MSSA in 15%.[14,15] In this cohort, the incidence of paraspinal abscesses was close to 90%, caused by both bacterial species (Table 3).

Drainage and saline irrigation of posterior septic collections appears to be a generally accepted procedure.[14] However, there are no standardized indications regarding anterior collections. In principle, provided that there is no alteration of spinal biomechanics, instability, or neurological compromise, initial management consists of antibiotic therapy.

Diagnostic confirmation by histopathology, bacteriology, or both methods allowed us to corroborate, albeit inversely, the usefulness of the algorithm proposed by Ju et al.[4] Other authors have reported disparate results, with a reliability of 91% at Boston Children's Hospital and 50% at Phoenix Children's Hospital.[4,11,15] Computed tomography has moderate sensitivity in infectious disease; it is useful for bone tissue analysis and 3D reconstructions. However, long-term carcinogenic effects related to radiation exposure in children have been reported.[16] Therefore, its indication should be selective, and whenever possible, biopsies should be performed using image-intensifier–assisted needle techniques with limited imaging sequences. Magnetic resonance imaging is the imaging modality of choice in patients with spinal infection, with a sensitivity of 96%, specificity of 94%, and accuracy of 92%.[1] Occasionally, on T2-weighted sequences, a "flare phenomenon" may be observed, which has also been described in stress fractures and neoplastic disease.[17] Granulomatous tissue formation may mimic a paraspinal abscess in hematological malignancies. The association of spondylitis and abscess should be considered tuberculosis until proven otherwise.[18-21] For this reason, we developed a comparative table with pyogenic infections based on the literature (Table 4).[19-21]

Table 4. Summary of main clinical variables and complementary studies.

Case	Age/Sex	Signs/ Symptoms	Reactive Infection	Blood culture	Site	Abscess	X-ray-CT scan	MRI	Ultra-sound	Bone biopsy/ Germ	Pathological anatomy	Sequela	Follow-up (months)
1	12 years F	Fever, Back pain, ↓functional	Yes	(+) MRSA	T11	Yes 360 + epidural	Mixed Kyphosis	Classic		Yes/ MRSA	Osteomyelitis	Kyphosis	36
2	3 months M	Fever, Torticollis, opisthotonos	Yes	(-)	C2	Yes 360 + epidural	Lysis	Classic		Yes/ MRSA	Osteomyelitis	No	24
3	15 years M	Low back pain	No	(-)	L3	No	Lysis	Classic		Yes (-)	Osteomyelitis	No	12
4	10 years M	Low back pain	Yes	(-)	L3	Yes Psoas	No	Classic		Yes (-)	Osteomyelitis	No	12
5	13 years M	Back pain	Yes	(-)	Facet arthritis T9-T10	Yes Paraspinal Drainage	(-)	Classic		Yes/ MSSA	Osteomyelitis	No	16
6	6 years F	Fever, low back pain	Yes	(-)	Lumbosa-cral	Yes Paraspinal MRSA drainage	(-)	No	Yes	No	No	No	6
7	9 years F	Fever, back pain	Yes	(-)	Thoracic, lumbar	Yes Paraspinal Drainage. MRSA	(-)	No	Yes	No	No	No	6
8	13 years M	Fever, Torticollis	Yes	(-)	Cervical	Yes Paraspinal Drainage MRSA	Yes Abscess	Abscess	No	No	No	No	18
9	14 years M	Fever, back pain	Yes	(+) MSSA	Cervical, thoracic	Yes Paraspinal Drainage MSSA	No	Abscess	No	No	No	No	6

F = female; M = male; MRSA = methicillin-resistant *Staphylococcus aureus*; MSSA = methicillin-sensitive *Staphylococcus aureus*; CT = computed tomography; MRI = magnetic resonance imaging. Classic MRI refers to the pattern of infection detailed in the text.

Unlike spondylodiscitis, in which the indication for needle aspiration remains controversial, we believe that in patients with bone lesions and negative blood cultures, biopsy is essential because of its bacteriological relevance and histopathological diagnostic certainty, particularly in view of the broad differential diagnosis.

The main limitations of this study are its retrospective design and the size of the cohort; however, the latter is relative, as this analysis addresses rare forms of spinal infection in children.

CONCLUSIONS

Pyogenic vertebral osteomyelitis without disc involvement is common in late childhood and adolescence, as is the concomitant presence of paraspinal abscesses and the etiological predominance of *S. aureus*. We recommend the application of Ju's algorithm and, in cases of negative blood cultures, bone biopsy for bacteriological and histopathological diagnosis, surgical drainage of soft tissue abscesses, and targeted antibiotic therapy.

With inferential statistics, the variables were analyzed using the Wilcoxon nonparametric rank test and the Pearson correlation coefficient. For bone infection and abscesses, all variables were statistically significant when compared with the final definitive diagnosis (bacteriological or histological), $p < 0.002$.

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REFERENCES

1. Arbelaez A, Restrepo F, Castillo M. Spinal infections: clinical and imaging features. *Top Magn Reson Imaging* 2014;23(5):303-14. https://doi.org/10.1097/RMR.0000000000000032
2. Wiley AM, Trueta J. The vascular anatomy of the spine and its relationship to pyogenic vertebral osteomyelitis. *J Bone Joint Surg Br* 1959;41:796-809. https://doi.org/10.1302/0301-620X.41B4.796
3. Miranda MG. Patología infecciosa infantil. In: Romano O, Fernández C. *Lo esencial en Ortopedia y Traumatología.* La Plata: EDULP; 2023, p. 460-478.
4. Ju KL, Zurakowski D, Kocher MS. Differentiating between methicillin-resistant and methicillin-sensitive Staphylococcus aureus osteomyelitis in children: an evidence-based clinical prediction algorithm. *J Bone Joint Surg Am* 2011;93(18):1693-701. https://doi.org/10.2106/JBJS.J.01154
5. Organización Panamericana de la Salud. *Tratamiento de las enfermedades infecciosas 2020-2022*, 8ª ed. Washington, DC: OPS; 2019, p. 70-3.
6. Fernandez M, Carrol CL, Baker CJ. Discitis and vertebral osteomyelitis in children: an 18-year review. *Pediatrics* 2000;105(6):1299-304. https://doi.org/10.1542/peds.105.6.1299
7. Fernández CA. Espondilodiscitis. In: Romano O, Fernández C. *Lo esencial en Ortopedia y Traumatología*. La Plata: EDULP; 2023, p. 749-65.
8. Ceroni D, Chargui M, De Marco G, Steiger C, Dayer R. Better Comprehension of primary pyogenic spinal infections. *Pediatr Infect Dis J* 2023;42(1):e39-e40. https://doi.org/10.1097/INF.0000000000003745
9. Mas-Atance J, Gil-García MI, Jover-Sáenz A, Curià-Jové E, Jové-Talavera R, Charlez-Marco A, et al. Septic arthritis of a posterior lumbar facet joint in an infant: a case report. *Spine (Phila Pa 1976)* 2009;34(13):E465-8. https://doi.org/10.1097/BRS.0b013e3181a4e64b
10. Bouali N, Haddaji N, Hamadou WS, Ghorbel M, Bechambi O, Mahdhi A, et al. Methicillin-resistant *Staphylococcus aurous:* Epidemiology, transmission and new alternative therapies: A narrative review. *Iran J Public Health* 2023;52(8):1555-64. https://doi.org/10.18502/ijph.v52i8.13395
11. Pendleton A, Kocher MS. Methicillin-resistant staphylococcus aureus bone and joint infections in children. *J Am Acad Orthop Surg* 2015;23(1):29-37. https://doi.org/10.5435/JAAOS-23-01-29

12. Hawkshead JJ 3rd, Patel NB, Steele RW, Heinrich SD. Comparative severity of pediatric osteomyelitis attributable to methicillin-resistant versus methicillin-sensitive Staphylococcus aureus. *J Pediatr Orthop* 2009;29(1):85-90. https://doi.org/10.1097/BPO.0b013e3181901c3a
13. Díaz Gallardo P, Mangupli M, Galera H, Bruno P, Bustos D, Ferrer G, et al. *Staphylococcus aureus* sensible a la meticilina frente a *Staphylococcus aureus* resistente en la artritis séptica aguda: estudio experimental, epidemiológico y clínico en niños. *Rev Asoc Argent Ortop Traumatol* 2011;76(2):112-21. Available at: https://www.scielo.org.ar/scielo.php?pid=s1852-74342011000200003&script=sci_arttext
14. Fujita Y, Matsudera S, Watanabe S, Yamaguchi T, Suzuki K, Ohkusu M, et al. Extensive subcutaneous abscess due to Panton-Valentine leucocidin-positive community-associated methicillin-resistant Staphylococcus aureus in an infant. *Tohoku J Exp Med* 2022;258(4):303-7. https://doi.org/10.1620/tjem.2022.J086
15. Wade Shrader M, Nowlin M, Segal LS. Independent analysis of a clinical predictive algorithm to identify methicillin-resistant Staphylococcus aureus osteomyelitis in children. *J Pediatr Orthop* 2013;33(7):759-62. https://doi.org/10.1097/BPO.0b013e3182a11cf7
16. Brenner D, Elliston. C, Hall E, Berdon W. Estimated risks of radiation-induced fatal cancer from pediatric CT. *AJR Am J Roentgenol* 2001;176(2):289-96. https://doi.org/10.2214/ajr.176.2.1760289
17. Azouz EM. Magnetic resonance imaging of benign bone lesions: cysts and tumors. *Top Magn Reson Imaging* 2002;13(4):219-29. https://doi.org/10.1097/00002142-200208000-00003
18. Fernández CA, Miranda MG, Fiore NJ. Tumores espinales primarios en la infancia: epidemiología, diagnóstico, estadificación y tratamiento. *Rev Asoc Argent Ortop Traumatol* 2010;75(1):13-26. Available at: https://www.scielo.org.ar/scielo.php?pid=S1852-74342010000100003&script=sci_arttext&tlng=pt
19. Lee, KY. Comparison of pyogenic spondylitis and tuberculous spondylitis. *Asian Spine J* 2014;8(2):216-23. https://doi.org/10.4184/asj.2014.8.2.216
20. Jain AK. Tuberculosis of the spine: a fresh look at an old disease. *J Bone Joint Surg Br* 2010;92(7):905-13. https://doi.org/10.1302/0301-620X.92B7.24668
21. Manzone P, Quiroz LJ, Vallejos Arce MS, Mariño Ávalos E, Laluf AF, et al. Mal de Pott en la provincia del Chaco. *Rev Asoc Argent Ortop Traumatol* 2017;82(3):206-19. Available at: https://www.scielo.org.ar/scielo.php?pid=S1852-74342017000300007&script=sci_arttext

Vertebral Hydatidosis

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ABSTRACT
Background: More than 50% of cases of bone hydatidosis involve the spine. Although pharmacological treatment is well established, surgical management is challenging due to the complexity of the lesions and adjacent anatomical structures, and local recurrence rates remain high. **Objective:** To analyze a case series of patients with vertebral hydatidosis and to evaluate lesion distribution, clinical presentation, treatment, and complications. **Materials and Methods:** A multicenter study was conducted including patients with vertebral hydatidosis and a minimum follow-up of one year. Data collected included characteristics of cystic lesions, type of surgery performed, and postoperative outcomes. **Results:** Seven patients (mean age: 40.17 years) with a mean follow-up of 13 years were included. The most frequent involvement extended from the lumbar spine to the sacrum. Treatment consisting of surgical resection, spinal fixation, and albendazole therapy resulted in improvement of pain and neurological symptoms. The most frequent complication was recurrence. **Conclusions:** Lumbosacral and sacral involvement were the most common locations, and the liver was the most frequent extravertebral site. Pain responded well to treatment consisting of surgical resection and antiparasitic therapy. Local recurrence remains the most common complication.
Keywords: Hydatidosis; spine; antiparasitic therapy; recurrence; complications.
Level of Evidence: III

Hidatidosis vertebral

RESUMEN
Introducción: Más del 50% de los casos de hidatidosis ósea ocurren en la columna. El tratamiento farmacológico está bien establecido, pero su abordaje quirúrgico se ve dificultado por la complejidad de las lesiones y las estructuras adyacentes, y las tasas de recidiva local son altas. **Objetivo:** Analizar una serie de casos de hidatidosis vertebral y evaluar la distribución, el cuadro clínico, el tratamiento y las complicaciones. **Materiales y Métodos:** Estudio multicéntrico de pacientes con hidatidosis vertebral y un seguimiento mínimo de un año. Se registraron las características de las lesiones quísticas, el tipo de cirugía y los resultados posoperatorios. **Resultados:** Se incluyó a 7 pacientes (edad promedio 40.17 años) con un seguimiento medio de 13 años. La ubicación extendida desde la columna lumbar hasta el sacro fue la más frecuente. El tratamiento con resección quirúrgica, fijación y albendazol mejoró el cuadro doloroso y neurológico. La complicación más frecuente fue la recidiva. **Conclusiones:** Las localizaciones lumbosacra y sacra fueron las más frecuentes, y la localización extravertebral más común fue en el hígado. El dolor respondió bien al tratamiento que consistió en resección quirúrgica y un agente antiparasitario. La recidiva local es la complicación más frecuente.
Palabras clave: Hidatidosis; columna; antiparasitario; recidiva; complicaciones.
Nivel de Evidencia: III

INTRODUCTION

Hydatid disease is a rare condition with slow progression that may lead to neurological complications.[1,2] It is a manifestation of the tropical disease caused by the parasite *Echinococcus granulosus*. According to the World Health Organization, it is one of the most neglected and geographically widespread parasitic diseases.[3] It is more prevalent in warm regions, such as South America, Mediterranean countries, the Middle East, New Zealand, central and southern Russia, Australia, China, North Africa, and East Africa.[4] Humans inadvertently become intermediate hosts through contact with or ingestion of water and food contaminated by domestic dogs.[5]

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Hydatid cysts are primarily located in the liver and lungs (90 to 99.5 percent). Skeletal involvement is very rare (0.5 to 4 percent),[6] with spinal involvement being the most frequent skeletal manifestation (50 percent). Of these cases, 49.9 percent involve the thoracic spine, followed by the lumbar region (21.2 percent).[2,7] The disease progresses slowly and may remain inactive for prolonged periods.[6] It has been demonstrated that cysts can grow between 1 and 5 cm per year.[8] Diagnosis is based on imaging studies combined with serological tests (arc 5).[6]

The objective of this study was to evaluate a series of cases of vertebral hydatid disease in order to analyze vertebral and extravertebral distribution, neurological involvement, administered treatment, and complications.

MATERIALS AND METHODS

A multicenter study was conducted in patients with vertebral hydatid disease with a minimum follow up of one year. Demographic data, vertebral and extravertebral location, preoperative and postoperative symptoms, neurological status according to the Frankel scale, type of surgery performed, and postoperative outcomes were recorded.

RESULTS

Five men and two women were evaluated. The mean age at the time of treatment was 44.71 years (range 20 to 64), with a mean follow up of 13 years (range 4 to 22).

In six patients, the disease involved multiple vertebral levels. The lumbosacral and sacral regions were the most frequently affected sites (four cases). The liver was the most common extravertebral location (Table).

Table. Vertebral distribution of hydatid cysts.

Patient	Affected vertebral sector	Extravertebral lesion
1	Thoracolumbar	Liver
2	Lumbosacral	Liver
3	Lumbosacral and sacral	Liver
4	Thoracic	Liver
5	Lumbar, lumbosacral, and sacral	Pelvis
6	Sacrum	Liver, pelvis
7	Lumbar, lumbosacral, and sacrum	Liver

The mean axial spinal pain score was 8.29 before treatment and decreased to 2.14 at the end of follow up. Radicular pain to the lower limb decreased from a mean value of 7.25 at baseline to 0.75 at the final evaluation (Figure 1).

One patient improved from Frankel grade D to E, another from grade C to D, and the remaining patients had no neurological deficit.

All patients received antiparasitic treatment with albendazole under infectious disease supervision, along with surgical excision of the cystic vesicles. Two intraoperative cyst rupture events were recorded. Five patients required additional spinal fixation with osteosynthesis material due to more severe bone involvement (Figure 2). Two patients experienced recurrence without cyst rupture during the primary surgery. One of them required two additional surgical procedures, and the other required one.

One patient developed a surgical site infection. Two patients presented new spinal foci, and one developed extravertebral involvement.

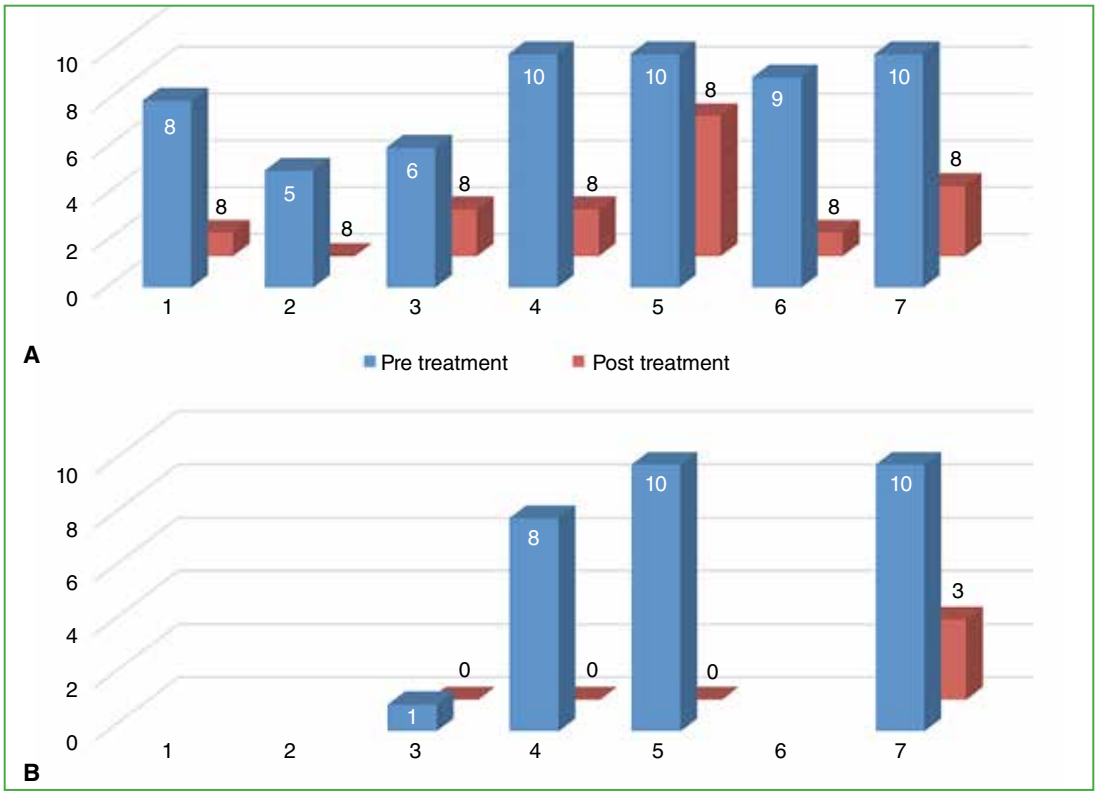

Figure 1. Pain intensity at the beginning and at the end of the evaluation. **A**. Axial spinal pain. **B**. Radiating pain.

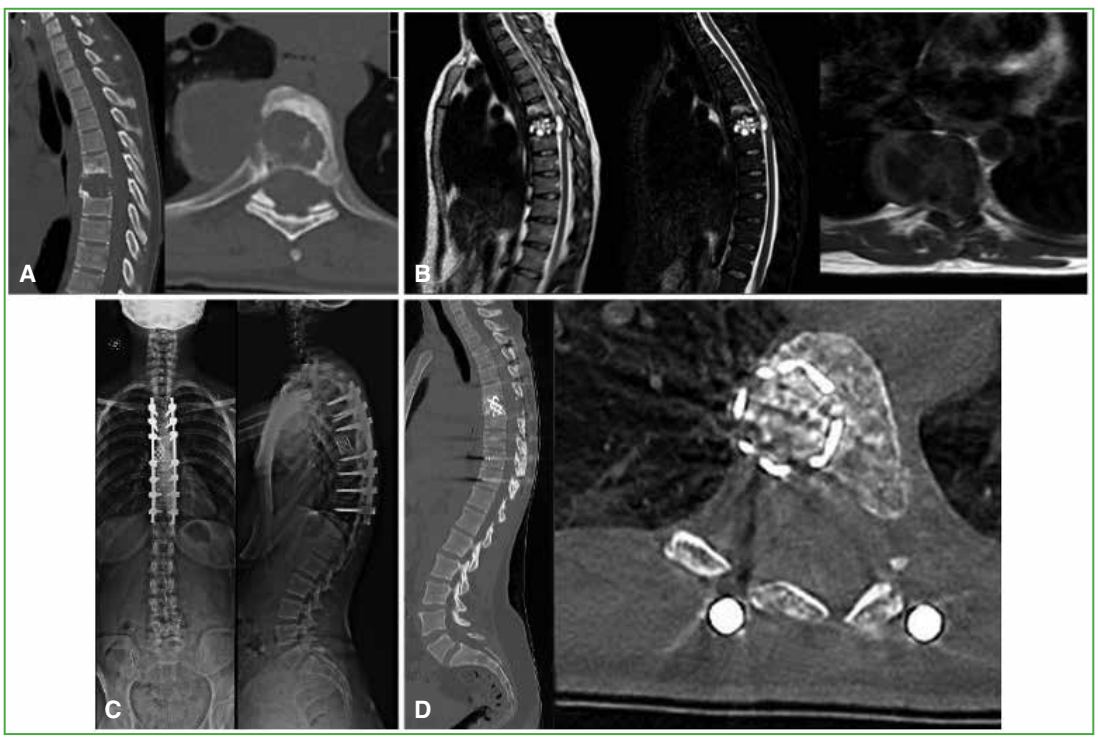

Figure 2. 37-year-old woman presenting with back pain and paraparesis. **A**. Computed tomography of the thoracic spine, sagittal and axial sections. **B**. Magnetic resonance imaging of the thoracic spine, sagittal section in T2 and STIR sequences and axial section in T1 sequence. **C**. Postoperative spinogram. **D**. Computed tomography of the thoracic region, sagittal and axial sections at two years of follow up.

DISCUSSION

Vertebral hydatid disease is a rare condition with slow progression that may lead to neurological complications.[1,2]

Currently, there is no expert consensus regarding the management of bone hydatid disease. Radical surgery has been proposed as a curative option,[7,9] but complete removal of spinal cysts is difficult to achieve, in addition to the potential complications related to the proximity of neural structures.[2]

Pharmacological treatment includes albendazole, with a recommended dose of 10 to 15 mg/kg/day for at least six continuous months, which improves prognosis and reduces the recurrence rate.[6,7]

Local recurrence is the most frequent postoperative complication. The main predisposing factor is cyst rupture during surgery. To reduce this risk, irrigation with hypertonic saline solution has been recommended.[2,7]

The review article by Cinalli et al.[2] included 99 patients with vertebral hydatid disease. Of these, 68.7% had thoracic involvement, 25% lumbar involvement, 2% cervicothoracic involvement, 2% sacral involvement, 1% thoracolumbar involvement, and 1% cervical involvement. Seventy six patients required between one and five surgical procedures, and 76% experienced local recurrence. In the present series, the most frequent location was more distal, involving the lumbosacral region. Two of seven cases presented local recurrence, which was not related to vesicle rupture.

CONCLUSIONS

In this series, vertebral hydatid disease predominantly affected men. The most common locations were the lumbosacral and sacral regions, and the most frequent extravertebral location was the liver.

At presentation, the pain scale indicated severe axial and radicular pain. Both types of pain responded very well to treatment. Neurological involvement was absent or minimal.

The usual treatment consisted of surgical resection with stabilization and administration of albendazole. Local recurrence remains the most frequent complication.

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REFERENCES

1. Sioutis S, Reppas L, Bekos A, Soulioti E, Saranteas T, Koulalis D, et al. Echinococcosis of the spine. *EFORT Open Rev* 2021;6(4):288-96. https://doi.org/10.1302/2058-5241.6.200130
2. Cinalli M, Zubieta Orihuela G, Alvarez Martini CA, Arrué A, Bazán PL. Tratamiento de la hidatidosis vertebral y factores que influyen en la recidiva local. Revisión sistemática. *Rev Asoc Argent Ortop Traumatol* 2026;91(1):50-5. https://doi.org/10.15417/issn.1852-7434.2026.91.1.2131
3. World Health Organization. *World Health Statistics 2015*. World Health Organization; 2015, p. 162.
4. Gezercan Y, Ökten AI, Çavuş G, Açık V, Bilgin E. Spinal hydatid cyst disease. *World Neurosurg* 2017;108:407-17. https://doi.org/10.1016/j.wneu.2017.09.015
5. Liang Q, Xiang H, Xu L, Wen H, Tian Z, Yunus A, et al. Treatment experiences of thoracic spinal hydatidosis: a single-center case-series study. *Int J Infect Dis* 2019;89:163-8. https://doi.org/10.1016/j.ijid.2019.09.024
6. Meng Y, Ren Q, Xiao J, Sun H, Huang Y, Liu Y, et al. Progress of research on the diagnosis and treatment of bone cystic echinococcosis. *Front Microbiol* 2023;14:1273870. https://doi.org/10.3389/fmicb.2023.1273870
7. Neumayr A, Tamarozzi F, Goblirsch S, Blum J, Brunetti E. Spinal cystic echinococcosis—a systematic analysis and review of the literature: part 1. Epidemiology and anatomy. *PLoS Negl Trop Dis* 2013;7(9):e2450. https://doi.org/10.1371/journal.pntd.0002450

8. Kaloostian PE, Gokaslan ZL. Spinal hydatid disease: a multidisciplinary pathology. *World Neurosurg* 2015;83(1):52-3. https://doi.org/10.1016/j.wneu.2013.07.106
9. Cattaneo L, Manciulli T, Cretu CM, Giordani MT, Angheben A, Bartoloni A, et al. Cystic echinococcosis of the bone: A european multicenter study. *Am J Trop Med Hyg* 2019;100(3):617-21. https://doi.org/10.4269/ajtmh.18-0758

Endoscopic Surgery for Lumbar Disc Disease: Our Experience in 136 Cases

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ABSTRACT

Introduction: Endoscopic spine surgery has grown exponentially worldwide in recent years and is mainly used for the treatment of disc herniation and spinal stenosis. Few studies addressing this technique have been published in our country; therefore, we considered it relevant to report our experience. **Materials and Methods:** A retrospective evaluation was conducted of patients who underwent endoscopic discectomy between December 2022 and December 2024, with a minimum follow-up of four months. The following variables were analyzed: sex, age, affected level and side, surgical approach, pre- and postoperative Visual Analog Scale (VAS) scores, presence or absence of neurological deficit, use of a surgical drill, operative time, complications, and disc recurrence. **Results:** A total of 136 patients were evaluated (mean age: 47 years), with a mean follow-up of 11.8 months. Radicular and lumbar VAS scores showed significant improvement at 30 days after surgery ($p < 0.001$). Seven cases of disc recurrence were recorded, along with one dural tear, two transient neurological deficits, and one postoperative hematoma. **Conclusions:** Endoscopic discectomy is a safe technique that achieves clinical outcomes comparable to those of traditional surgical approaches, with less tissue aggression and a low complication rate. Our results are consistent with those reported in the literature.

Keywords: Endoscopy; disc herniation; discectomy.
Level of Evidence: IV

Cirugía endoscópica para la enfermedad discal de la columna lumbar. Nuestra experiencia en 136 casos

RESUMEN

Introducción: La cirugía endoscópica de columna ha crecido exponencialmente durante los últimos años, en el mundo, y se emplea principalmente para el tratamiento de hernias de disco y estenosis. Se han publicado pocos estudios sobre esta técnica en nuestro país, por lo que consideramos interesante comunicar nuestra experiencia. **Materiales y Métodos:** Se evaluó retrospectivamente a pacientes sometidos a una discectomía endoscópica entre diciembre de 2022 y diciembre de 2024, y con un seguimiento mínimo de 4 meses. Se analizaron las siguientes variables: sexo, edad, nivel y lado afectado, vía de acceso, puntajes pre y posoperatorios de la escala analógica visual, presencia o no de déficit neurológico, empleo de taladro quirúrgico, duración del procedimiento, complicaciones y recidiva discal. **Resultados:** Se evaluó a 136 pacientes (edad promedio 47 años) con un seguimiento promedio de 11.8 meses. Los puntajes radicular y lumbar de la escala analógica visual mejoraron significativamente a los 30 días de la cirugía ($p <0,001$). Se registraron 7 recidivas discales, una rotura del saco dural, 2 déficits neurológicos transitorios y un hematoma posoperatorio. **Conclusiones:** La discectomía endoscópica es una técnica segura, y logra resultados clínicos similares a los de otras técnicas tradicionales, pero con un menor nivel de agresión y una baja tasa de complicaciones. Nuestros resultados son similares a los reportados en otros estudios.

Palabras clave: Endoscopia; hernia; discectomía.
Nivel de Evidencia: IV

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INTRODUCTION

The history of percutaneous endoscopic spine surgery dates back to 1989, when Schreiber, Suezawa, and Leu[1] added discoscopy to the percutaneous discectomy first described by Hijikata in 1975 and later popularized by Kambin, who introduced the description of the safety triangle that bears his name for accessing the intervertebral disc in 1986.[2] Subsequently, Mayer and Brock adopted this technique and were the first to compare endoscopic discectomy with microdiscectomy in 1993. Overall results were similar; however, patients who underwent the endoscopic procedure returned to work earlier. They also concluded that endoscopy was an appropriate procedure for patients with contained disc disease and small subligamentous disc herniations.[3] In 1999, Yeung popularized Kambin's approach by describing a surgical technique in which discectomy begins inside the disc and progresses outward in search of the herniation. This inside-out technique is associated with a higher risk of recurrence due to indirect visualization and annular damage.[4] For this reason, in 2005, Ruetten et al. refined the surgical technique and described the transforaminal and extraforaminal approach, which avoids entering the disc and directly targets the herniated fragment, thereby reducing residual pathology and recurrence.[5] Ruetten et al. also described the interlaminar approach, which is currently one of the most widely used techniques in endoscopic spine surgery.[6]

At present, endoscopic spine surgery is indicated for a wide range of spinal disorders, including intervertebral disc herniation, whether central, paracentral, foraminal, extraforaminal, or migrated, spinal stenosis, infectious spondylodiscitis such as pyogenic or epidural abscess, and revision surgeries such as recurrent disc herniation, interbody cage displacement, or bone cement leakage into the spinal canal.[7]

These indications are gradually expanding to include more complex procedures, such as interbody fusion and the treatment of spinal tumors.[7]

A large number of international studies have been published analyzing and reporting outcomes in patients undergoing endoscopic spine surgery, particularly for disc pathology. Many of these studies include comparisons with traditional surgical techniques. In Argentina, however, reports on this technique remain scarce.

The aim of this study was to analyze the outcomes achieved by our surgical team in patients who underwent endoscopic discectomy over a period exceeding two years.

MATERIALS AND METHODS

A descriptive and observational study was conducted with retrospective analysis of 136 patients who underwent endoscopic spine surgery between December 2022 and December 2024. All procedures were performed by the same surgical team at five surgical centers in the Autonomous City of Buenos Aires, Argentina.

Inclusion criteria were patients with no prior history of spine surgery who underwent lumbar endoscopic discectomy and had a minimum follow-up of four months. Exclusion criteria included patients with a history of spine surgery or those who underwent endoscopic procedures for other conditions, such as spondylodiscitis, recurrent disc herniation, or spinal stenosis.

Three transforaminal endoscopes were used: Elliquence® (Boca Raton, FL, USA), Joimax® (Irvine, CA, USA), and Hanover® (Whippany, NJ, USA), as well as an iLESSYS PRO® interlaminar endoscope (Joimax, Irvine, CA, USA). The selection of the endoscope was based solely on insurance coverage and availability, as all systems have similar technical characteristics. When bone resection was required to access the disc herniation, a Primado2® surgical drill (NSK, Shinagawa-ku, Tokyo, Japan) with a head compatible with the aforementioned endoscopes was used.

The following variables were recorded: sex, age, affected level and side, preoperative and postoperative visual analog scale scores, presence or absence of neurological deficit, surgical approach, use of a surgical drill, duration of the procedure, complications, and disc recurrence.

Surgical Technique

Transforaminal Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position, reducing lumbar lordosis to increase the cephalocaudal diameter of the foramen to be addressed. A posterolateral or lateral approach is selected according to the surgical objective. The height of the iliac crests and the position of the kidneys are considered as relevant anatomical landmarks. Using fluoroscopy, a strict anteroposterior view of the target level is obtained, ensuring that both endplates are parallel, the pedicles are equidistant, and the spinous process is centered. The midline is marked, as well as a lateral projection line over the disc with a 30-degree cephalocaudal angulation. A lateral fluo-

roscopic view is then obtained, and the entry point is marked, which may be located between the tip of the spinous process and the inferior articular facet. An 18-gauge spinal needle is introduced under anteroposterior fluoroscopic guidance and advanced to the pedicular midline, where resistance is typically felt, indicating disc entry. Position is confirmed with a lateral view. A guidewire is then inserted, followed by sequential dilators, placement of the working cannula, and insertion of the endoscope. The extruded disc fragment is identified and removed according to its location (Figure 1).

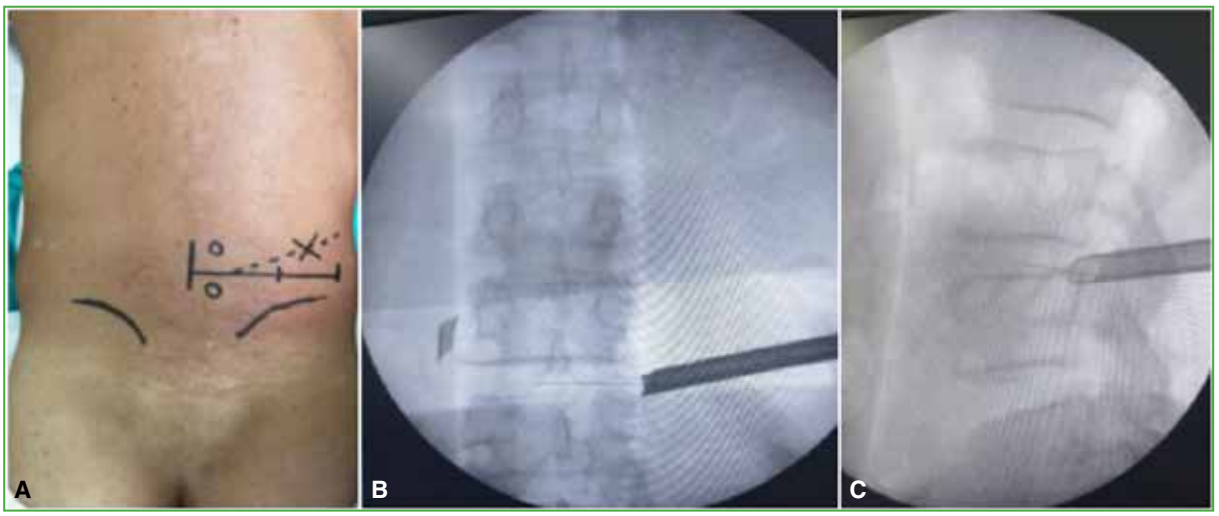

Figure 1. A. Marking of the midline and the lateral projection line on the disc at a 30° angle in the cephalocaudal direction. **B and C.** Anteroposterior and lateral fluoroscopic views showing the correct position of the guide pin.

Extraforaminal Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Unlike the transforaminal technique, a posterolateral approach is used and planned based on preoperative imaging (Figure 2), as extraforaminal disc herniations do not require a highly lateral entry point. This technique is technically challenging at the L5 S1 level due to interference from the iliac crests, making it more suitable for levels L4 L5 and above.

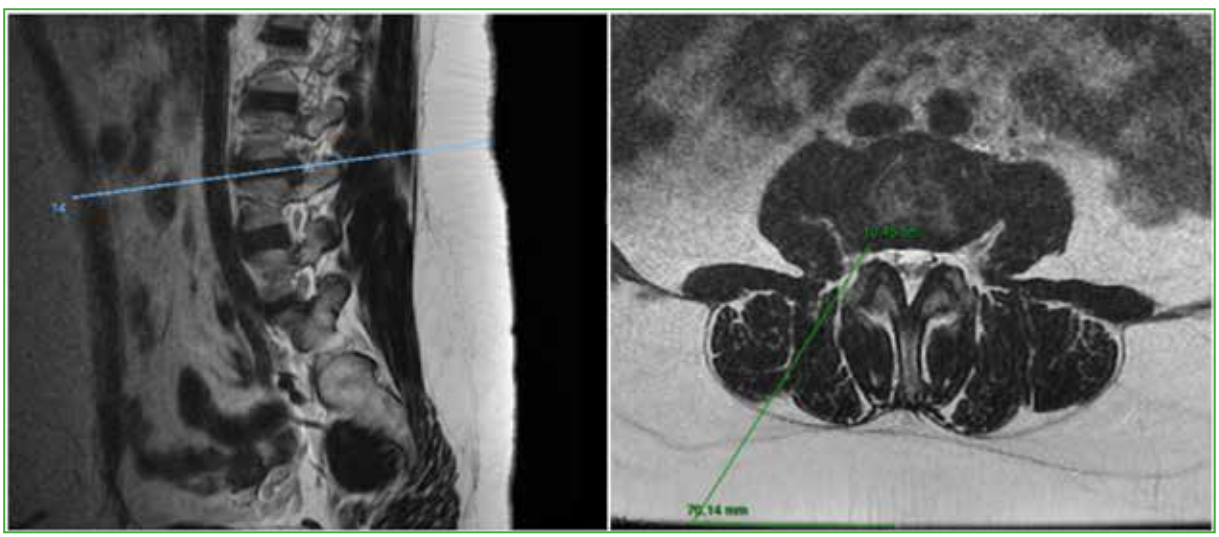

Figure 2. Preoperative planning of the extraforaminal approach on magnetic resonance imaging (sagittal and axial views).

A strict anteroposterior fluoroscopic view is obtained to visualize endplates parallel to the target disc. The midline is marked, followed by lateral marking according to the preoperative plan. The dilator is inserted and the endoscope is advanced. Fluoroscopic confirmation of correct positioning is performed. When planning is accurate, the extraforaminal disc herniation is usually the first structure visualized (Figure 3).

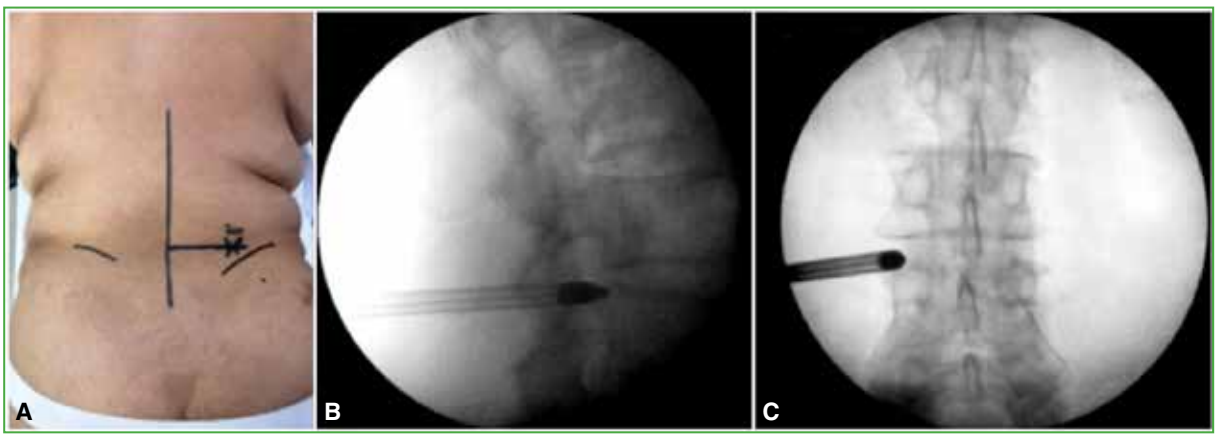

Figure 3. A. Marking of the midline and subsequent lateral marking according to preoperative planning.
B and C. Anteroposterior and lateral fluoroscopic control to verify the correct position of the dilator.

Interlaminar Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Using direct anteroposterior fluoroscopic guidance, the interlaminar window to be addressed is identified. A skin and fascial incision is performed, and the dilator is advanced. A lateral fluoroscopic view is obtained to confirm the working trajectory and to ensure adequate depth beyond the fascia. This step is particularly important in obese patients. The endoscope is inserted and the ligamentum flavum is identified. The ligament is opened in a medial to lateral direction until the epidural space is reached and neural structures are visualized. The nerve root is then gently mobilized medially, and the working cannula is advanced to allow disc fragment removal (Figure 4).

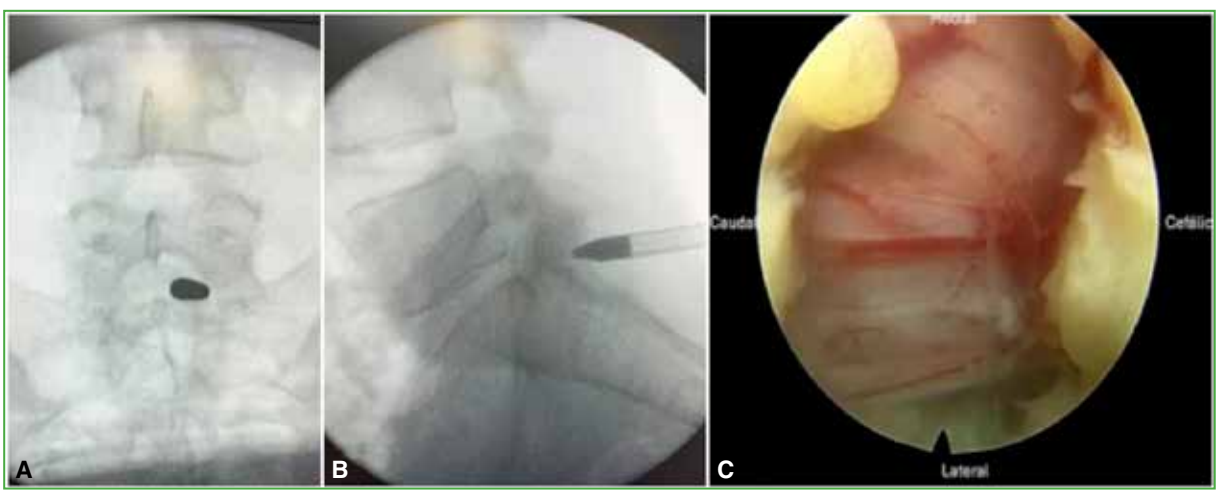

Figure 4. A and B. Anteroposterior and lateral fluoroscopic control confirming the correct position of the dilator.
C. Endoscopic view of the exiting nerve root and the dural sac.

L5-S1 Transfacet Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Using direct anteroposterior fluoroscopy, the tip of the superior articular facet of S1 is identified and marked with a 16-gauge needle. An 8 mm skin incision is made and the lumbar fascia is opened. The working cannula and endoscope are advanced together. Lateral drilling of the inferior vertebral facet is performed using a diamond burr. As space is progressively created in the medial and ventral directions, the cannula is advanced. Once the anterior cortical bone of the facet is identified, it is resected using a 3 mm Kerrison rongeur. Fluoroscopic confirmation of the correct working direction is then performed (Figures 5-7).

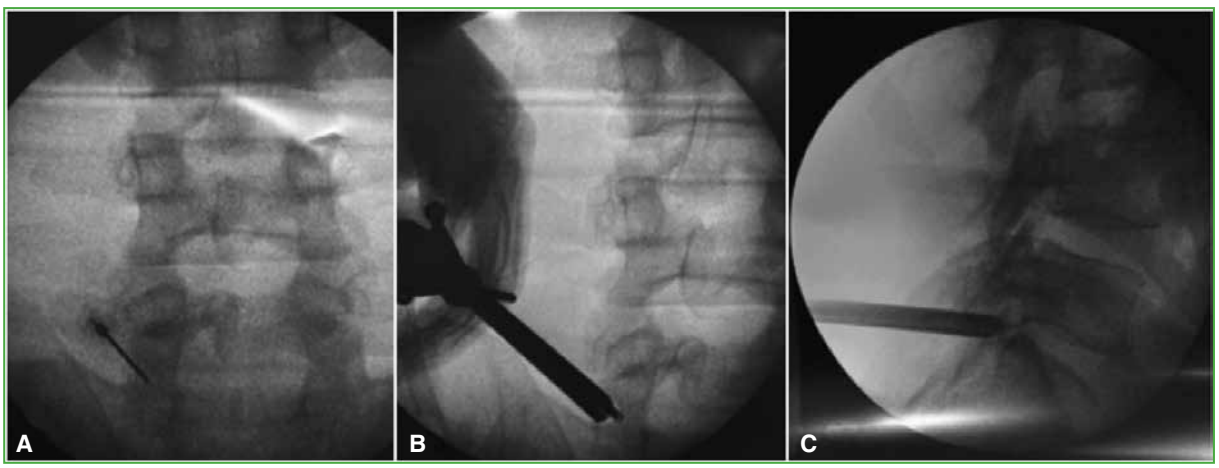

Figure 5. A. Fluoroscopic control to identify the left superior articular facet of S1 using a 16 G needle**.**
B and C. Anteroposterior and lateral fluoroscopic views showing the correct working trajectory.

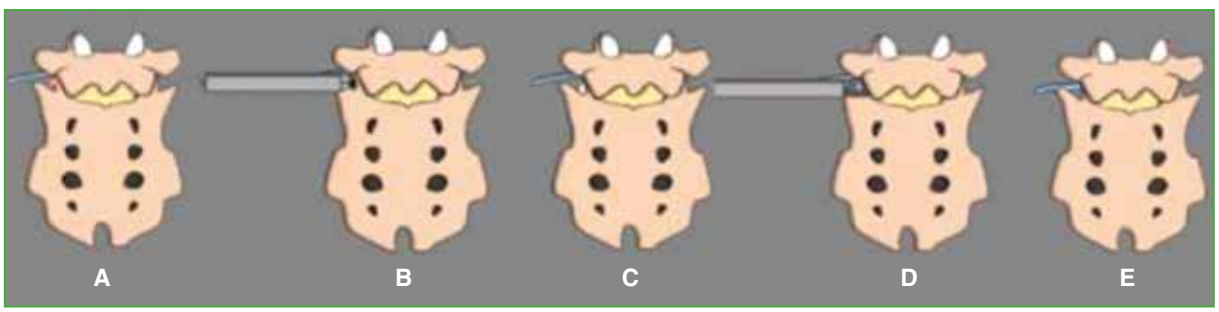

Figure 6. A. Lateral identification of the superior articular facet of S1. **B.** Drilling of the facet from lateral to medial and in a ventral direction. **C.** Visualization of the extruded disc fragment. **D.** Excision of the disc fragment. **E.** Free L5 nerve root.

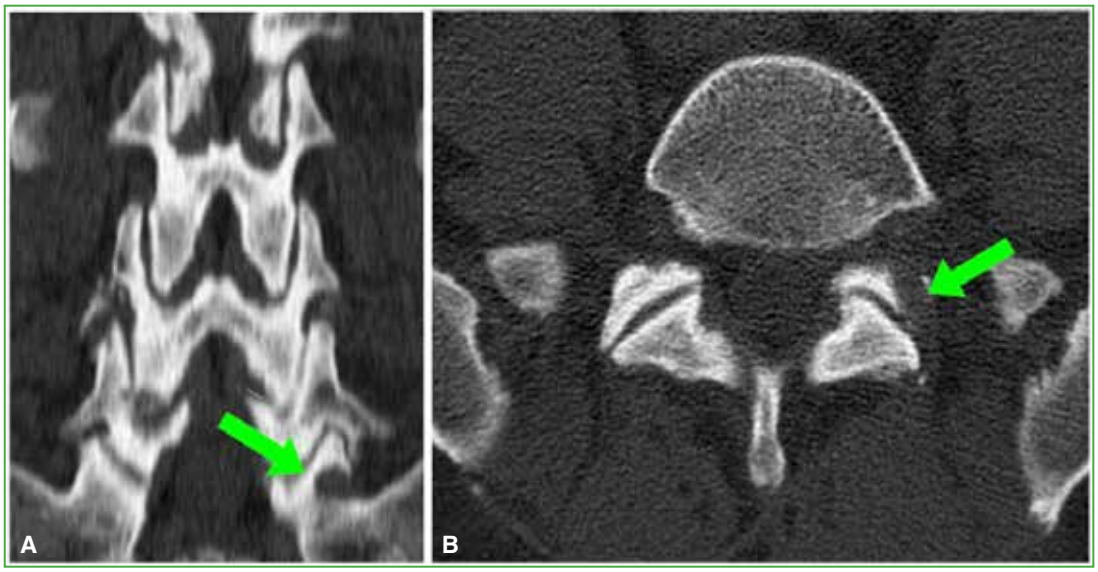

Figure 7. A and **B.** Postoperative computed tomography scan. Green arrows indicate the trajectory of the surgical drill through the facet.

Neuromonitoring

Seventy-two percent of the patients underwent intraoperative neuromonitoring, including motor and somatosensory evoked potentials of the lower limbs, as well as free-run and stimulated electromyography.

Rehabilitation

All patients were encouraged to begin standing and ambulation with the assistance of a physical therapist upon recovery from general anesthesia, which occurred between 90 and 180 minutes after surgery. Rehabilitation was delayed in patients who underwent surgery during evening or nighttime hours.

RESULTS

A total of 154 endoscopic spine surgeries were performed between December 2022 and December 2024. Eighteen patients were excluded for the following reasons: recurrent disc herniation in six cases, spondylodiscitis in two cases, lumbar spinal stenosis in six cases, loss to follow-up in three cases, and one patient in whom the endoscopic procedure was initiated but conversion to conventional discectomy was required due to technical difficulty with the approach. This last patient had a disc herniation initially treated endoscopically but required intraoperative conversion (Figure 8).

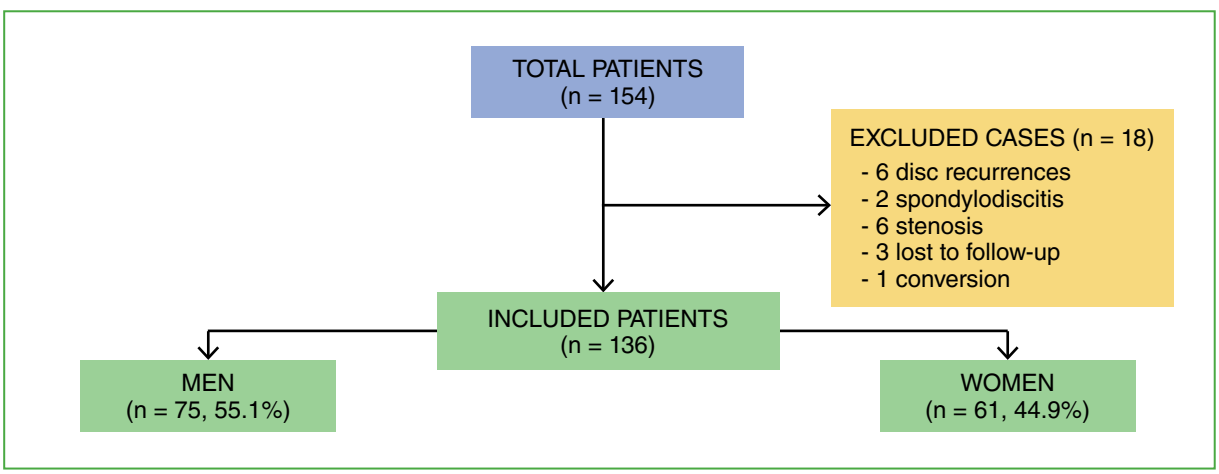

Figure 8. Flowchart of the study sample.

The final sample consisted of 136 patients who underwent surgery for lumbar disc herniation, all with a single affected level. Seventy-five patients (55.1%) were male and 61 (44.9%) were female. The mean age was 47.2 years, with a range from 18 to 83 years. The mean follow-up period was 11.8 months, ranging from 4 to 25 months. The left side was more frequently affected in 71 cases (52.2%), and the most commonly involved level was L5 S1 in 71 cases (52.2%), followed by L4 L5 in 42 cases (30.8%). Before surgery, 78.6% of patients presented with isolated radiculopathy, while the remaining 29 patients (21.4%) also exhibited some degree of motor deficit.

Although all four previously described surgical approaches were used, the interlaminar approach was the most frequently employed, accounting for 114 cases (83.2%), followed by the transforaminal approach in 10 cases (7.3%) (Figure 9). The mean operative time was 64 minutes, with a range from 15 to 195 minutes. When operative time was analyzed according to the surgical approach, extraforaminal discectomy was the fastest, with a mean duration of 47 minutes, whereas the transfacet approach had the longest mean operative time at 71 minutes.

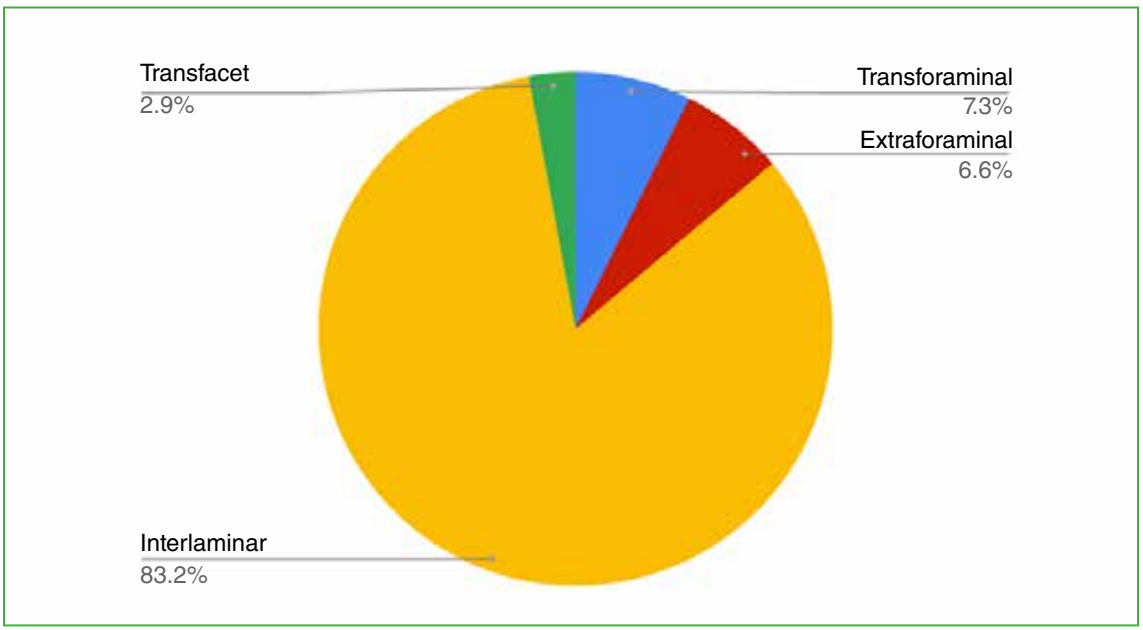

Figure 9. Distribution of surgical approaches performed.

In most patients (41.9%), the Elliquence® transforaminal endoscope was used. In 37% of cases, the use of a surgical drill was required. Patients ambulated at a mean of 3 hours after surgery, with a range from 1 to 5 hours. Hospital discharge occurred at a mean of 9 hours after completion of the procedure, ranging from 5 to 36 hours.

Regarding functional outcomes, the mean radicular visual analog scale score decreased from 8.5 preoperatively to 1.7 at 30 days ($p < 0.001$), to 0.7 at 3 months ($p < 0.001$), and to 0.2 at 6 months ($p < 0.001$). The 6-month evaluation included 97 patients with at least 6 months of follow-up. The mean lumbar visual analog scale score decreased from 1.6 preoperatively to 1.3 at 30 days ($p < 0.004$), to 0.9 at 3 months ($p < 0.001$), and to 0.5 at 6 months ($p < 0.001$), also evaluated in 97 patients with sufficient follow-up.

Four complications were recorded, representing 2.9% of the sample, including both intraoperative and postoperative events. One patient with an L4 L5 disc herniation treated via the interlaminar approach sustained a dural sac injury smaller than 2 mm. The tear was not repaired, and the patient had a favorable outcome without additional treatment. Two patients developed transient quadriceps paresis graded 3 out of 5 in the immediate postoperative period. Both had undergone a transforaminal approach, and the deficit was interpreted as neuropraxia caused by endoscope positioning and pressure on the nerve root. Both patients fully recovered muscle strength within 60 days following surgery, with rehabilitation and pregabalin at a dose of 75 mg per day. One patient presented with persistent pain and progressive loss of strength in the immediate postoperative period. Magnetic resonance imaging revealed a hematoma in the surgical field, which was drained endoscopically 36 hours after the initial procedure.

The patient showed good clinical evolution and fully recovered muscle strength within 48 hours. No surgical site infections were recorded.

Seven cases of disc recurrence were diagnosed, representing 5.1% of the sample. Recurrence occurred at a mean of 86 days after surgery, with a range from 3 to 240 days. In all recurrence cases, the initial approach had been interlaminar. One patient was treated with conventional surgery, while the remaining six underwent repeat endoscopic surgery. All patients had favorable outcomes (Table).

Table. Details of the seven disc recurrences.

	Recurrence 1	Recurrence 2	Recurrence 3	Recurrence 4	Recurrence 5	Recurrence 6	Recurrence 7
Sex	M	F	M	F	F	F	M
Age (years)	44	37	60	44	42	22	49
Level	L4-L5	L5-S1	L4-L5	L5-S1	L4-L5	L5-S1	L5-S1
Approach	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar
Surgical drill	No	No	Yes	No	Yes	No	No
Time to recurrence (days)	240	30	60	60	180	90	30
Endoscope system	Ellicuence®	Ellicuence®	Hanover®	Hanover®	Joimax®	Joimax®	Hanover®
Management	Endoscopic	Open	Endoscopic	Endoscopic	Endoscopic	Endoscopic	Endoscopic

F = female; M = male.

DISCUSSION

Endoscopic spine surgery is a minimally invasive procedure that represents the cutting edge of spinal surgery and is gradually gaining acceptance among spine surgeons.[8,9] This percutaneous technique is currently well established for decompression procedures. However, its use in other types of surgery, such as spinal fusion, tumor surgery, or deformity correction, remains under discussion. It has been demonstrated that this technique achieves clinical outcomes comparable to those of other minimally invasive and open techniques, as measured by the visual analog scale and the Oswestry Disability Index, while offering advantages such as reduced intraoperative blood loss, shorter operative time, and consequently, a lower complication rate.[7,8,10,11] In our study, although no direct comparison with other surgical techniques was performed, we observed not only a significant improvement in clinical scores but also early ambulation and rapid hospital discharge. Regarding discharge timing, it is important to note that this varied depending on the time of surgery. Patients operated on in the morning were discharged earlier, whereas those operated on in the afternoon or evening were usually discharged the following day.

Although endoscopic discectomy is considered a safe technique, it is not free of complications. Disc recurrence is undoubtedly the most frequent complication and has been reported to range from 4% to 12% in different studies.[7,12-14] Ren et al.[14] retrospectively evaluated 1159 patients who underwent endoscopic discectomy for disc herniation, with a mean follow-up of 38 months, and reported a disc recurrence rate of 11.2%, occurring on average 10 months after surgery. High body mass index, disc protrusions compared to extrusions, and Modic-type changes were identified as risk factors for recurrence. In contrast, a recent systematic review by Compagnone et al.[15] reported substantially lower recurrence rates, specifically 3.5% for the interlaminar approach and 3% for the transforaminal approach. In our series, the disc recurrence rate was 5.1%. When analyzing the seven patients who experienced recurrence, all shared certain characteristics, including preserved disc height and posterolateral herniations. Although this rate is relatively low compared with that reported in much of the international literature, it may increase with longer follow-up. Other complications described in the literature include dural sac injury, reported in 4% to 10% of cases, and nerve injury, reported in less than 3%.[7,12-14] Although both complications occurred in our series, the overall complication rate was low at 2.9%, and all affected patients recovered without permanent sequelae.

In Argentina, reports on endoscopic spine surgery are extremely scarce. The first was published by Dr. Antoni in 1994, describing interlaminar arthroscopic discectomy in 14 patients, with favorable outcomes.[16] In 2017, Van Isseldyk et al.[17] reported results in 42 patients, showing a significant decrease in the Oswestry Disability Index, with three reoperations due to persistent symptoms. In 2019, Frucella and Maldonado[18] evaluated 60 patients undergoing 77 endoscopic discectomies and reported significant improvement in functional scores, a 3.3% reoperation rate due to persistent symptoms in the immediate postoperative period, an 11.6% rate of persistent pain in the medium term, and one case of radicular deficit.

An important difference between our study and the aforementioned national series, as well as many international reports, is the predominant use of the interlaminar approach over the transforaminal approach. This choice was based exclusively on the surgical team's familiarity and comfort with this technique.

The main strength of this study is the large number of patients included, representing the largest national series published to date. However, several limitations must be acknowledged, including the retrospective design, the use of four different surgical approaches, and a minimum follow-up period of 4 months, which may be insufficient to fully assess long-term recurrence rates and could potentially influence the results.

CONCLUSIONS

Endoscopic discectomy is a safe surgical technique that achieves clinical outcomes comparable to those of traditional techniques, while offering the advantages of lower surgical invasiveness and a low complication rate. The results of our series are consistent with those reported in the existing literature.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Schreiber A, Suezawa Y, Leu H. Does percutaneous nucleotomy with discoscopy replace conventional discectomy? Eight years of experience and results in treatment of herniated lumbar disc. *Clin Orthop Relat Res* 1989;(238):35-42. PMID: 2910617
2. Mayer HM. A history of endoscopic lumbar spine surgery: What have we learnt? *Biomed Res Int* 2019;2019:4583943. https://doi.org/10.1155/2019/4583943
3. Mayer HM, Brock M. Percutaneous endoscopic discectomy: surgical technique and preliminary results compared to microsurgical discectomy. *J Neurosurg* 1993;78(2):216-25. https://doi.org/10.3171/jns.1993.78.2.0216
4. Yeung AT. Minimally invasive disc surgery with the Yeung Endoscopic Spine System (YESS). *Surg Technol Int* 1999;8:267-77. PMID: 12451541
5. Ruetten S, Komp M, Godolias G. An extreme lateral access for the surgery of lumbar disc herniations inside the spinal canal using the full-endoscopic uniportal transforaminal approach-technique and prospective results of 463 patients. *Spine (Phila Pa 1976)* 2005;30(22):2570-8. https://doi.org/10.1097/01.brs.0000186327.21435.cc
6. Ruetten S, Komp M, Godolias G. A new full-endoscopic technique for the interlaminar operation of lumbar disc herniations using 6-mm endoscopes: prospective 2-year results of 331 patients. *Minim Invasive Neurosurg* 2006;49(2):80-7. https://doi.org/10.1055/s-2006-932172
7. Chen KT, Kim JS, Huang AP, Lin MH, Chen CM. Current indications for spinal endoscopic surgery and potential for future expansion. *Neurospine* 2023;20(1):33-42. https://doi.org/10.14245/ns.2346190.095
8. Lewandrowski KU, Hellinger S, De Carvalho PST, Freitas Ramos MR, Soriano-Sánchez JA, Xifeng Z, et al. Dural tears during lumbar spinal endoscopy: Surgeon skill, training, incidence, risk factors, and management. *Int J Spine Surg* 2021;15(2):280-94. https://doi.org/10.14444/8038

9. Zhou C, Zhang G, Panchal RR, Ren X, Xiang H, Xuexiao M, et al. Unique complications of percutaneous endoscopic lumbar discectomy and percutaneous endoscopic interlaminar discectomy. *Pain Physician* 2018;21(2):E105-E112. PMID: 29565953
10. Gadjradj PS, Rubinstein SM, Peul WC, Depauw PR, Vleggeert-Lankamp CL, Seiger A, et al. Full endoscopic versus open discectomy for sciatica: randomised controlled non-inferiority trial. *BMJ* 2022;376:e065846. https://doi.org/10.1136/bmj-2021-065846
11. Gadjradj PS, Harhangi BS, Amelink J, van Susante J, Kamper S, van Tulder M, et al. Percutaneous transforaminal endoscopic discectomy versus open microdiscectomy for lumbar disc herniation: A systematic review and meta-analysis. *Spine (Phila Pa 1976)* 2021;46(8):538-49. https://doi.org/10.1097/BRS.0000000000003843
12. Wagner R, Haefner M. Indications and contraindications of full-endoscopic interlaminar lumbar decompression. *World Neurosurg* 2021;145:657-62. https://doi.org/10.1016/j.wneu.2020.08.042
13. Sauri-Barraza J, Silvia-Peña L. Endoscopic surgery in the lumbar spine: experience of the ABC Medical Center. *An Med ABC* 2023;68(3). https://doi.org/10.24875/AMH.M23000034
14. Ren G, Liu L, Zhang P, Xie Z, Wang P, Zhang W, et al. Machine learning predicts recurrent lumbar disc herniation following percutaneous endoscopic lumbar discectomy. *Global Spine J* 2024;14(1):146-52. https://doi.org/10.1177/21925682221097650
15. Compagnone D, Mandelli F, Ponzo M, Langella F, Cecchinato R, Damilano M, et al. Complications in endoscopic spine surgery: a systematic review. *Eur Spine J* 2024;33(2):401-8. https://doi.org/10.1007/s00586-023-07891-2
16. Antoni D, Claro M, Jañez R. Cirugía artroscópica del disco lumbar. *Artroscopía (Buenos Aires)* 1994;1(2):81-5. Available at: https://bit.ly/48d9eCT
17. Van Isseldyk F, Nicola T, Pastore J. Discectomía percutánea endoscópica lumbar (PELD): Análisis estadístico de 42 casos intervenidos en Argentina. *Revista Argentina de Neurocirugía* 2017;31:177-184. Available at: https://aanc.org.ar/ranc/items/show/619
18. Frucella G, Maldonado D. Discectomía endoscópica lumbar percutánea: Presentación de 60 casos intervenidos en Argentina con pacientes despiertos. *Surg Neurol Int* 2019;10(Suppl 1):S37-S45. https://doi.org/10.25259/SNI_325_2019

Factors Associated with Recurrence of Vertebral Fractures after Vertebroplasty in Older Adults

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ABSTRACT

Introduction: Osteoporotic vertebral fractures are a common cause of morbidity in older adults. Identifying risk factors for refracture is crucial to prevent complications. **Objective:** To evaluate clinical and imaging variables associated with vertebral refracture after vertebroplasty. **Materials and Methods:** An observational study was conducted including a consecutive series of patients who underwent vertebral cementation between 2017 and 2024. The cohort was divided into two groups according to the presence (refracture group, RG) or absence (non-refracture group, NRG) of refracture within two years, defined as a new fracture in either of the two vertebrae adjacent above or below the treated level. Clinical, surgical, and imaging variables were compared. Bone density was assessed using the mean Hounsfield units (HU) of the adjacent vertebrae. **Results:** A total of 118 patients were included (RG: 80; NRG: 38). No significant differences were observed in age, sex, or comorbidities between groups. A history of osteoporotic fracture was more frequent in the RG (42.67% vs. 21.62%, p = 0.03). The number of fractured vertebrae was higher in the RG (2 vs. 1, p = 0.005). Bone density below the treated vertebra was significantly lower in the RG (70 HU vs. 95.69 HU, p = 0.001). In multivariate analysis, lower bone density was the only independent predictor of refracture (OR 0.98; 95%CI 0.96–0.99). The median refracture-free interval was 12 months. **Conclusion:** Lower bone density in the vertebrae adjacent below the treated level is associated with a higher risk of vertebral refracture.

Keywords: Osteoporosis; vertebral fractures; Hounsfield units; vertebroplasty; bone density; kyphoplasty.
Level of Evidence: III

Factores asociados a la recurrencia de las fracturas vertebrales tras una vertebroplastia en el adulto mayor

RESUMEN

Introducción: Las fracturas vertebrales osteoporóticas constituyen una causa frecuente de morbilidad en adultos mayores. Identificar factores de riesgo de refractura resulta crucial para prevenir complicaciones. **Objetivo:** Evaluar variables clínicas e imagenológicas asociadas con la refractura vertebral. **Materiales y Métodos:** Estudio observacional de una serie consecutiva de pacientes sometidos a cementación entre 2017 y 2024. La cohorte se dividió en 2 grupos: con refractura (CF) y sin refractura (SF) dentro de los 2 años, definida como nueva fractura en las 2 vértebras adyacentes por encima o por debajo del nivel tratado. Se compararon variables clínicas, quirúrgicas e imagenológicas. La densidad ósea se midió usando el promedio de unidades Hounsfield (UH) en las vértebras adyacentes. **Resultados:** Se incluyó a 118 pacientes (CF 80, SF 38). No se observaron diferencias significativas en la edad, el sexo ni las comorbilidades. El antecedente de fractura osteoporótica fue más frecuente en el grupo CF (42,67% vs. 21,62%, p = 0,03). El número de vértebras fracturadas fue mayor en el grupo CF (2 vs. 1, p = 0,005). La densidad ósea debajo de la vértebra tratada fue significativamente menor en el grupo CF (70 UH vs. 95,69 UH, p = 0,001). En el análisis multivariado, la densidad ósea inferior fue el único factor predictivo independiente (OR 0,98; IC95% 0,96-0,99). La mediana de tiempo sin refractura fue de 12 meses. **Conclusión:** Una menor densidad ósea en las vértebras adyacentes inferiores al nivel tratado se asocia con un mayor riesgo de refractura.

Palabras clave: Osteoporosis; fracturas vertebrales; unidad Hounsfield; vertebroplastia; densidad ósea; cifoplastia.
Nivel de Evidencia: III

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INTRODUCTION

Osteoporotic vertebral fractures are common in older adults and are associated with pain, loss of function, and an increased risk of subsequent compression fractures. Vertebroplasty is a widely used technique to relieve pain and stabilize these fractures; however, refractures represent a relevant complication and have an impact on morbidity, mortality, and length of hospital stay.[1]

The risk of refracture has been attributed to several factors, including age, sex, bone density, and clinical history.[2] Bone density can be assessed using traditional methods such as dual-energy X-ray absorptiometry; however, recent studies have proposed the use of Hounsfield units (HU), obtained from computed tomography (CT) scans, as a useful tool for estimating local vertebral bone density.[3]

The aim of this study was to identify clinical, surgical, and imaging-related factors associated with vertebral refracture after vertebroplasty, with special emphasis on the analysis of bone density measured in HU in the vertebrae adjacent to the treated level.

MATERIALS AND METHODS

A retrospective observational study was conducted including patients who underwent vertebroplasty or kyphoplasty for an osteoporotic vertebral fracture between January 2017 and February 2024 at our hospital. Patients aged 50 years or older were included if they presented with low back pain associated with a vertebral fracture resulting from low-energy trauma, had evidence of a recent fracture on computed tomography, were initially treated with vertebroplasty or kyphoplasty, had complete imaging studies (computed tomography and magnetic resonance imaging), and had a minimum clinical follow-up of 12 months.

Patients with fractures caused by high-energy trauma, initial treatment with instrumented fixation, previous spinal surgery, burst fractures, neurological deficits, pathological fractures (tumoral or infectious), incomplete imaging studies, or loss to clinical follow-up were excluded.

Demographic and clinical variables were obtained from electronic medical records. The following data were recorded: age, body mass index, history of diabetes, smoking status, chronic corticosteroid use, bisphosphonate therapy, and history of vertebral fractures. Surgical parameters were also documented, including the location and number of fractured vertebrae, type of procedure performed (vertebroplasty or kyphoplasty), volume of cement injected, cement distribution pattern, presence of cement leakage (including intradiscal leakage), occurrence of refracture, and time elapsed until refracture.

All patients underwent a preoperative CT scan of the thoracic or lumbar spine using a 320-detector CT scanner (Toshiba Aquilion One). Trabecular bone density was assessed in HU using the PACS system. For each patient, two vertebrae above and two below the fractured level were selected. In each vertebra, an axial slice at the mid-vertebral body level was identified and correlated with the sagittal view. An oval region of interest (ROI) centered on the cancellous bone was placed, and the system automatically calculated the trabecular attenuation value. For analysis, the mean HU value of the two upper adjacent vertebrae and the mean HU value of the two lower adjacent vertebrae were used.

Percutaneous vertebroplasty was performed under general anesthesia and sterile conditions in the catheterization laboratory (Azurion 3 M12, Philips). With the patient in the prone position, the affected vertebra was accessed via a unilateral or bilateral transpedicular approach, depending on the case, under fluoroscopic guidance using anteroposterior and lateral views. Polymethyl methacrylate cement was injected slowly using a mechanical delivery system. At the end of the procedure, patients remained under observation for 4 hours and were discharged on the same day if no complications occurred.

Statistical Analysis

Categorical variables were analyzed using the χ^2 test, and continuous variables using Student's *t*-test. Variables that were statistically significant in the bivariate analysis were included in a multivariable logistic regression model to identify independent risk factors for refracture. Receiver operating characteristic (ROC) curve analysis was performed to assess the discriminatory ability of diagnostic variables and predictive models and to determine the optimal cutoff point for the mean HU value below the fractured vertebra, with the aim of facilitating its clinical application. Time free from refracture was estimated using Kaplan–Meier survival curves. A p value <0.05 was considered statistically significant.

RESULTS

The analysis included 476 patients, of whom 118 met the inclusion criteria. Eighty patients sustained refractures (RG), while 38 did not present new fractures (NRG). The proportion of women was similar between groups: 65 patients (81.25%) in the RG and 29 patients (78.38%) in the NRG ($p = 0.72$). Median age was 77 years (range 40–91) in the RG and 79 years (range 56–95) in the NRG ($p = 0.44$).

Regarding comorbidities, obesity was present in 3 patients (3.75%) in the RG and 3 patients (8.11%) in the NRG ($p = 0.32$). Twenty-four patients (30%) in the RG and 9 patients (24.32%) in the NRG were smokers ($p = 0.53$). Cardiovascular comorbidities were reported in 27 patients (33.75%) in the RG and 10 patients (27.03%) in the NRG ($p = 0.47$). Corticosteroid therapy was used by 9 patients (11.25%) in the RG and 2 patients (5.56%) in the NRG ($p = 0.33$), while bisphosphonate therapy was reported in 18 patients (22.5%) and 4 patients (11.11%), respectively ($p = 0.15$).

The number of fractured vertebrae was higher in RG patients (median 2, range 1–7) compared with NRG patients (median 1, range 1–4) ($p = 0.005$). Mean HU values above the fracture were significantly lower in the RG (mean 69.52; range 10–230) than in the NRG (mean 88.96; range 24.5–189.5) ($p = 0.01$). Similarly, mean HU values below the fracture were significantly lower in the RG (mean 70.00; range 14–135) compared with the NRG (mean 95.69; range 37.5–191.5) ($p = 0.001$).

Intraoperatively, trabecular cement distribution was similar between groups: 17 patients (21.25%) in the RG and 9 patients (24.32%) in the NRG ($p = 0.71$). Cement leakage into the adjacent intervertebral disc was observed in 11 patients (13.75%) in the RG and 5 patients (13.51%) in the NRG ($p = 0.97$).

In the multivariable logistic regression analysis, the mean HU value below the fracture was identified as an independent risk factor for refracture (odds ratio [OR] 0.98; 95% confidence interval [CI] 0.96–0.99). In contrast, the mean HU value above the fracture was not significantly associated with refracture (OR 1.00; 95% CI 0.98–1.02). A history of vertebral fracture (OR 1.59; 95% CI 0.59–4.28) and the number of fractured vertebrae (OR 1.47; 95% CI 0.91–2.35) were also not identified as significant risk factors. ROC curve analysis identified an optimal cutoff value of 87.75 HU for the mean HU value below the fracture, with a sensitivity of 75% and a specificity of 58.3%, according to Youden's index (Figure 1).

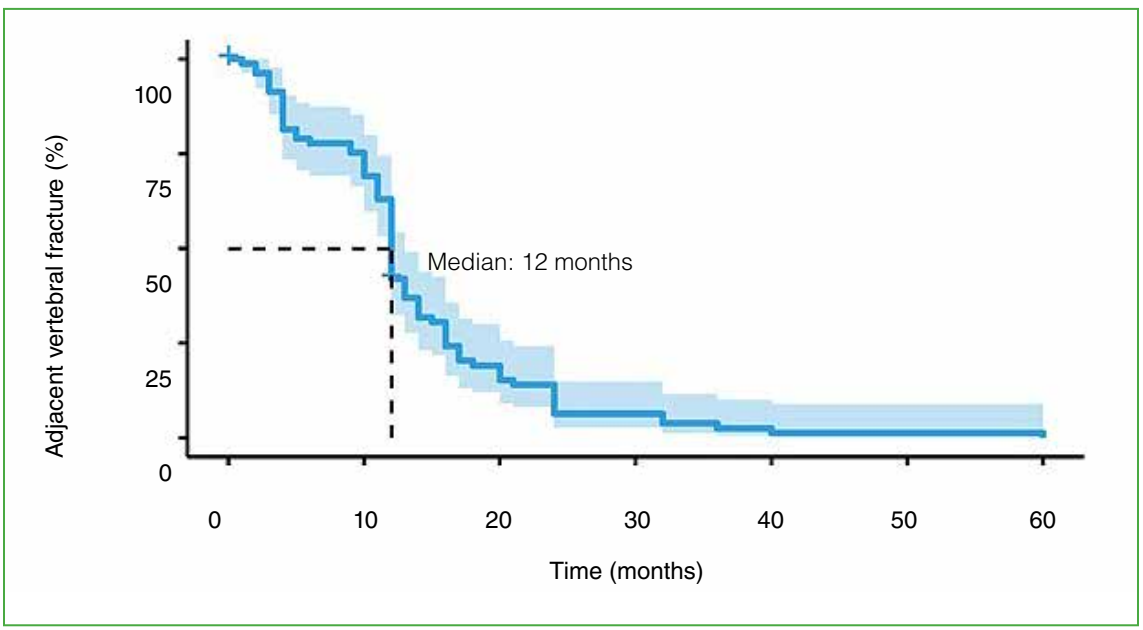

Figure 1. ROC curve of the average Hounsfield unit (HU) value below the fracture for predicting vertebral refracture.

Refracture-free survival, estimated using Kaplan–Meier curves, was 12 months (Figure 2).

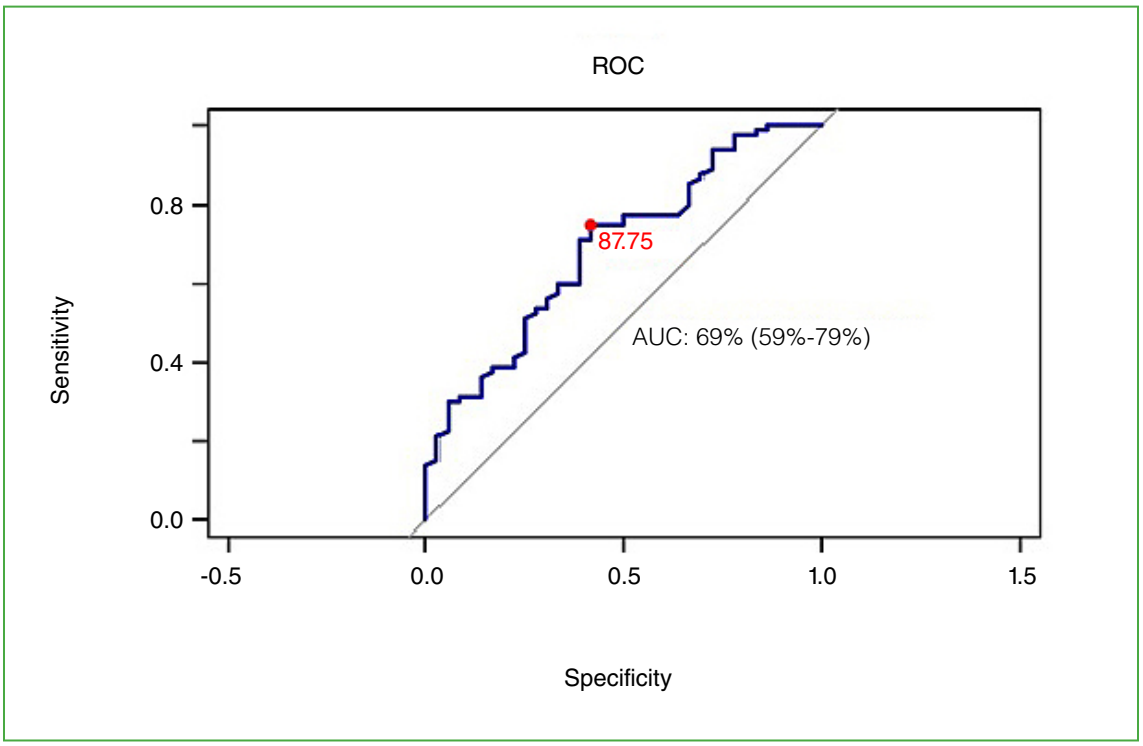

Figure 2. Time to refracture estimated using the Kaplan–Meier survival curve.

DISCUSSION

This study provides a comprehensive overview of vertebral refracture after vertebroplasty and the factors associated with its occurrence, with particular emphasis on the role of previous fractures and bone density in adjacent segments. Our main finding was that lower average bone density in the vertebrae located below the fractured level, measured in Hounsfield units (HU), constituted an independent risk factor for refracture following vertebroplasty.

An association between previous vertebral fractures and an increased incidence of new fractures in adjacent segments has been widely reported.[4] An initial fracture may predispose patients to subsequent fractures due to biomechanical alterations that modify load distribution along the spine, thereby increasing stress on neighboring vertebrae, particularly in inferior segments. Melton[5] previously demonstrated that vertebral fractures can weaken the surrounding bone structure, favoring the development of additional fractures. In our cohort, patients with prior fractures and a greater number of fractured vertebrae showed a higher refracture rate; however, these variables did not retain statistical significance in the multivariable analysis.

En investigaciones previas, se ha señalado que el uso prolongado de corticoides puede llevar a una reducción significativa en la densidad mineral ósea, incrementando el riesgo de fracturas.[6] Aunque, en nuestro estudio, el uso de corticoides no fue estadísticamente significativo como factor de riesgo para las refracturas, es importante señalar que los pacientes del grupo CF usaban el doble de corticoides que los del grupo SF (SF 5,56% vs. CF 11,25%). Esto sugiere que, aunque no hubo un impacto directo en los resultados, no se debe subestimar el efecto acumulativo de los corticoides en la salud ósea a largo plazo.

Our results also indicate that patients with a history of vertebral fractures exhibit lower bone density in adjacent segments, which may reflect structural weakening and increased vulnerability to refracture. This observation is consistent with the findings of Sornay-Rendu et al.,[7] who identified previous vertebral fractures as a strong pre-

dictor of bone loss in neighboring vertebrae. Together, these findings reinforce the concept that prior fractures contribute substantially to progressive deterioration of spinal bone health.

Identification of these risk factors is critical for optimizing clinical management. In this context, the cutoff value of 87.75 HU in vertebrae located below the fracture level, derived from ROC curve analysis, demonstrated a sensitivity of 75% and a specificity of 58%. This threshold may facilitate early identification of patients at increased risk of refracture. A preventive strategy incorporating regular monitoring of patients with previous fractures and application of this HU-based threshold could help reduce the incidence of new fractures. Additional interventions—such as bisphosphonate therapy, promotion of physical activity, and fall-prevention education—remain essential components of comprehensive osteoporosis management. This approach aligns with the 2019 World Health Organization recommendations, which emphasize early intervention in high-risk populations.

Several limitations of this study should be acknowledged. Its retrospective design may introduce selection bias and limits causal inference. Additionally, the study population was drawn from a single center, which may restrict the generalizability of the findings. Finally, the relatively small sample size may have limited the statistical power of certain analyses.

CONCLUSIONS

Patients with an average HU value below 87.75 in the vertebrae inferior to the fractured level are at increased risk of refracture after vertebroplasty. This finding establishes a clinically useful threshold for identifying particularly vulnerable individuals. In such patients, closer follow-up and proactive prevention-oriented education are recommended, as these strategies may improve quality of life and reduce morbidity associated with subsequent fractures.

Prospective studies are warranted to determine whether targeted interventions—such as preventive cement augmentation in this high-risk subgroup—could provide benefits beyond those achieved with conventional follow-up alone.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Jang HD, Kim EH, Lee JC, Choi SW, Kim K, Shin BJ. Current concepts in the management of osteoporotic vertebral fractures: a narrative review. *Asian Spine J* 2020;14(6):898-909. https://doi.org/10.31616/asj.2020.0594
2. Montero-Odasso MM, Kamkar N, Pieruccini-Faria F, Osman A, Sarquis-Adamson Y, Close J, et al.; Task Force on Global Guidelines for Falls in Older Adults. Evaluation of clinical practice guidelines on fall prevention and management for older adults: a systematic review. *JAMA Netw Open* 2021;4(12):e2138911. https://doi.org/10.1001/jamanetworkopen.2021.38911. Erratum in*: JAMA Netw Open* 2023;6(8):e2332257. https://doi.org/10.1001/jamanetworkopen.2023.32257
3. Zhang SB, Xu HW, Yi YY, Hu T, Wang SJ, Wu DS. Evaluation of the use of CT attenuation for the prediction of subsequent vertebral fracture in patients with osteoporosis. *Pain Physician* 2021;24(4):E493-E500. https://doi.org/10.1177/21514585211045204
4. Kanis JA, Bunlet N, Cooper C, Delmas PD, Borgstrom F, Rizzoli R, et al. European guidance for the diagnosis and management of osteoporosis in postmenopausal women. *Osteoporos Int* 2019;30:3-44. https://doi.org/10.1007/s00198-018-4704-5

5. Melton LJ 3rd. Adverse outcomes of osteoporotic fractures in the general population. *J Bone Miner Res* 2003;18(6): 1139-41. https://doi.org/10.1359/jbmr.2003.18.6.1139
6. Gonnelli S, Caffarelli C, Maggi S, Rossi S, Siviero P, Gandolini G, et al.; BREAK Study Group. The assessment of vertebral fractures in elderly women with recent hip fractures: the BREAK Study. *Osteoporos Int* 2013;24(4):1151-9. https://doi.org/10.1007/s00198-012-2119-2
7. Sornay-Rendu E, Duboeuf F, Chapurlat RD. Prior fractures and bone mineral density in elderly women: the OFELY study. *Bone* 2005;37:74-9. https://doi.org/10.1016/j.bone.2004.07.072

Is Facet Tropism Associated with Degenerative Disc Disease and the Laterality of Disc Protrusions?

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ABSTRACT

Objective: To evaluate whether an association exists between facet tropism (FT) and severe degenerative disc disease (DDD) at the same spinal level, and whether there is a correlation between the side of lumbar disc protrusion and the side of the more sagittally oriented facet joint at that level. **Materials and Methods:** Magnetic resonance imaging studies of 300 L4–L5 and L5–S1 levels were analyzed. Bilateral facet orientation angles, the difference in facet inclination between both sides, and the degree of disc degeneration were measured. In a subgroup of 93 L4–L5 and L5–S1 levels with disc protrusions, the correspondence between protrusion laterality and the side of the more sagittal facet joint was assessed. **Results:** No statistically significant association was found between FT and severe DDD (p = 0.0904). Likewise, no significant difference in facet inclination was observed between levels with mild and severe DDD (p = 0.9207). In the subgroup with lumbar disc protrusions, no statistically significant association was identified between the side of the protrusion and the side of the more sagittally oriented facet joint (p = 0.1500). **Conclusions:** No statistically significant association was found between facet tropism and severe degenerative disc disease at the L4–L5 and L5–S1 levels, nor between the side of disc protrusion and the side of the more sagittally oriented facet joint at those levels.

Keywords: Intervertebral disc degeneration; intervertebral disc displacement; facet tropism; lumbar spine.
Level of Evidence: III

¿Se asocia el tropismo facetario con la enfermedad degenerativa y la lateralidad de las protrusiones?

RESUMEN

Objetivos: Evaluar si existe una asociación entre la presencia de tropismo facetario y la enfermedad degenerativa del disco severa en ese nivel, y si existe una correlación entre el lado de la protrusión lumbar y el lado de la articulación facetaria más sagital en ese mismo nivel estudiado. **Materiales y Métodos:** Se evaluaron las imágenes de resonancia magnética de 300 niveles L4-L5 y L5-S1, midiendo los grados de inclinación facetaria bilateralmente, la diferencia entre la inclinación de las facetas de ambos lados y el grado de degeneración discal. En un subgrupo de 93 niveles L4-L5 y L5-S1 con protrusiones discales, se evaluó si la lateralidad se correspondía con el lado en el que la faceta era más sagital. **Resultados:** No se halló una asociación estadísticamente significativa entre el tropismo facetario y la enfermedad degenerativa del disco severa (p = 0,0904). Lo mismo ocurrió al comparar la diferencia de grados entre aquellos con enfermedad degenerativa del disco leve o severa (p = 0,9207). En el subgrupo con protrusiones lumbares, no se encontró una asociación estadísticamente significativa entre el lado de la protrusión y el lado de la faceta más sagital (p = 0,1500). **Conclusiones:** No halló una asociación estadísticamente significativa entre el tropismo facetario y la enfermedad degenerativa del disco severa en los niveles L4-L5 y L5-S1, ni entre el lado de la protrusión y el lado de la faceta más sagital en esos mismos niveles.

Palabras clave: Degeneración del disco intervertebral; desplazamiento del disco intervertebral; lumbar; tropismo facetario.
Nivel de Evidencia: III

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INTRODUCTION

Facet joints assist the intervertebral disc in load bearing, and their degeneration is associated with degenerative disc disease at the same spinal level, and vice versa, forming a functional complex of three joints per level. In addition, facet joints protect the disc from excessive torsional stress and contribute to segmental stability during flexion, extension, and rotation.[1-4] Facet orientation is defined as the angle of the facet joint relative to the sagittal plane and influences the degree of vertebral mobility and rotation along different axes.[2,3]

Facet tropism is defined as the difference in facet joint inclination between the right and left sides.[1,2,3,5] This asymmetry may generate abnormal loading of the facet joints and the intervertebral disc, thereby increasing the likelihood of disc damage. During lumbar spine flexion, the vertebra tends to rotate toward the side with the more coronally oriented facet joint, producing an unbalanced force on the disc. Over time, this may lead to annulus fibrosus damage on the more sagittally oriented side through a traction mechanism, thus predisposing to disc protrusion on that side. This same mechanism may also contribute to the development of degenerative disc disease at that level.[1,3,6-8]

The present study evaluated whether an association exists between the presence of facet tropism and severe degenerative disc disease at the same level. Additionally, we assessed whether there is a correlation between the side of lumbar disc protrusion and the side of the more sagittally oriented facet joint at that level.

In a previously published study that included a smaller number of analyzed levels, no statistically significant association was found between the degree of facet orientation asymmetry and the severity of degenerative disc disease. However, this analysis was secondary within that investigation.[9] In the present study, we evaluated a larger number of spinal levels to confirm or refute those findings.

MATERIALS AND METHODS

Magnetic resonance imaging studies were evaluated using a Siemens Espree 1.5 Tesla high field scanner. A total of 300 lumbar levels at L4 to L5 and L5 to S1 were analyzed in 150 patients, including 87 women and 63 men, with an age range from 33 to 82 years. Bilateral facet joint inclination angles were measured, as illustrated in Figure 1, along with the difference between facet inclinations on both sides and the degree of disc degeneration according to the Pfirrmann classification[9] shown in Figure 2.

Based on disc degeneration severity, patients were divided into two groups. Mild degenerative disc disease included Pfirrmann grades 1, 2, and 3, whereas severe degenerative disc disease included grades 4 and 5. Facet tropism was considered present when there was a difference of 5 degrees or more between the inclination of the facet joints on each side.[1,10] Facet angles were measured on the mid axial slice of the corresponding disc, parallel to the inferior endplate of the superior vertebral body.

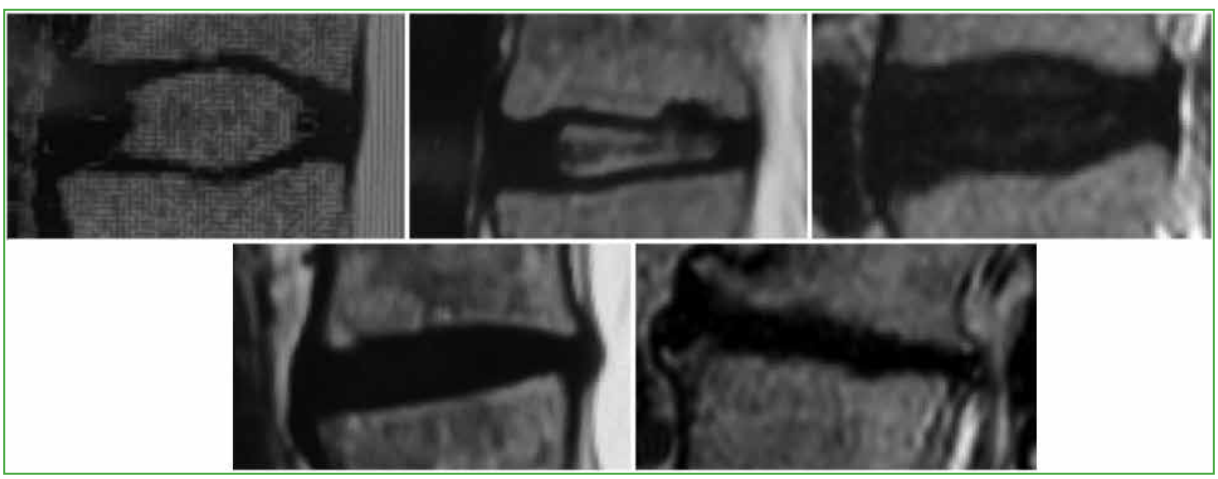

Figure 1. Measurement of facet orientation. The facet orientation angle was measured bilaterally relative to the sagittal plane on axial magnetic resonance imaging slices.

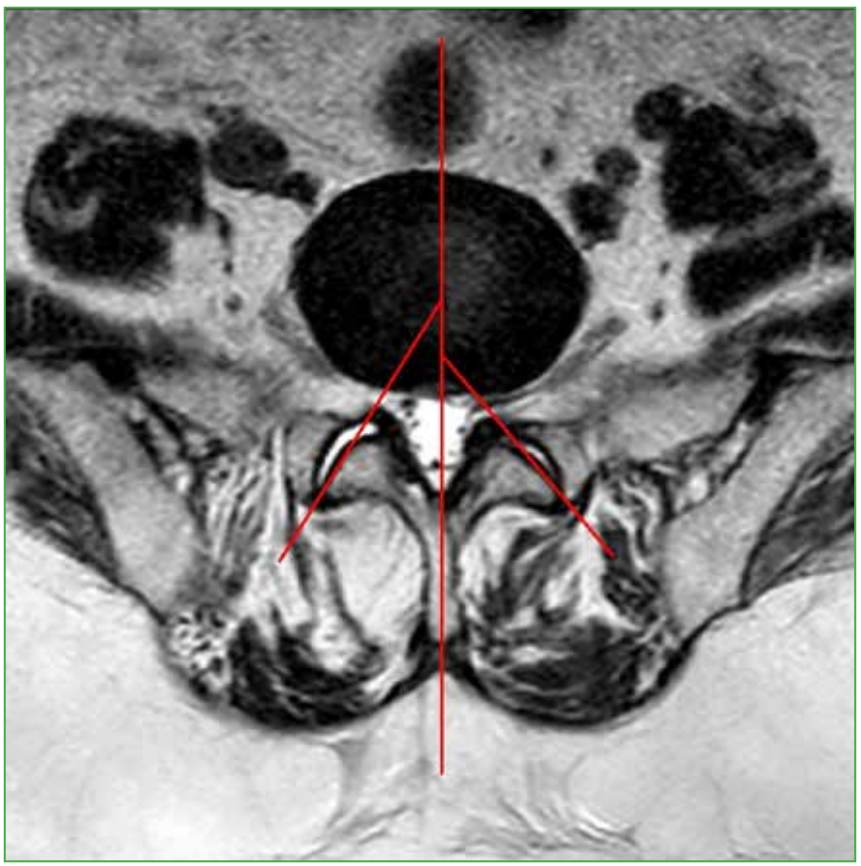

Figure 2. Pfirrmann classification of degenerative disc disease. Grade 1: homogeneous disc structure with preserved disc height. Grade 2: heterogeneous disc signal, with or without horizontal bands. Grade 3: gray disc with heterogeneous signal and unclear distinction between the annulus fibrosus and nucleus pulposus. Grade 4: gray to black disc with heterogeneous signal and decreased disc height. Grade 5: black, collapsed disc.

The primary objective of the study was to evaluate whether facet tropism is associated with more severe disc degeneration. To this end, levels were divided into two groups, with facet tropism and without facet tropism, and their association with the two degenerative disc disease groups was analyzed. In addition, the magnitude of the difference in facet inclination between sides was compared between the mild and severe degenerative disc disease groups. Furthermore, in a subgroup of 93 levels at L4 to L5 and L5 to S1 presenting with disc protrusions, we evaluated whether protrusion laterality corresponded to the side with the more sagittally oriented facet joint. For this analysis, disc protrusions were classified into two categories. One group included protrusions lateralized toward the side of the more sagittal facet joint, and the other included protrusions located on the less sagittal side or centrally and symmetrically distributed.

All analyses were performed per spinal level rather than per patient. All measurements were conducted exclusively by the authors of the study. All magnetic resonance imaging studies had been requested for evaluation of low back pain or lumbar radiculopathy.

Exclusion criteria included previous lumbar spine surgery, scoliosis, tumor, infection, or fracture in the lumbar region, lumbosacral transitional vertebra, and lytic spondylolisthesis. Upper lumbar levels were not included, as they have a different anatomical facet orientation, with a greater sagittal component, which could potentially affect the results.

Statistical Analysis

The Mann–Whitney test was used for quantitative variables, and Fisher's exact test was used for categorical variables. A p value <0.05 was considered statistically significant.

RESULTS

The results are shown in the Table. When evaluating the association between facet tropism and severe degenerative disc disease, no statistically significant association was found (p = 0.0904). Similarly, no statistically significant difference was observed when comparing the degree of facet inclination difference between levels with mild and severe degenerative disc disease (p = 0.9207). In the subgroup of patients with lumbar disc protrusions, no statistically significant association was found between the side of the protrusion and the side of the most sagittally oriented facet joint (p = 0.1500).

Table. Results.

	Mild DDD	Severe DDD	p
With FT (n = 102)	57	45	0.0904*
Without FT (n = 198)	106	92	
Difference in facet orientation	4.54	3.99	0.9207**
Subgroup of patients with lumbar protrusion			
	Towards the more sagittal side	Towards the less sagittal or central side	
With FT (n = 53)	17	36	0.1500*
Without FT (n = 40)	15	25	

FT = facet tropism; DDD = degenerative disc disease.
*Fisher's exact test; **Mann-Whitney test.

DISCUSSION

It remains unclear whether facet tropism is a consequence of disc and facet degeneration leading to progressive joint remodeling, or whether it represents a developmental condition that may, in turn, predispose to degenerative disc disease and facet degeneration. It is also possible that both mechanisms coexist.[3,4,11] The criteria used to define facet tropism vary widely in the literature. Although in this study we defined facet tropism as an asymmetry of 5 degrees or more between the orientation of the facet joints on each side, other studies have used thresholds ranging from 1 to 10 degrees, while some define facet tropism as a difference greater than one standard deviation.[1,5,10,11] These methodological differences may clearly influence the results reported across studies.

In contrast to studies reporting a significant correlation between facet tropism and degenerative disc disease, our study did not demonstrate an association between facet tropism and severe degenerative disc disease. This discrepancy may be partially explained by differences in how disc degeneration was classified. In the present study, degenerative disc disease was divided into mild and severe categories based on Pfirrmann grades, whereas other studies considered only the presence or absence of degeneration, or used different grading groupings.[2,9,12-15] Özdemir and Boyalı found no statistically significant relationship between facet tropism and degenerative disc disease at the L3 to L4, L4 to L5, and L5 to S1 levels.[13] Noren et al. also reported no association between the magnitude of facet tropism and the presence of degenerative disc disease at the same lumbar levels.[3] Vanharanta et al. found no significant correlation between the presence of facet tropism and degenerative disc disease, nor between the magnitude of the facet tropism angle and disc degeneration.[16] These findings are consistent with those of our study. Similarly, Boden et al. and Kong et al. reported no association between facet tropism and degenerative disc disease.[17,18] In contrast, Gao et al. reported that facet tropism was associated with three degenerative conditions related to disc disease: degenerative spondylolisthesis, degenerative scoliosis, and lumbar disc herniation.[14] Karatas et al. reported a significant association between facet tropism and degenerative disc disease at L5 to S1, while Pichaisak et al. observed a similar association at L4 to L5.[4,19]

Although no association was found in our study between the side of the most sagittally oriented facet joint and the side of disc protrusion, the literature presents conflicting results on this issue. Ke et al. reported that disc herniations at L4 to L5 were more frequent on the more sagittal facet side in patients aged 18 to 35 years.[9] Similar to our findings, Cassidy et al. found no association between the sagittal or coronal orientation of the facet joints and the side of disc herniation at L4 to L5 and L5 to S1.[10] Zhou et al. also failed to demonstrate such a correlation when evaluating all lumbar levels.[2] Degulmadi et al. reported an association between the more sagittal facet side and disc herniation at L4 to L5 and L5 to S1. They proposed that, during flexion and extension, the more coronal facet resists angular motion, whereas the more sagittal facet does not, allowing excessive rotation that generates indirect tension on the annulus fibrosus on the sagittal side, potentially leading to disc prolapse on that same side.[12] Conversely, Tisot et al. reported a statistically significant correlation between the more coronally oriented facet joint and the side of disc herniation. The authors suggested that lower resistance to shear forces on the coronal facet side results in increased rotational stress (*twist*) and progressive damage to the annulus fibrosus fibers on that side.[11]

This study has several limitations. Although 300 levels were analyzed, the presence of disc protrusions was not evaluated at all levels, which prevented analysis of the association between facet tropism and the development of lumbar disc protrusions. As a result, the subgroup of levels with protrusions was smaller than it could have been.

In addition, the association between facet tropism and spinal instability was not evaluated, as only magnetic resonance imaging was analyzed. However, this relationship has been partially studied previously, and no statistically significant association was reported.[1]

CONCLUSIONS

No statistically significant association was found between facet tropism and severe degenerative disc disease at the L4 to L5 and L5 to S1 levels. Likewise, no association was identified between the side of the disc protrusion and the side of the most sagittally oriented facet joint at these same levels.

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REFERENCES

1. Bendersky D, Asem M, Navarrete O. Lumbar facet effusions and other degeneration parameters and its association with instability. *Neurol India* 2022;70(Suppl):S224-S229. https://doi.org/10.4103/0028-3886.360912
2. Zhou Q, Teng D, Zhang T, Lei X, Jiang W. Association of facet tropism and orientation with lumbar disc herniation in young patients. *Neurol Sci* 2018;39(5):841-6. https://doi.org/10.1007/s10072-018-3270-0
3. Noren R, Trafimow J, Andersson GB, Huckman MS. The role of facet joint tropism and facet angle in disc degeneration. *Spine (Phila Pa 1976)* 1991;16(5):530-2. https://doi.org/10.1097/00007632-199105000-00008
4. Pichaisak W, Chotiyarnwong C, Chotiyarnwong P. Facet joint orientation and tropism in lumbar degenerative disc disease and spondylolisthesis. *J Med Assoc Thai* 2015;98(4):373-9. PMID: 25958712
5. Yadav S, Arya R, Dakshinamoorthy R, Jha AA, Jain S, Kumar I. Facet tropism/inclination and its association with intervertebral disc herniation in the lumbar spine – a radiological evaluation. *Rev Bras Ortop* 2022;57(6):941-6. https://doi.org/10.1055/s-0042-1742338
6. Lai Q, Liu Y, Guo R, Lv X, Wang Q, Zhu J, et al. A study of lumbar disc herniation and facet joint asymmetry. *Int Surg* 2018;103(1-2):87-94. https://doi.org/10.9738/INTSURG-D-16-00119.1
7. Karacan I, Aydin T, Sahin Z, Cidem M, Koyuncu H, Aktas I, et al. Facet angles in lumbar disc herniation: their relation to anthropometric features. *Spine (Phila Pa 1976)* 2004;29(10):1132-6. https://doi.org/10.1097/00007632-200405150-00016

8. Samartzis D, Cheung JP, Rajasekaran S, Kawaguchi Y, Acharya S, Kawakami M, et al. Is lumbar facet joint tropism developmental or secondary to degeneration? An international, large-scale multicenter study by the AOSpine Asia Pacific Research Collaboration Consortium. *Scoliosis Spinal Disord* 2016;11:9. https://doi.org/10.1186/s13013-016-0062-2
9. Ke S, Sun T, Zhang W, Zhang J, Li Z. Are there correlations between facet joint parameters and lumbar disk herniation laterality in young adults? *J Clin Neurosci* 2023;109:50-6. https://doi.org/10.1016/j.jocn.2023.01.013
10. Cassidy JD, Loback D, Yong-Hing K, Tchang S. Lumbar facet joint asymmetry. Intervertebral disc herniation. *Spine (Phila Pa 1976)* 1992;17(5):570-4. PMID: 1621158
11. Tisot RA, Vieira JDS, Collares DDS, Stumm LD, Fontana MF, Pasini A, et al. Influence of facet tropism on the location of lumbar disc herniation. *Coluna/Columna* 2018;17(1):23-6. https://doi.org/10.1590/S1808-185120181701179264
12. Degulmadi D, Dave B, Krishnan A, Patel D. The relationship of facet joint orientation and tropism with lumbar disc herniation and degenerative spondylolisthesis in the lower lumbar spine. *Asian Spine J* 2019;13(1):22-8. https://doi.org/10.31616/asj.2018.0116
13. Özdemir Ö, Boyalı O. Relationship between facet tropism, lumbar degeneration and facet degeneration. *J Turk Spinal Surg* 2023;34(1):13-7. https://doi.org/10.4274/jtss.galenos.2022.54254
14. Gao T, Lai Q, Zhou S, Liu X, Liu Y, Zhan P, et al. Correlation between facet tropism and lumbar degenerative disease: a retrospective analysis. *BMC Musculoskelet Disord* 2017;18(1):483. https://doi.org/10.1186/s12891-017-1849-x
15. Alonso F, Kirkpatrick CM, Jeong W, Fisahn C, Usman S, Rustagi T, et al. Lumbar facet tropism: a comprehensive review. *World Neurosurg* 2017;102:91-6. https://doi.org/10.1016/j.wneu.2017.02.028
16. Vanharanta H, Floyd T, Ohnmeiss DD, Hochschuler SH, Guyer RD. The relationship of facet tropism to degenerative disc disease. *Spine (Phila Pa 1976)* 1993;18(8):1000-5. https://doi.org/10.1097/00007632-199306150-00008
17. Boden SD, Riew KD, Yamaguchi K, Branch TP, Schellinger D, Wiesel SW. Orientation of the lumbar facet joints: association with degenerative disc disease. *J Bone Joint Surg Am* 1996;78(3):403-1. https://doi.org/10.2106/00004623-199603000-00012
18. Kong MH, He W, Tsai YD, Chen NF, Keorochana G, Do DH, et al. Relationship of facet tropism with degeneration and stability of functional spinal unit. *Yonsei Med J* 2009;50(5):624-9. https://doi.org/10.3349/ymj.2009.50.5.624
19. Karatas Y, Kaya B, Kalkan E. The relationship of facet tropism with disc degeneration at L5-S1 level. *Clin Surg* 2019;4:2569. Available at: https://www.clinicsinsurgery.com/open-access/the-relationship-of-facet-tropism-with-disc-degeneration-at-l5-5139.pdf

Our Experience in the Management of Dural Tears in Lumbar Spine Surgery

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ABSTRACT

Introduction: Incidental durotomy is a recognized complication in spine surgery. Its management usually includes suturing and, occasionally, augmentation techniques; however, there is no consensus regarding the optimal treatment strategy. The aim of this study was to present our institutional experience in the management of incidental durotomy using a standardized dural repair protocol. **Materials and Methods:** A retrospective study was conducted including 1,040 patients who underwent posterior lumbosacral spine surgery for herniated or degenerative disc disease between 2000 and 2023. Procedures included discectomy, decompression with or without arthrodesis and instrumentation, in both primary and revision surgeries. Thirty-seven patients with incidental durotomy were identified and treated according to an institutional protocol, with a minimum follow-up of two years. **Results:** Thirty-seven of the 1,040 patients (mean age: 48 years) sustained a dural tear. All cases were diagnosed intraoperatively and treated with 4-0 nylon sutures, with local fascia augmentation according to defect size; 11 patients required augmentation. Three patients developed persistent cerebrospinal fluid leakage without associated symptoms, which was successfully managed with bed rest, Trendelenburg positioning, and acetazolamide. Two patients developed surgical site infection and required debridement and targeted antibiotic therapy. No recurrences were observed during follow-up. **Conclusions:** The institutional protocol for the management of incidental durotomy proved effective in preventing complications, reducing morbidity, and lowering associated healthcare costs. Its systematic application may contribute to standardizing the management of this complication in spine surgery.

Keywords: Durotomy; augmentation; fascia; tear.

Level of Evidence: IV

Nuestra experiencia con el tratamiento del desgarro dural en la cirugía de columna lumbar

RESUMEN

Introducción: La durotomía incidental es una complicación reconocida en la cirugía de columna, y su manejo incluye sutura y, en ocasiones, técnicas de aumentación; sin embargo, no existe consenso sobre el tratamiento ideal. El objetivo de este artículo es presentar la experiencia institucional en el manejo de este cuadro mediante un protocolo estandarizado de reparación dural. **Materiales y Métodos:** Se realizó un estudio retrospectivo de 1040 pacientes operados mediante un abordaje posterior de columna lumbosacra por enfermedad herniaria o degenerativa discal, entre 2000 y 2023. Los procedimientos incluyeron discectomía, descompresión con o sin artrodesis e instrumentación, tanto en cirugías primarias como de revisión. Se identificó a 37 pacientes con durotomía incidental, tratados según un protocolo institucional y con un seguimiento mínimo de 2 años. **Resultados:** Treinta y siete de los 1040 pacientes (edad promedio 48 años) tenían un desgarro dural. A todos se los diagnosticó durante la cirugía y trató con sutura de nailon 4.0 y aumentación con fascia local según el tamaño del defecto; 11 pacientes requirieron esta técnica. Tres tuvieron una filtración persistente de líquido cefalorraquídeo, sin síntomas, tratada exitosamente con reposo, posición de Trendelenburg y acetazolamida. Dos desarrollaron una infección en el sitio quirúrgico, y requirieron limpieza y antibioticoterapia específica. No se registraron recidivas durante el seguimiento. **Conclusiones:** El protocolo institucional de reparación de las durotomías incidentales demostró ser efectivo, permitió prevenir complicaciones, disminuir la morbilidad y reducir los costos asociados. Su aplicación sistemática podría contribuir a estandarizar el manejo de esta complicación en la cirugía de columna.

Palabras clave: Durotomía; aumentación; fascia; desgarro.

Nivel de Evidencia: IV

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INTRODUCTION

Incidental durotomy is a well-recognized complication of lumbar spine surgery. In a review of 641 patients who underwent lumbar spine surgery, Wang et al.[1] reported an incidental durotomy rate of 14%. Jones et al.[2] analyzed 450 patients who underwent lumbar spine surgery and reported a prevalence of incidental durotomy of 4%. Overall, reported prevalence rates range from 1% to 17%, depending on the series evaluated and the type of procedure performed.[3-9] Incidental durotomy is more frequent in revision procedures, in patients who have received radiotherapy, or in those who have undergone epidural corticosteroid injections within the three months preceding surgery.[10-12] Although several studies have shown that long-term outcomes in patients who undergo dural tear repair are favorable and even comparable to those of patients without dural tears, medicolegal complications may arise and procedural costs may increase.[1,2] In a review of malpractice litigation related to spine surgery, Goodkin and Laska reported that 23 of 146 cases, corresponding to 16%, were associated with dural tears. [13]

Several consequences or sequelae have been described, including pseudomeningocele formation, nerve root inflammation associated with sciatica or paresis, postural headache, and, when a persistent dural tear with cerebrospinal fluid fistula is present, meningitis, arachnoiditis, delayed wound healing, or surgical site infection.[3,4,14-16]

The objective of this article is to present the management of dural tears using a standardized treatment protocol implemented at our institution.

MATERIALS AND METHODS

A retrospective case series study was conducted following a repair protocol consisting of primary suture reinforced with lumbar fascia augmentation in patients with durotomy during lumbar spine surgery.

The study period extended from January 2000 to December 2023. A total of 1,040 patients who underwent surgery for disc disease of the lumbosacral spine were reviewed. Inclusion criteria comprised posterior approach procedures, including discectomy and decompression with or without arthrodesis and with or without instrumentation. Both primary and revision surgeries for lumbar degenerative disease were included, provided that all procedures were performed by the same surgical team. Patients who underwent thoracic spine surgery, those operated on through approaches other than posterior, and patients referred from other institutions with cerebrospinal fluid fistula were excluded.

All dural tears were identified intraoperatively and managed using the repair technique described below.

Repair Technique

All dural tears were repaired using 4.0 nylon with a continuous suture. Depending on tear length, greater than 10 mm, and the quality of the dura mater, repair was reinforced with augmentation using lumbar fascia harvested from the same patient at the surgical site, in 11 cases. Repair was performed with the patient in the Trendelenburg position and was assessed using the Valsalva maneuver after returning the patient to the neutral position. The fascia was closed with Vicryl® 0, the subcutaneous tissue with Vicryl® 2.0, and the skin with 3.0 nylon. No drains were used. Antibiotics were administered for 48 hours, and thromboembolism prophylaxis was maintained until patient ambulation.

Bed rest ranged from 5 to 7 days, depending on the repaired lesion and local wound conditions. Sitting was initiated on postoperative day 5, and standing on postoperative day 6 or 7.

Treatment Protocol

If an incidental durotomy occurs during surgery, primary repair with continuous suture is performed when defects measure less than 10 mm and the dura mater is preserved. Augmentation with local fascia is performed when defects measure more than 10 mm or when there is dural tearing.

In the immediate postoperative period, in cases of asymptomatic cerebrospinal fluid fistula without infection, bed rest, Trendelenburg positioning, and acetazolamide are indicated. Other options include epidural blood patch, wound sealing, and lumbar drainage. In patients with symptomatic fistula and infection, wound debridement and revision of the repair are indicated. In patients with symptoms without infection, the indication for surgical versus conservative treatment depends on the presence or absence of neurological symptoms (Figure).

Using this treatment protocol, all cases of incidental durotomy or cerebrospinal fluid fistula were resolved without sequelae.

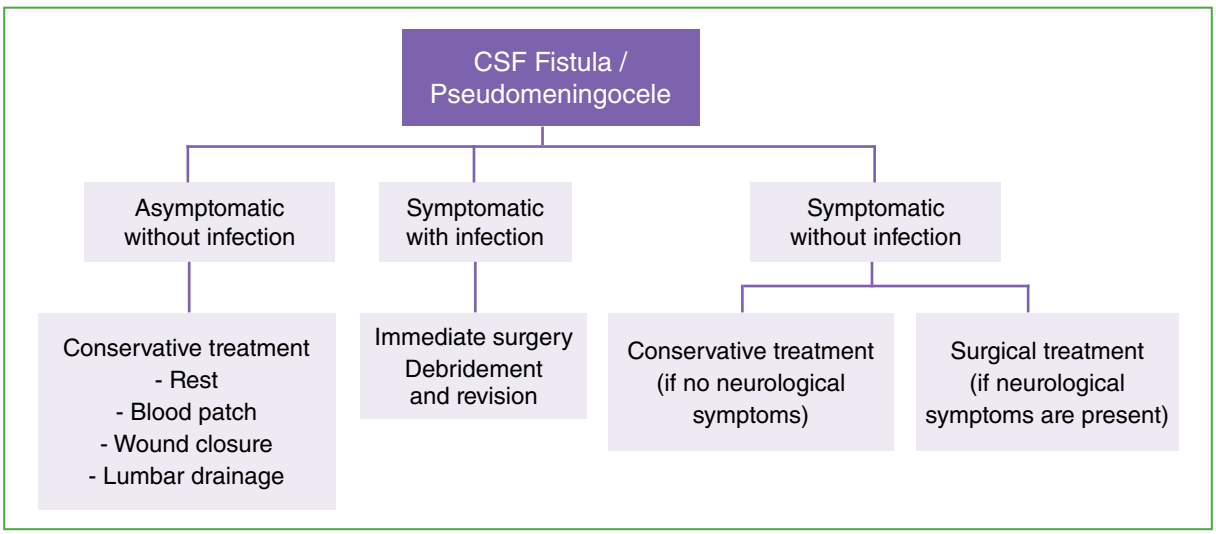

Figure. Management of cerebrospinal fluid fistula according to the protocol.
CSF = cerebrospinal fluid.

RESULTS

Thirty-seven of the 1,040 patients, corresponding to 3.5 percent, had a dural tear. The mean age was 48 years. Twenty-six cases, representing 70.2 percent, were repaired with suture alone, and 11 cases, corresponding to 29.7 percent, required augmentation with lumbar fascia. All dural tears were identified and treated intraoperatively. Thirty-two percent of the cohort, corresponding to 12 patients, had undergone previous surgery (Table).

Table. Type of surgery and incidence of dural tears.

	Number of patients	Number of patients with tears	% of dural tear
Primary surgeries	728	25	3.4
Revision surgeries	312	12	3.8
Total surgeries	1040	37	3.5

In three patients who underwent revision surgery, representing 8 percent, cerebrospinal fluid leakage from the wound persisted without symptoms or signs of infection. In these cases, bed rest in the Trendelenburg position was prolonged and acetazolamide was administered at a dose of 250 mg orally every 8 hours. Leakage resolved after three weeks of bed rest.

Two patients (5.4%) who underwent revision surgery developed surgical site infection and required wound debridement and revision of the dural defect, together with targeted antibiotic therapy.

In all patients, the condition resolved without sequelae or recurrence after more than two years of follow-up.

Fourteen patients underwent postoperative magnetic resonance imaging for reasons unrelated to the dural tear. In four of these patients, a pseudomeningocele was detected, without clinical consequences.

DISCUSSION

Therapeutic options for dural tears include primary repair with sutures, closed subarachnoid drainage, laser sealing, fat, fascia, or muscle grafting, epidural blood patching, fibrin sealants or cyanoacrylate polymer adhesives, Gelfoam®, bed rest, and avoidance of drainage. To date, the effectiveness of these different treatment strategies has not been demonstrated in prospective randomized studies. [2-4,6-8,15,17-24]

Cain et al. evaluated the repair process of dural tears created in adult Beagle dogs and reported that formation of the primary fibroblastic bridge begins from the sixth day after repair. This finding is considered when determining the duration of postoperative bed rest. Reduction of cerebrospinal fluid pressure contributes to healing of the dural defect.[14]

According to Wang et al., an unrecognized or unrepaired dural tear may not produce symptoms, but in some cases it can lead to the formation of a pseudomeningocele or a cerebrospinal fluid fistula during the postoperative period. The prevalence of this complication remains unknown.[1]

Jones et al. compared long-term outcomes in 17 patients with incidental dural tears repaired intraoperatively with those of a control group without dural tears. They found no significant differences between the two groups and concluded that intraoperative identification and repair of dural tears does not affect final outcomes or increase morbidity.[2] Wang et al. reported similar findings.[1] Our study yielded comparable results, whereas Saxler et al. reported opposing outcomes.[21]

Eismont et al. recommended careful closure of any dural tear detected during surgery, using suture plus fat grafting for small tears and suture plus fascia grafting for larger defects. They did not recommend the use of drains because of the risk of durocutaneous fistula formation.[3] In contrast, Wang et al. suggested that bed rest is ineffective for the treatment of cerebrospinal fluid fistula.[1] Hodges et al. reported similar conclusions in their study.[22]

Weinstein et al.[23] reported a surgical site infection rate of 2.1%, and Cammisa et al. reported a rate of 8.1%,[7] neither of which reached statistical significance. Long-term outcomes of procedures complicated by dural tears that were adequately repaired were comparable to those of procedures without this complication in the study by Wang et al.[1]

Lewandrowski et al. conducted a survey of spine surgeons specialized in endoscopic procedures regarding the management of incidental dural tears. They reported that 52% did not repair the dural tear, 40% used sealants, and 8% performed direct repair. The postoperative fistula rate was negligible at 0.025%. However, rates of radiculopathy associated with incidental durotomy were 12.4% for dysesthesia, 3.4% for hyperesthesia, and 2.2% for muscle weakness. The published study did not include a standardized treatment protocol.[25]

In our study group, lumbar dural tears in 37 patients were repaired using 4.0 nylon suture, with or without fascia augmentation according to defect size, in order to prevent the complications described in the literature.

The strengths of this study include extensive experience in the management of this condition, as well as the implementation of a standardized intraoperative and postoperative treatment protocol for dural tears. Patient follow-up was conducted by the same surgical team.

CONCLUSIONS

A two-year follow-up using the institutional protocol for the repair of incidental lumbar dural tears described above allowed effective management of this intraoperative complication, avoiding postoperative sequelae, reducing morbidity, and lowering associated costs. Systematic application of this protocol may contribute to standardizing the management of incidental dural tears in spine surgery.

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REFERENCES

1. Wang JC, Bohlman HH, Riew KD. Dural tears secondary to operations on the lumbar spine. Management and results after a two-year-minimum follow-up of eighty-eight patients. *J Bone Joint Surg Am* 1998;80(12):1728-32. https://doi.org/10.2106/00004623-199812000-00002
2. Jones AA, Stambough JL, Balderston RA, Rothman RH, Booth RE Jr. Long-term results of lumbar spine surgery complicated by unintended incidental durotomy. *Spine (Phila Pa 1976)* 1989;14(4):443-6. https://doi.org/10.1097/00007632-198904000-00021
3. Eismont FJ, Wiesel SW, Rothman RH. Treatment of dural tears associated with spinal surgery. *J Bone Joint Surg Am* 1981;63(7):1132-6. PMID: 7024283

4. Kitchel SH, Eismont FJ, Green BA. Closed subarachnoid drainage for management of cerebrospinal fluid leakage after an operation on the spine. *J Bone Joint Surg Am* 1989;71(7):984-7. PMID: 2760094
5. Barrios C, Ahmed M, Arrotegui JI, Björnsson A. Clinical factors predicting outcome after surgery for herniated lumbar disc: an epidemiological multivariate analysis. *J Spinal Disord* 1990;3(3):205-9. PMID: 2134430
6. Black P. Cerebrospinal fluid leaks following spinal surgery: use of fat grafts for prevention and repair. Technical note. *J Neurosurg* 2002;96(2 Suppl):250-2. https://doi.org/10.3171/spi.2002.96.2.0250
7. Cammisa FP Jr, Girardi FP, Sangani PK, Parvataneni HK, Cadag S, Sandhu HS. Incidental durotomy in spine surgery. *Spine (Phila Pa 1976)* 2000;25(20):2663-7. https://doi.org/10.1097/00007632-200010150-00019
8. Finnegan WJ, Fenlin JM, Marvel JP, Nardini RJ, Rothman RH. Results of surgical intervention in the symptomatic multiply-operated back patient. Analysis of sixty-seven cases followed for three to seven years. *J Bone J Surg Am* 1979;61(7):1077-82. PMID: 489651
9. Shaikh S, Chung F, Imarengiaye C, Yung D, Bernstein M. Pain, nausea, vomiting and ocular complications delay discharge following ambulatory microdiscectomy. *Can J Anaesth* 2003;50(5):514-8. https://doi.org/10.1007/BF03021067
10. McCormack BM, Zide BM, Kalfas IH. Cerebrospinal fluid fistula and pseduomeningocele after spine surgery. In: Benzel EC (ed). *Spine surgery: techniques*, *complication avoidance and management*. Philadelphia: Churchill Livingstone; 1999, p. 1465-74.
11. Wiesel SW. The multiply-operated lumbar spine. *Instruct Course Lecture* 1985;34:68-77. https://doi.org/10.1053/j.semss.2008.08.002
12. Shakya A, Sharma A, Singh V, Rathore A, Garje V, Wadgave V, et al. Preoperative lumbar epidural steroid injection increases the risk of a dural tear during minimally invasive lumbar discectomy. *Int J Spine Surg* 2022;16(3):505-11. https://doi.org/10.14444/8249
13. Goodkin R, Laska LL. Unintended "incidental" durotomy during surgery of the lumbar spine: medicolegal implications. *Surg Neurol* 1995;43(1):4-12; discussion 12-4. https://doi.org/10.1016/0090-3019(95)80031-b
14. Bosacco SJ, Gardner MJ, Guille JT. Evaluation and treatment of dural tears in lumbar spine surgery: a review. *Clin Orthop Relat Res* 2001;(389):238-47. https://doi.org/10.1097/00003086-200108000-00033
15. Cain JE Jr, Lauermann WC, Rosenthal HG, Broom MJ, Jacobs RR. The histomorphologic sequence of dural repair: observations in the canine model. *Spine (Phila PA 1976)* 1991;16(8 Suppl):319-23. PMID: 1785079
16. Koo J, Adamson R, Wagner FC Jr, Hrdy DB. A new cause of chronic meningitis: infected lumbar pseudomeningocele. *Am J Med* 1989;86(1):103-4. https://doi.org/10.1016/0002-9343(89)90238-6
17. Foyt D, Johnson JP, Kirsch AJ, Bruce JN, Wazen JJ. Dural closure with laser tissue welding. *Otolaryngol Head Neck Surg* 1996;115 (6):513-8. https://doi.org/10.1016/S0194-59989670005-0
18. Nash CL, Kaufman B, Frankel VH. Postsurgical meningeal pseudocysts of the lumbar spine. *Clin Orthop Relat Res*.1971;75:167-78. https://doi.org/10.1097/00003086-197103000-00023
19. Patel MR, Louie W, Rachlin J. Postoperative cerebrospinal fluid leaks of the lumbosacral spine: management with percutaneous fibrin glue. *AJR AmJ Neuroradiol* 1996;17(3):496-500. PMID: 8881244
20. Salenius P, Laurent LE. Results of operative treatment of lumbar disc herniation. A survey of 886 patients. *Acta Orthop Scand* 1977;48(6):630-4. https://doi.org/10.3109/17453677708994809
21. Saxler G, Krämer J, Barden B, Kurt A, Pförtner J, Bernsmannet K. The long-term clinical sequelae of incidental durotomy in lumbar disc surgery. *Spine (Phila Pa 1976)* 2005;30(20):2298-302. https://doi.org/10.1097/01.brs.0000182131.44670.f7
22. Hodges SD, Humphreys SC, Eck JC, Covington LA. Management of incidental durotomy without mandatory bed rest. A retrospective review of 20 cases. *Spine (Phila Pa 1976)* 1999;24(19):2062-4. https://doi.org:10.1097/00007632-199910010-00017
23. Weinstein MA, McCabe JP, Cammisa FP Jr. Postoperative spinal wound infection: a review of 2,391 consecutive index procedures. *J Spinal Disord* 2000;13(5):422-6. https://doi.org/10.1097/00002517-200010000-00009
24. Gandhi J, DiMatteo A, Joshi G, Smith NL, Ali Khan SA. Cerebrospinal fluid leaks secondary to dural tears: a review of etiology, clinical evaluation, and management. *Int J Neurosci* 2021;131(7):689-95. https://doi.org/10.1080/00207454.2020.1751625
25. Lewandrowski KU, Hellinger S, Teixeira De Carvalho PS, Freitas Ramos MR, Soriano-Sánchez JA, Xifeng Z, et al. Dural tears during lumbar spinal endoscopy: surgeon skill, training, incidence, risk factors, and management. *Int J Spine Surg* 2021;15(2):280-94. https://doi.org/10.14444/8038

Treatment of Vertebral Hydatidosis and Factors Influencing Local Recurrence: A Systematic Review

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ABSTRACT

Background: Bone hydatidosis is rare, but approximately half of the cases involve the spine. Treatment is challenging because of the complexity of the lesions and adjacent structures; moreover, local recurrence rates are high. The aim of this review was to describe the outcomes of surgical treatments in patients with vertebral hydatidosis and to evaluate factors associated with recurrence. **Materials and Methods:** A systematic review of articles addressing the surgical treatment of vertebral hydatidosis was performed. Data collected included characteristics of cystic lesions, type of surgery performed, and postoperative outcomes. **Results:** Data from 99 patients were analyzed. The most frequent presentation was extradural intraspinal involvement of the thoracic spine; 74.5% of patients presented with incomplete neurological deficits. Decompression surgery, resection of cysts, and spinal stabilization were performed in 75% of cases, and all patients received postoperative albendazole therapy. All patients experienced symptomatic improvement, although 27.9% did not achieve complete recovery. Among patients with follow-up longer than one year, 76% developed local recurrence. An association was found between the type of surgery performed and local recurrence ($p = 0.05$). **Conclusions:** Vertebral hydatidosis is a rare disease with slow progression and potential neurological complications. When selecting the surgical approach, lesion location, neurological involvement, and spinal stability should be considered. Recurrence is a frequent complication; however, a definitive predisposing cause could not be identified.
Keywords: Vertebral hydatidosis; surgical treatment; local recurrence.
Level of Evidence: III

Tratamiento de la hidatidosis vertebral y factores que influyen en la recidiva local. Revisión sistemática

RESUMEN

Introducción: La hidatidosis ósea es infrecuente, pero la mitad de los casos ocurre en la columna vertebral. El tratamiento es dificultoso por la complejidad de las lesiones y las estructuras adyacentes, además, las tasas de recidiva local son altas. El objetivo de esta revisión es describir los resultados de los tratamientos quirúrgicos aplicados en pacientes con hidatidosis vertebral y evaluar los factores asociados con la recidiva. **Materiales y Métodos:** Se realizó una revisión sistemática con artículos sobre el tratamiento quirúrgico de la hidatidosis vertebral. Se registró la siguiente información: características de las lesiones quísticas, tipo de cirugía realizada y resultados posoperatorios. **Resultados:** Se recolectaron datos de 99 pacientes. La lesión más frecuente fue la intraespinal extradural en la columna torácica; el 74,5% tenía déficit neurológico incompleto. En el 75% de los pacientes, se realizó una cirugía de liberación, resección de vesículas y estabilización espinal y todos recibieron tratamiento farmacológico con albendazol en el posoperatorio. En todos los pacientes, mejoraron los síntomas, aunque no de forma completa en el 27,9%. El 76% de los pacientes con un seguimiento >1 **año tuv**o recidiva. Se halló una asociación entre el tipo de cirugía y la recidiva local ($p = 0,05$). **Conclusiones:** La hidatidosis vertebral es una enfermedad infrecuente que tiene una progresión lenta y puede asociarse con complicaciones neurológicas. Para elegir la vía de abordaje es útil tener en cuenta la localización, la afectación neurológica y la estabilidad espinal. La recidiva es una complicación frecuente, no se puede confirmar la causa predisponente.
Palabras clave: Hidatidosis vertebral; tratamiento quirúrgico; recidiva local.
Nivel de Evidencia: III

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INTRODUCTION

Hydatid disease is a zoonotic parasitic disease caused by *Echinococcus granulosus*. According to the World Health Organization, it is one of the most neglected and geographically widespread parasitic diseases.[1] It is more prevalent in warm regions, including South America, Mediterranean countries, the Middle East, New Zealand, central and southern Russia, Australia, China, and North and East Africa.[2] Humans inadvertently become intermediate hosts through contact with, or consumption of, water and food contaminated by domestic dogs.[3]

Hydatid cysts primarily develop in the liver and lungs (90–99.5%) and only rarely in the skeleton (0.5–4%).[4] However, approximately half of all cases of osseous hydatid disease involve the spine, with the thoracic region being the most frequently affected (49.9%), followed by the lumbar region (21.2%).[5] Disease progression is slow and lesions may remain inactive for prolonged periods;[6] cyst growth rates of 1 to 5 cm per year have been reported.[7] Diagnosis is based on imaging studies in combination with serological tests.[4]

At present, there is no consensus regarding the surgical management of this disease. The most appropriate treatment for osseous hydatid disease is en bloc resection of the affected bone; however, when spinal involvement is present, achieving this goal is often difficult because of the complexity of the lesions and adjacent anatomical structures,[4,8] in addition to the high rates of local recurrence reported as a complication.[2]

Given these therapeutic challenges, the primary objective of our review was to describe postoperative outcomes in patients with vertebral hydatid disease who underwent surgical treatment. The secondary objective was to assess the association between lesion characteristics, the type of surgical procedure performed, and the occurrence of local recurrence.

MATERIALS AND METHODS

A systematic review of the literature was conducted in accordance with the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines. A search was performed in the PubMed, LILACS, and SciELO databases, covering the period from January 2013 to June 2024. The search terms used were "spinal hydatidosis" and "surgical treatment." Selection filters included human studies and publications in Spanish and English.

Articles reporting patients with a diagnosis of vertebral hydatidosis who underwent surgical treatment, with or without associated pharmacological therapy, were included.

Articles were excluded if they did not provide individual patient data, included patients who had previously received other unspecified treatments, or failed to report postoperative outcomes.

The search and initial screening of articles were conducted independently by two investigators. The second screening stage and data extraction were performed by two independent reviewer groups, with a third evaluator involved to resolve any potential disagreements.

Recorded data included study characteristics (author, year, and study design), number of patients, and demographic information.

Variables were categorized as follows:

- Characteristics of spinal involvement: spinal location of cysts and lesion type according to the Braithwaite and Lees classification[9] (type 1, primary intramedullary cyst; type 2, intradural extramedullary cyst; type 3, extradural cyst; type 4, vertebral involvement; type 5, paravertebral cyst). Preoperative neurological status was recorded as complete deficit, incomplete deficit, or no deficit.
- Treatment performed: type of surgical procedure (group 1: curettage or cyst resection; group 2: decompression, cyst resection, and spinal stabilization; group 3: en bloc resection of the affected vertebra). Preoperative and/or postoperative pharmacological treatments administered, as well as alternative treatments, were also documented.
- Outcomes: postoperative symptoms (complete or incomplete recovery), local recurrence, and postoperative complications.

Statistical Analysis

Data were described as frequencies and percentages. Associations were assessed using the χ^2 test between cystic lesion characteristics ("spinal location" and "lesion type according to the Braithwaite and Lees classification"), type of surgery, and local recurrence.

Additionally, patients were grouped according to the surgical procedure performed, and associations between type of surgery and outcome variables were evaluated. A p value <0.05 was considered statistically significant.

Statistical analyses were performed using Stata/MP version 16.0 (StataCorp LLC, College Station, Texas, USA).

RESULTS

The search of the different databases yielded 379 scientific articles. After applying the eligibility criteria, nine studies were included in the review,[2,3,8,10-15] (Figure), representing a total of 99 patients with vertebral hydatid disease treated surgically (Table 1).

All articles consisted of case series and case reports; no studies with a higher level of evidence were identified.

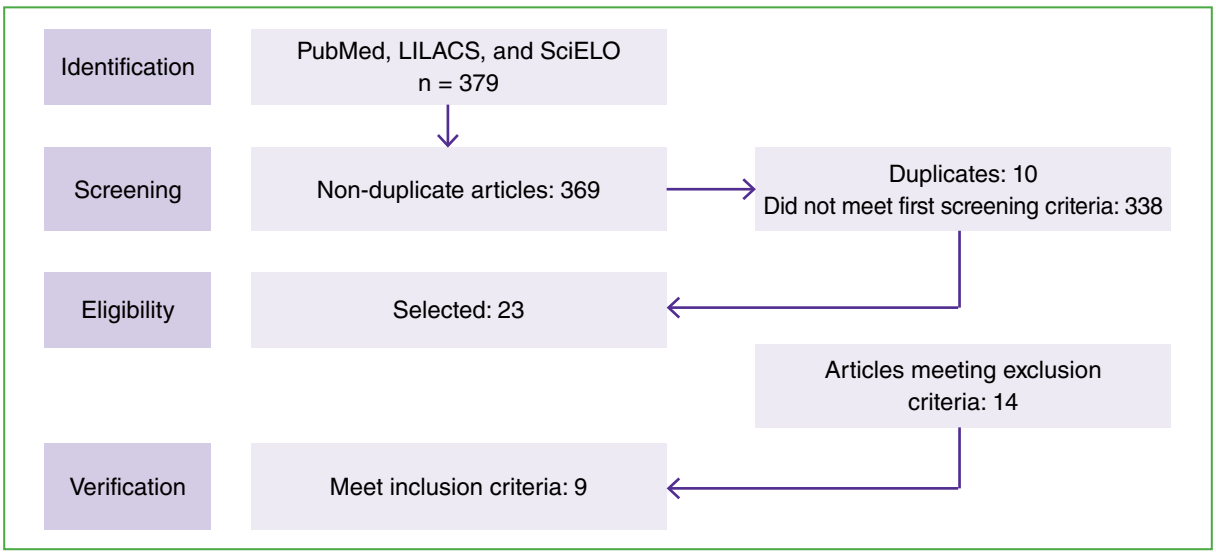

Figure. Flow chart through the different phases of a systematic review.

Table 1. Articles included in the review

Author (year)	Sample	Country	Type of study	Level of Evidence
Liu et al.[10] (2022)	1	China	Case report	IV
Luan et al.[8] (2022)	33	China	Case series	III
Villanueva et al.[11] (2020)	2	Chile	Case report	IV
Liang et al.[3] (2019)	16	China	Case series	III
Velasco et al.[12] (2018)	1	Uruguay	Case report	IV
Gezercan et al.[2] (2017)	8	Turkey	Case series	III
El Hammoumi et al.[13] (2015)	1	Morocco	Case report	IV
Abdelhakim et al.[14] (2014)	1	Tunisia	Case report	IV
Kafaji et al.[15] (2013)	36	Germany	Case series	III

Lesion Characteristics

Spinal involvement was distributed as follows: thoracic spine (68 patients), lumbar spine (25 patients), cervicothoracic spine (2 patients), sacrum (2 patients), thoracolumbar spine (1 patient), and cervical spine (1 patient).

Regarding lesion type according to the Braithwaite and Lees classification, this system was not used in all articles to describe cyst location. When not specified, investigators classified the lesions based on the published imaging findings. Forty-eight patients had type 3 lesions, 32 had type 4 lesions, 17 had type 5 lesions, and 2 had type 2 lesions.

Preoperatively, 74.5% of patients presented with an incomplete neurological deficit, 1% with a complete deficit, and 25% had no neurological deficit but reported pain.

Treatment

Seventy-six patients underwent decompression surgery, cyst resection, and spinal stabilization; 17 underwent curettage or cyst resection; and the remaining six underwent en bloc resection. On average, two surgical procedures were performed per patient (range, 1–5).

Cyst resection alone was performed mainly in patients with type 4 (64%) and type 5 (35%) lesions. Decompression combined with cyst resection and stabilization was performed primarily in patients with type 3 (61%) and type 4 (21%) lesions. En bloc resection was mainly performed in patients with type 4 (83%) and type 3 (16.6%) lesions.

All patients received postoperative albendazole therapy for a mean duration of 6.5 months. One article reported preoperative treatment consisting of a single dose administered to nine patients.[3]

Alternative therapies included radiotherapy in four patients (total dose 6900 cGy delivered in 23 fractions over 30 days)[3] and in one additional patient in whom the dose was not specified.[3,10]

Postoperative Period

The mean follow-up duration was 4.4 years (range, 1 month to 11 years).

All patients showed clinical improvement after surgery; however, 27.9% of those with incomplete neurological deficits failed to achieve full neurological recovery.

Local recurrence was documented in 76% of patients with more than one year of follow-up.

Eight patients died during follow-up; 87.5% of these patients had type 3 lesions.

Analysis of Variables

An association was identified between the type of surgical procedure and local recurrence ($p = 0.05$). In the group that underwent decompression, curettage, and spinal stabilization, the local recurrence rate was 88.37%. It should be noted that the en bloc resection group was excluded from this analysis because of the small number of patients (Table 2).

Table 2. Relationship between type of surgery and hydatid cyst recurrence.

Type of surgery	Recurrence		Total
	No	Yes	
Curettage/cyst resection	10	5	15
Decompression, resection, and spinal stabilization	24	38	62
Total	34	43	77

Pearson's $\chi^2 = 3.82$; $p = 0.05$.

No association was found between lesion level and local recurrence ($p = 0.49$), nor between lesion type (according to the Braithwaite and Lees classification) and local recurrence ($p = 0.48$).

DISCUSSION

Vertebral hydatid disease is an uncommon condition with slow progression, but it may lead to neurological complications.[16] In our search, only nine articles published over the past 10 years reported patients with spinal hydatid disease treated surgically.

The thoracic spine was the most frequently affected region, consistent with previously published data.[5] In most articles, the Braithwaite and Lees classification[9] was used to describe cyst location. Although this classification is purely descriptive, we believe it may be useful for planning the surgical approach and technique.

At present, there is no expert consensus regarding the management of osseous hydatid disease. Radical surgery has been proposed as a curative option,[5,6] but complete removal of spinal cysts is often difficult to achieve, compounded by the risk of complications due to their proximity to neural structures. When radical treatment is not feasible, palliative surgery combined with long-term pharmacological therapy may be considered. The most commonly used agent is albendazole, administered at a recommended dose of 10–15 mg/kg/day for at least 6 consecutive months, to improve prognosis and reduce recurrence rates.[4,5]

Local recurrence is the most frequent postoperative complication. Cyst rupture during surgery has been suggested as a contributing factor;[17] however, this information was not explicitly reported in all articles, precluding comparative analysis of this variable. Certain strategies, such as irrigation with hypertonic saline solution, have been recommended to reduce recurrence rates.[5] Only a small number of patients received conventional radiotherapy, but there is no evidence in the literature supporting its effectiveness.[5,17]

An association was observed between the type of surgery and local recurrence, with higher complication rates in more aggressive procedures involving decompression and spinal stabilization. Nevertheless, given the level of evidence of the included studies, unreported factors, such as intraoperative cyst rupture or the use of saline irrigation, may have influenced these results.

CONCLUSIONS

The optimal choice of surgical technique for the treatment of vertebral hydatid disease remains unclear in the literature. Consideration of cyst location, neurological involvement, and spinal stability may be helpful when deciding between radical surgery and palliative procedures combined with pharmacological treatment.

Local recurrence is a very common complication, particularly following more complex surgical procedures; however, it is not possible to determine with certainty which factors most strongly influence its occurrence.

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REFERENCES

1. WHO. *World Health Statistics 2015.* Geneva: World Health Organization; 2015, p. 162.
2. Gezercan Y, Ökten AI, Çavuş G, Açık V, Bilgin E. Spinal hydatid cyst disease. *World Neurosurg* 2017;108:407-17. https://doi.org/10.1016/j.wneu.2017.09.015
3. Liang Q, Xiang H, Xu L, Wen H, Tian Z, Yunus A, et al. Treatment experiences of thoracic spinal hydatidosis: a single-center case-series study. *Int J Infect Dis* 2019; 89:163-8. https://doi.org/10.1016/j.ijid.2019.09.024
4. Meng Y, Ren Q, Xiao J, Sun H, Huang Y, Liu Y, et al. Progress of research on the diagnosis and treatment of bone cystic echinococcosis. *Front Microbiol* 2023;14:1273870. https://doi.org/10.3389/fmicb.2023.1273870
5. Neumayr A, Tamarozzi F, Goblirsch S, Blum J, Brunetti E. Spinal cystic echinococcosis--a systematic analysis and review of the literature: part 1. Epidemiology and anatomy. *PLoS Negl Trop Dis* 2013;7(9):e2450. https://doi.org/10.1371/journal.pntd.0002450

6. Cattaneo L, Manciulli T, Cretu CM, Giordani MT, Angheben A, Bartoloni A, et al. Cystic echinococcosis of the bone: A European Multicenter Study. *Am J Trop Med Hyg* 2019;100(3):617-21. https://doi.org/10.4269/ajtmh.18-0758
7. Kaloostian PE, Gokaslan ZL. Spinal hydatid disease: a multidisciplinary pathology. *World Neurosurg* 2015;83(1):52-3. https://doi.org/10.1016/j.wneu.2013.07.106
8. Luan H, Liu K, Deng Q, Sheng W, Maimaiti M, Guo H, et al. Multiple debridement of cavity lesions combined with antiparasitic chemotherapy in the treatment of mid or advanced spinal echinococcosis: a retrospective study of 33 patients. *Int J Infect Dis* 2022;114:261-7. https://doi.org/10.1016/j.ijid.2021.11.014
9. Braithwaite PA, Lees RF. Vertebral hydatid disease: radiological assessment. *Radiology* 1981;140(3):763-6. https://doi.org/10.1148/radiology.140.3.7280247
10. Liu P, Feng H, Liu J. A case of extensive thoracolumbar spinal intradural cystic echinococcosis. *World Neurosurg* 2022;165:89-90. https://doi.org/10.1016/j.wneu.2022.06.034
11. Villanueva FJS, Barbieri SL, Gallardo FA. Hidatidosis vertebral intrarraquídea. Una patología médico-quirúrgica. Reporte de dos casos. *Rev Asoc Argent Ortop Traumatol* 2020;85(1):56-64. https://doi.org/10.15417/issn.1852-7434.2020.85.1874
12. Velasco JM, Sapriza S, Galli N, García F. Vertebral hydatidosis: bibliographical review and clinical case report. *Coluna/Columna* 2018;17(4):326-9. https://doi.org/10.1590/S1808-185120181704191824
13. El Hammoumi MM, El Mostarchid B, Kabiri EH. Posterior approach to intrathoracic hydatid cyst invading the dorsal spine. *Arch Bronconeumol* 2015;51(11):600-1. https://doi.org/10.1016/j.arbres.2015.05.011
14. Abdelhakim K, Khalil A, Haroune B, Oubaid M, Mondher M. A case of sacral hydatid cyst. *Int J Surg Case Rep* 2014;5(7):434-6. https://doi.org/10.1016/j.ijscr.2014.03.025
15. Kafaji A, Al-Zain T, Lemcke J, Al-Zain F. Spinal manifestation of hydatid disease: a case series of 36 patients. *World Neurosurg* 2013;80(5):620-6. https://doi.org/10.1016/j.wneu.2013.06.013
16. Sioutis S, Reppas L, Bekos A, Soulioti E, Saranteas T, Koulalis D, et al. Echinococcosis of the spine. *EFORT Open Rev* 2021;6(4):288-96. https://doi.org/10.1302/2058-5241.6.200130
17. Neumayr A, Tamarozzi F, Goblirsch S, Blum J, Brunetti E. Spinal cystic echinococcosis--a systematic analysis and review of the literature: part 2. Treatment, follow-up and outcome. *PLoS Negl Trop Dis* 2013;7(9):e2458. https://doi.org/10.1371/journal.pntd.0002458

Brown Tumor of the Cervical Spine: Case Report

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ABSTRACT
Brown tumor is a pseudotumoral lesion characterized by cystic fibrous osteitis with hemorrhagic content, most commonly caused by primary hyperparathyroidism or secondary to chronic renal failure. Cervical spine involvement is extremely rare. We report the case of a 27-year-old woman with a history of hemodialysis due to chronic renal failure who presented with neck pain associated with progressive quadriparesis of 24 hours' duration. Imaging studies revealed a lytic lesion with sclerotic margins involving the soft tissues and the posterior arch of C5, with severe spinal cord compression at that level. Tumor resection and decompressive laminectomy at C5 were performed. Postoperative clinical evolution was favorable. Histopathological examination confirmed the diagnosis of a brown tumor of the cervical spine.
Keywords: Spine; brown tumor; hyperparathyroidism.
Level of Evidence: IV

Tumor pardo de columna cervical. Presentación de un caso

RESUMEN
El tumor pardo es una lesión seudotumoral caracterizada por una osteítis fibrosa quística con contenido hemorrágico, habitualmente causado por hiperparatiroidismo primario o secundario a insuficiencia renal crónica. La localización en la columna cervical es sumamente inusual. Presentamos a una mujer de 27 años, con antecedentes de hemodiálisis por insuficiencia renal crónica. Concurrió con cervicalgia asociada a cuadriparesia progresiva de 24 h de evolución. Los estudios por imágenes revelaron una imagen lítica con bordes esclerosos que comprometía partes blandas y el arco posterior de C5 con una compresión medular severa en dicho nivel. Se procedió a la resección tumoral y la laminectomía descompresiva en C5. La evolución clínica posoperatoria fue favorable. El estudio anatomopatológico confirmó el diagnóstico de tumor pardo de columna cervical.
Palabras clave: Columna; tumor pardo; hiperparatiroidismo.
Nivel de Evidencia: IV

INTRODUCTION

A brown tumor is a pseudotumoral lesion characterized by cystic fibrous osteitis with hemorrhagic content, most commonly caused by primary hyperparathyroidism or secondary to chronic renal failure. Although these lesions are histologically benign, intense osteoclastic activity and the resulting metaplasia confer aggressive features due to bone destruction and extension into adjacent tissues.

The estimated incidence ranges from 1.5% to 13% and predominantly involves the long bones, jaws, skull, and pelvis.[1-3] Involvement of the cervical spine is exceedingly rare.

The objective of this article is to report the clinical presentation and surgical management of a patient with acute quadriparesis caused by a brown tumor of the cervical spine.

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CLINICAL CASE

A 27-year-old woman with a history of chronic renal failure requiring hemodialysis presented with nonspecific cervical pain of two months' duration and progressive loss of strength in all four limbs over the preceding 24 hours. Physical examination revealed quadriparesis, with a neurological deficit graded as 4/5 in the upper limbs and 3/5 in the lower limbs on the muscle strength scale, associated with a positive Hoffmann sign and bilateral patellar hyperreflexia.

Relevant laboratory findings included a parathyroid hormone level of 315 pg/mL (normal range, 15 to 70 pg/mL), alkaline phosphatase of 580 IU/L (normal range, 40 to 150 IU/L), and serum calcium of 8 mg/dL (normal range, 8.5 to 10.4 mg/dL).

Plain radiographs and computed tomography of the cervical spine demonstrated a large osteolytic lesion with sclerotic margins involving the posterior arch of the fifth cervical vertebra, with extension into the adjacent soft tissues (Figure 1). Magnetic resonance imaging revealed severe spinal cord compression at the level of the fifth cervical vertebra (Figure 2).

An emergency posterior approach to the cervical spine was performed, consisting of marginal tumor resection and decompressive laminectomy of the fifth cervical vertebra.

The immediate postoperative course was favorable. During this period, the patient initiated an intensive motor rehabilitation program, and complete neurological recovery was documented two months after surgery. Histopathological examination of the surgical specimen confirmed the diagnosis of a brown tumor of the cervical spine.

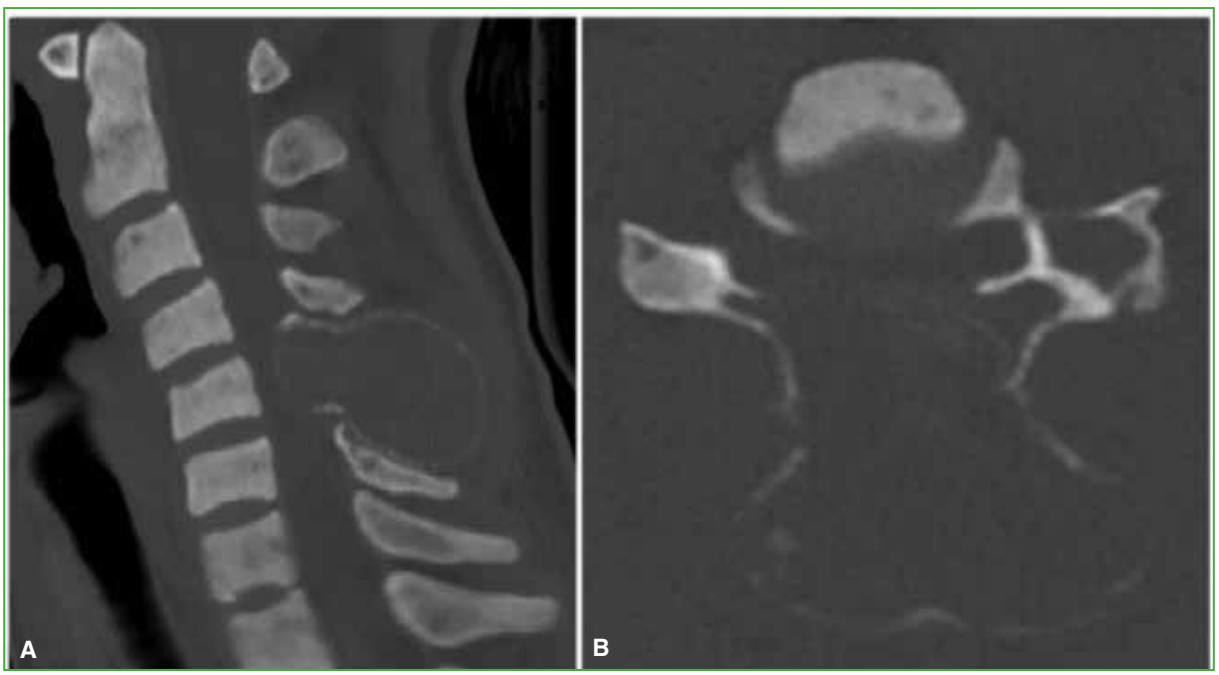

Figure 1. Computed tomography of the cervical spine. **A.** Sagittal section. **B.** Axial section. Involvement of the posterior arch of C5 is observed.

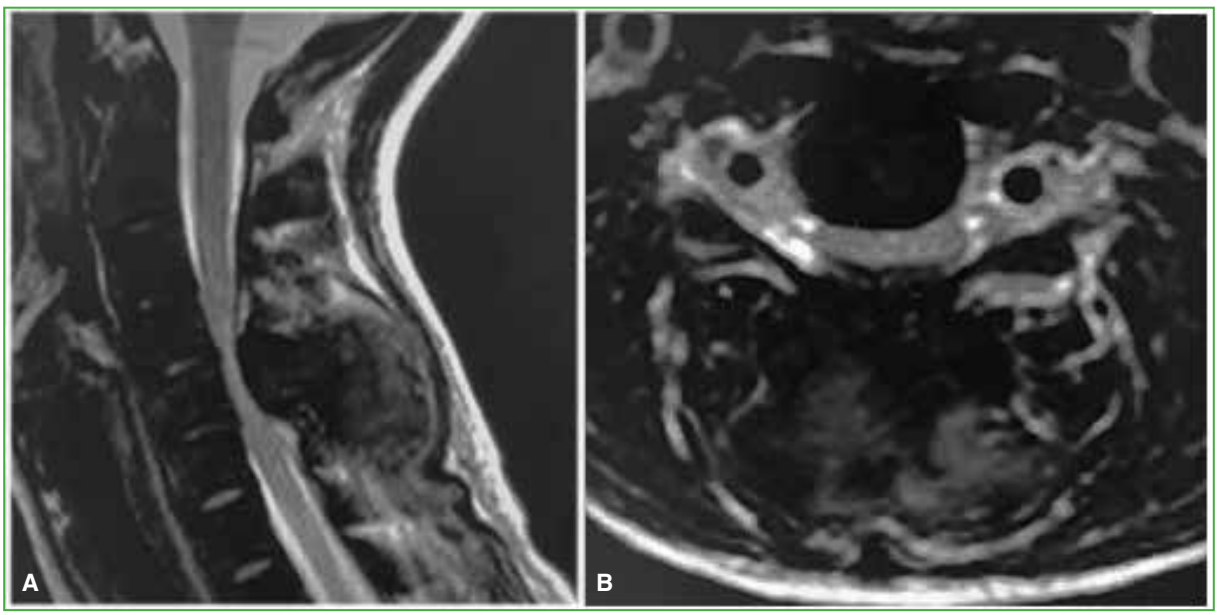

Figure 2. Magnetic resonance imaging of the cervical spine. **A**. Sagittal section. **B**. Axial section. The tumor involves the posterior arch of C5 and the adjacent soft tissues, resulting in spinal cord compression at this level.

DISCUSSION

A history of chronic renal disease is a fundamental element in the clinical suspicion of secondary hyperparathyroidism.[4] In this context, diagnosis is often delayed, as most patients present with progressive, nonspecific cervical pain of weeks to months in duration, with or without associated myeloradicular symptoms.[5-7] In our case, however, the clinical presentation and its course were acute and rapidly progressive.

Laboratory test results represent another key aspect, as they not only guide the diagnostic process but also allow differentiation among the various forms of hyperparathyroidism.[4] The common biochemical pattern is elevation of serum parathyroid hormone levels. In secondary hyperparathyroidism, this elevation is typically associated with normal or decreased serum calcium values, whereas primary and tertiary hyperparathyroidism are usually accompanied by hypercalcemia.

Brown tumors typically appear on plain radiographs or computed tomography as lytic, multilobulated lesions that may or may not present peripheral sclerotic margins. On magnetic resonance imaging, these lesions are hypointense on T1-weighted sequences and hyperintense or isointense on T2-weighted sequences, with a tendency to invade adjacent tissues. Intravenous contrast administration usually results in lesion enhancement.[7,8]

In our patient, the lesion involved the entire posterior arch of C5 and extended not only into the paravertebral soft tissues but also into the posterior epidural space, producing significant spinal cord compression.

Management of brown tumor is multidisciplinary, with treatment of the underlying hyperparathyroidism being the cornerstone. Despite clinical suspicion, the diagnosis must be confirmed by histopathological examination. Computed tomography guided needle biopsy is the most widely accepted method for obtaining tissue samples. However, in patients with progressive neurological deficits, diagnostic confirmation is obtained during emergency surgical intervention.[9,10]

When lesions are mechanically stable and there is no neurological involvement, conservative management is indicated, since optimization of serum parathyroid hormone levels often leads to lesion regression and, in some cases, complete resolution.[8] In contrast, surgical treatment is mandatory in the presence of vertebral segmental instability or spinal cord compression. Sánchez-Calderón et al., in a C4 lesion, and Liu et al., in a C6 lesion, performed decompression and stabilization using a combined approach. The first surgical stage consisted of anterior

corpectomy, followed by posterior cervical fixation in a second stage.[6,11] In our case, because the lesion involved only the posterior arch and affected less than 50 percent of the C5 facet joints, marginal tumor resection and decompressive laminectomy of C5 were sufficient, without the need for cervical spine stabilization.

CONCLUSIONS

Brown tumor involving the cervical spine is exceedingly rare. A history of hyperparathyroidism is a critical element in raising diagnostic suspicion. In the presence of progressive neurological deficits, emergency surgical treatment is indicated, and the surgical strategy depends primarily on the degree of instability generated by the vertebral lesion.

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REFERENCES

1. Sutton RA, Cameron EC. Renal osteodystrophy: pathophysiology. *Semin Nephrol* 1992;12(2):91-100. PMID: 1561500
2. Flores R, Lopes J, Caridade S. Secondary hyperparathyroidism presenting as a brown tumor: A case report and review of the literature. *Cureus* 2023;15(1):E33820. https://doi.org/10.7759/cureus.33820
3. Santoso D, Thaha M, Empitu MA, Kadariswantiningsih IN, Suryantoro SD, Haryati MR, et al. Brown tumour in chronic kidney disease: Revisiting an old disease with a new perspective. *Cancers* 2023;15(16):4107. https://doi.org/10.3390/cancers15164107
4. Guedes A, Becker RG, Nakagawa SA, Lima Guedes A. Update on brown tumor of hyperparathyroidism. *Rev Assoc Med Bras* 1992;70(suppl 1):e2024S132. https://doi.org/10.1590/1806-9282.2024S132
5. Alfawareh MD, Halawani MM, Attia WI, Almusrea KN. Brown tumor of the cervical spines: a case report with literature review. *Asian Spine J* 2015;9(1):110-20. https://doi.org/10.4184/asj.2015.9.1.110
6. Sánchez-Calderón MD, Ochoa-Cacique D, Medina Carrillo O, García González U, Vicuña González RM, Bravo Reyna CC, et al. Brown tumor of the cervical spine in a patient with secondary hyperparathyroidism: A case report. *Int J Surg Case Rep* 2018;51:328-30. https://doi.org/10.1016/j.ijscr.2018.09.023
7. Mirzashahi B, Vosoughi F, Besharaty S, Satehi SH. Missed C5 vertebral brown tumor causing spinal cord compression and myelopathy: A case report and literature review. *Clin Case Rep* 2022;10(1):e05331. https://doi.org/10.1002/ccr3.5331
8. Hu J, He S, Yang J, Ye C, Yang X, Xiao J. Management of brown tumor of spine with primary hyperparathyroidism: A case report and literature review. *Medicine* (Baltimore) 2019;98(14):e15007. https://doi.org/10.1097/MD.0000000000015007
9. Jackson W, Sethi A, Carp J, Talpos G, Vaidya R. Unusual spinal manifestation in secondary hyperparathyroidism: a case report. *Spine* (Phila Pa 1976) 2007;32(19):E557-60. https://doi.org/10.1097/BRS.0b013e3181453f85
10. Fineman I, Johnson JP, Di-Patre PL, Sandhu H. Chronic renal failure causing brown tumors and myelopathy. Case report and review of pathophysiology and treatment. *J Neurosurg* 1999;90(2 Suppl):242-6. https://doi.org/10.3171/spi.1999.90.2.0242
11. Liu Z, Yang H, Tan H, Song R, Zhang Y, Zhao L. Brown tumor of the cervical spine with primary hyperparathyroidism: A case report and literature review. *Medicine* (Baltimore) 2023;102(6):e32768. https://doi.org/10.1097/MD.0000000000032768

Post-Traumatic Hemorrhagic Facet Cyst Treated through a Contralateral Uniportal Interlaminar Endoscopic Approach: Case Report

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ABSTRACT
Hemorrhagic facet synovial cysts are an uncommon cause of radicular compression. Their management has evolved toward minimally invasive techniques aimed at achieving effective decompression with lower morbidity. We report the case of a 66-year-old man who developed progressive motor deficit in the lower limbs following minor trauma. Magnetic resonance imaging revealed a facet cyst at the L3–L4 level causing spinal canal compromise. To preserve spinal stability, contralateral uniportal interlaminar endoscopic decompression was performed using the over-the-top technique. This approach minimized surgical invasiveness, allowed immediate postoperative recovery, and proved to be a safe and effective treatment option.
Keywords: Juxtafacet cyst; hemorrhagic; endoscopy.
Level of Evidence: IV

Quiste facetario hemorrágico postraumático tratado por vía endoscópica uniportal interlaminar contralateral. Reporte de un caso

RESUMEN
Los quistes sinoviales facetarios hemorrágicos son una causa infrecuente de compresión radicular, su manejo ha evolucionado hacia técnicas mínimamente invasivas, buscando una descompresión efectiva con una morbilidad menor. Se presenta el caso de un hombre de 66 años con déficit motor progresivo en los miembros inferiores tras un traumatismo menor. La resonancia magnética mostró un quiste facetario en L3-L4 que comprometía el canal medular. Para preservar la estabilidad espinal, se realizó una descompresión endoscópica uniportal interlaminar mediante la técnica “over the top” (por encima de la lámina) con un abordaje contralateral. Este procedimiento minimizó la invasividad, permitió una recuperación posoperatoria inmediata y demostró ser una opción segura y eficaz.
Palabra clave: Quiste yuxtafacetario; quiste hemorrágico; endoscopia.
Nivel de Evidencia: IV

INTRODUCTION

Facet synovial cysts are benign cystic lesions arising from the facet joint capsule and represent a potential cause of radicular or central lumbar canal compression. Their prevalence in the general population ranges from 0.65% to 6.4% and they are clearly associated with degenerative spinal disease, particularly at the L4–L5 level, where mobility and biomechanical loading are greatest.[1] Although many are incidental findings, their progressive enlargement may lead to spinal canal stenosis and neurological symptoms.

The clinical presentation becomes acute and dramatically more severe when a rare complication occurs: intracystic hemorrhage. This event, likely secondary to rupture of microvessels within the synovial membrane, causes sudden cyst expansion, resulting in cauda equina syndrome or rapidly progressive paraparesis.[2,3] Although more

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than 500 cases of juxtafacet cysts have been reported, the hemorrhagic variant accounts for only approximately 10%, and its association with minor trauma as a triggering factor is exceptional, with only a limited number of cases described.[4]

The present case is unique, involving a hemorrhagic facet synovial cyst at an uncommon level (L3–L4), posing a surgical challenge due to its anatomical characteristics. It was triggered by minor trauma in a 66-year-old man who developed progressive motor deficit.

The objectives of this article are to present this exceptional case, describe its management through uniportal endoscopic decompression—a technically demanding yet minimally invasive option for this condition—and analyze the immediate postoperative course.

CLINICAL CASE

A 66-year-old man with no relevant medical, surgical, or pharmacological history presented for evaluation. His baseline functional status was excellent; he regularly practiced hiking and maintained an active lifestyle. The reason for consultation was trauma resulting from a fall from standing height that had occurred 10 days earlier. The patient developed progressive severe low back pain with radicular radiation, accompanied by weakness in the lower limbs, predominantly on the right side, which rapidly limited his ability to ambulate.

On physical examination, he reported incapacitating pain rated 10/10 on the visual analog scale. Neurological evaluation revealed significant paresis, with muscle strength graded 2/5 in bilateral ankle dorsiflexion. Deep tendon reflexes in the lower limbs were diminished.

The differential diagnoses considered included spontaneous epidural hematoma, acute sequestrated lumbar disc herniation, and complicated facet synovial cyst (with hemorrhage or inflammation). A contrast-enhanced lumbar MRI was performed, revealing a rounded cystic lesion, hyperintense on T2-weighted sequences, arising from the left L3–L4 facet joint. This lesion caused severe spinal canal compromise (greater than 80%) at that level, with marked displacement and compression of the cauda equina roots (Figure 1).

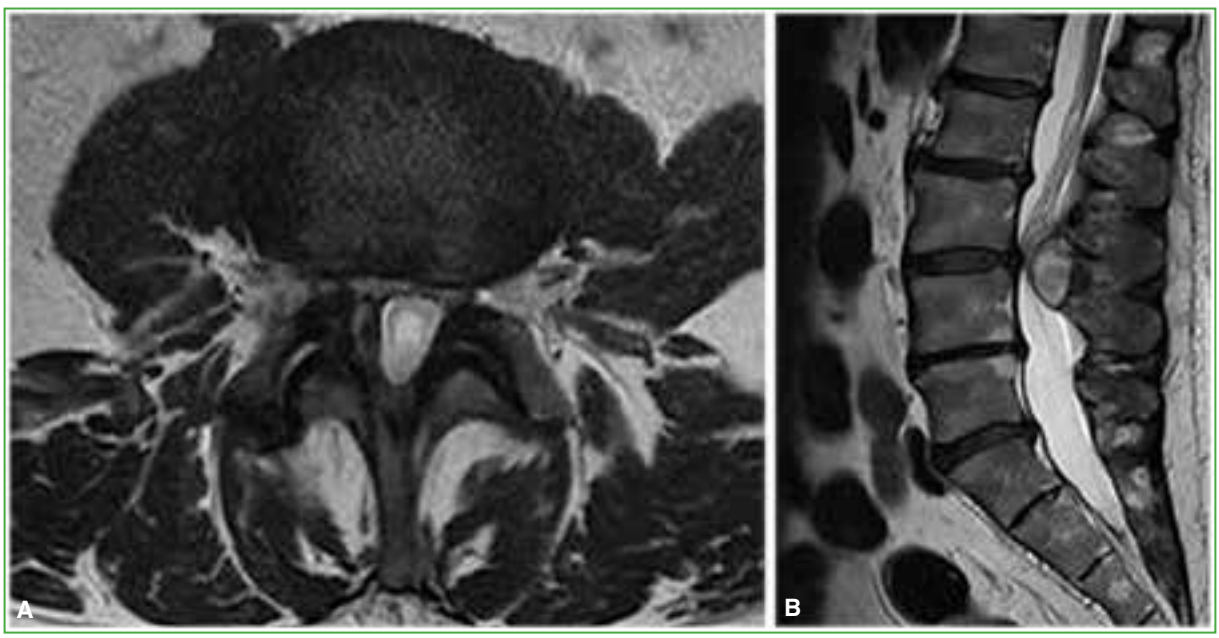

Figure 1. Magnetic resonance imaging of the lumbosacral spine, T2-weighted sequence. **A**. Axial view. **B**. Sagittal view.

The findings were consistent with a hemorrhagic juxtafacet synovial cyst. Given the acute presentation with progressive motor neurological deficit and severe radicular compression, the patient underwent urgent decompression. The objective was to relieve neural compression, reverse the motor deficit, and allow rapid functional recovery while minimizing invasiveness. A posterior interlaminar uniportal endoscopic decompression was performed using a contralateral (left-sided) approach and the "over-the-top" technique (above the dural sac) to achieve safe and complete cyst resection (Figures 2-5).

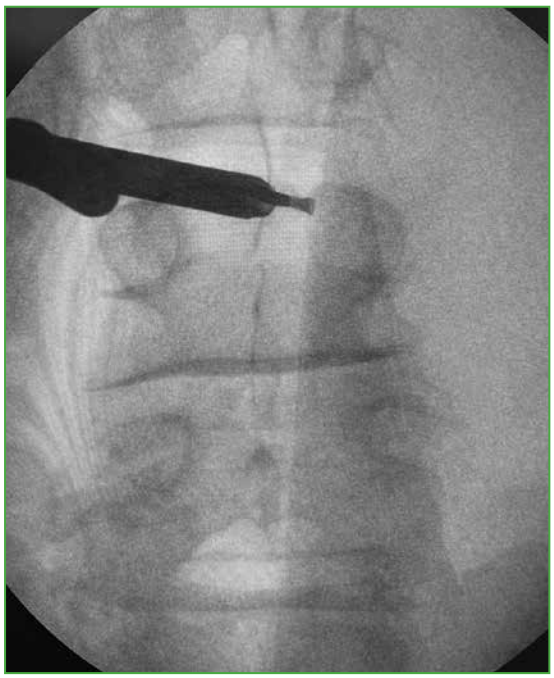

Figure 2. Intraoperative AP radiograph of the lumbar spine demonstrating the "over-the-top" technique in the L3-L4 intervertebral space.

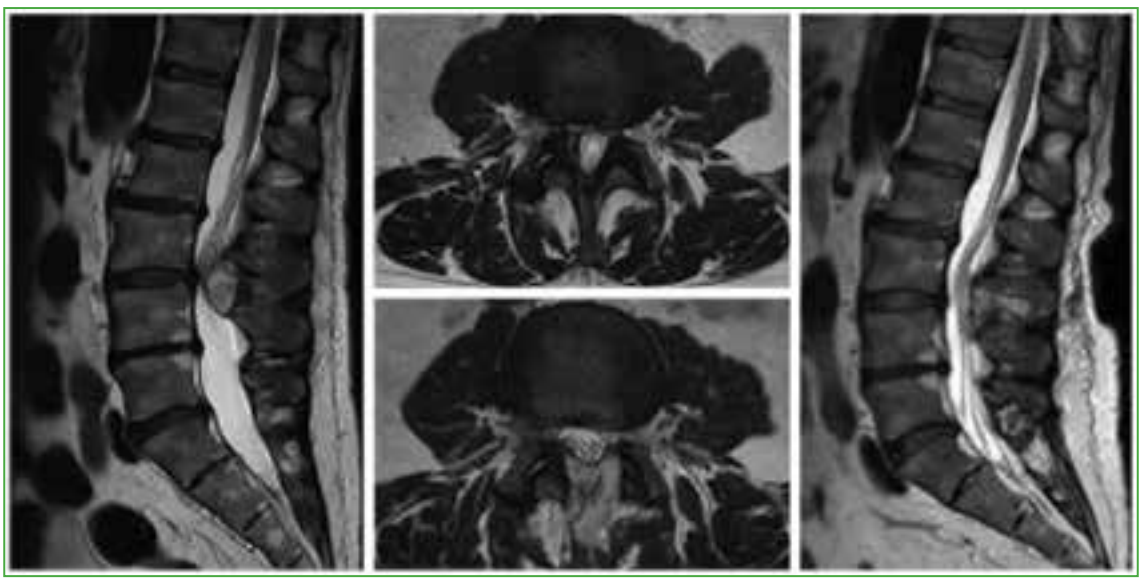

Figure 3. Magnetic resonance imaging of the lumbosacral spine, T2-weighted sequence. Sagittal and axial views. Preoperative cauda equina compression versus postoperative neural decompression.

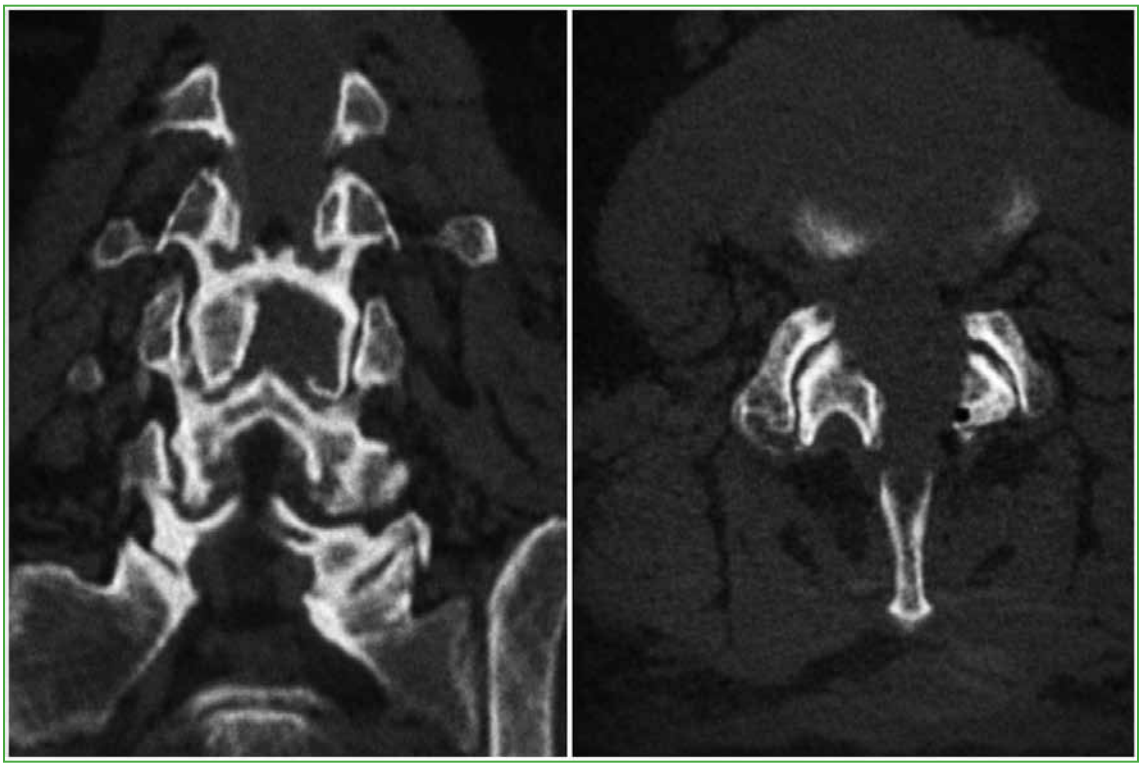

Figure 4. Computed tomography of the lumbosacral spine. Coronal and axial views demonstrating the postoperative result.

Figure 5. Soft tissues. Postoperative scar.

The procedure lasted 95 minutes. Blood loss was minimal and not quantifiable, and no intraoperative complications occurred.

The patient had a favorable immediate postoperative course. Within the first 24 hours, pain improved markedly (2/10 on the visual analog scale), and motor recovery was incipient. He was discharged 24 hours after surgery with an outpatient physical therapy program. At the 7-day follow-up, ankle dorsiflexion strength had improved to 5/5.

DISCUSSION

Our case illustrates a paradigmatic clinical presentation of a hemorrhagic juxtafacet synovial cyst: an acute and progressive motor neurological deficit triggered by minor trauma.[5] Although uncommon, this condition constitutes a surgical emergency, as neural compression requires prompt and complete decompression to prevent permanent neurological deficit;[1] therefore, the choice of surgical technique was critical.

In this context, uniportal endoscopic surgery was selected as the optimal strategy because of its unique ability to achieve radical decompression with minimal tissue disruption. Percutaneous techniques, such as aspiration or corticosteroid injections, were ruled out due to the high risk of recurrence and the solid hemorrhagic nature of the cyst, which makes such approaches ineffective.[6] Conversely, traditional open or microsurgical techniques, although effective, involve greater paraspinal muscle dissection, a higher risk of iatrogenic instability, and a longer postoperative recovery.[7,8]

The contralateral interlaminar ("over-the-top") approach was the cornerstone of our success. This technique, recommended for medial lesions and cysts at lower lumbar levels with adequate interlaminar space,[9] allowed complete cyst resection from a safe and ergonomic angle while fully preserving the integrity of the symptomatic facet joint capsule. This represents a decisive advantage over a transforaminal approach, which might have been insufficient for a cyst of this size and location, or a direct ipsilateral approach, which could have compromised facet stability on the affected side.[10]

Our results are consistent with and reinforce the emerging literature. The patient's immediate motor recovery and discharge within 48 hours exceed the average recovery reported with open techniques and align with the excellent outcomes described by Tacconi et al., in which endoscopic management achieved a 50% reduction in pain at 6 months with minimal morbidity.[5,11] Importantly, this case contributes a relevant nuance to the field of endoscopic spine surgery: it demonstrates that uniportal endoscopic decompression is not only a valid option but also an optimal strategy for the urgent management of complicated hemorrhagic cysts, achieving the same degree of neural decompression as open surgery while preserving the well-established advantages of minimally invasive techniques.

Publications from our region on the endoscopic management of this condition remain scarce, underscoring the need for larger case series and prospective studies.

CONCLUSIONS

Hemorrhagic facet synovial cysts are rare entities, likely underdiagnosed in clinical practice. Minor trauma appears to be the most common precipitating factor in acute presentations.

Among therapeutic options, endoscopic treatment offers a minimally invasive alternative to open surgery. Various endoscopic techniques can be tailored to the specific anatomical characteristics of the cyst and the patient, as illustrated in this case, allowing effective decompression with rapid postoperative recovery.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Eck JC, Triantafyllou SJ. Hemorrhagic lumbar synovial facet cyst secondary to anticoagulation therapy. *Spine J* 2005;5(4):451-3. https://doi.org/10.1016/j.spinee.2005.01.005
2. Summers RM, Quint DJ. Case report 712: Hemorrhagic synovial cyst arising from right L2-3 facet joint. *Skeletal Radiol* 1992;21(1):72-5. https://doi.org/10.1007/BF00243101
3. Cannarsa G, Clark SW, Chalouhi N, Zanaty M, Heller J. Hemorrhagic lumbar synovial cyst: case report and literature review. *Nagoya J Med Sci* 2015;77(3):481-92. PMID: 26412895
4. Xu R, Solakoglu C, Maleki Z, McGirt MJ, Gokaslan ZL, Bydon A. Hemorrhagic synovial cyst: the possible role of initial trauma and subsequent microtrauma in its pathogenesis: case report. *Neurosurgery* 2011;68(3):E858-865; discussion E865. https://doi.org/10.1227/NEU.0b013e3182080127
5. Tacconi L, Spinelli R, Serra G, Signorelli F, Giordan E. Full-endoscopic removal of lumbar juxtafacet cysts: A prospective multicentric study. *World Neurosurg* 2020;141:e414-22. https://doi.org/10.1016/j.wneu.2020.05.166
6. Kumaria A, Wood A, Gakhar HPS, Howarth SPS, Bateman AH. Facet joint cyst haematoma: a rare cause of cauda equina syndrome. *Br J Neurosurg* 2023;37(4):795-6. https://doi.org/10.1080/02688697.2019.1662370
7 Krzok G, Sampath SG, Peca M, Konakondlam S, Shen J, Telfeian AE. Interlaminar endoscopic resection of giant hemorrhagic ganglion cyst of the facet joint at L1 to L2 level. *Int J Spine Surg* 2025;19(5):604-10. https://doi.org/10.14444/8793
8. Kim HJ, Ko JH, Chang DG. Spontaneous regression of large-sized lumbar facet synovial cysts: two case reports and literature review. *BMC Musculoskelet Disord* 2025;26:616. https://doi.org/10.1186/s12891-025-08822-6
9. Wu HH, Wang GC, Sun LW, Chang KS, Yang JS, Chu L, et al. Symptomatic lumbar juxtafacet cyst treated by full endoscopic surgery. *World Neurosurg* 2019;130:e598-604. https://doi.org/10.1016/j.wneu.2019.06.168
10. Hadgaonkar S, Nagpal S, Bhilare PD, Sancheti P. Intraoperative navigation-based lumbar facet assessment for considering fusion in unilateral biportal endoscopic cyst excision. *Surg Neurol Int* 2025;16:435. https://doi.org/10.25259/SNI_848_2025
11. Tan H, Yu L, Li X, Yang Y, Zhu B. Percutaneous uniportal full-endoscopic surgery for treating symptomatic lumbar facet joint cysts under local anesthesia combined with monitored anesthesia care: a preliminary report of eight cases with at least 1 year follow-up. *Front Neurol* 2023;14:1278562. https://doi.org/10.3389/fneur.2023.1278562

Surgical Stabilization of C2–C3 Dislocation in Children Younger Than Eight Years

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ABSTRACT
Introduction: Traumatic dislocations of the C2–C3 segment in children are associated with a high risk of neurological injury and even death due to their inherent instability. Once the diagnosis is confirmed, surgical treatment is indicated. We describe a double-fixation technique performed during the same surgical procedure. Initially, reduction and primary stabilization of the C2–C3 segment are achieved using sublaminar cerclage or transfixation with a nonabsorbable suture. Subsequently, osteosynthesis with facet screws is performed. In younger children, minifragment screws and a custom-made plate are used, whereas in older children, standard adult instrumentation can be employed; in both cases, fixation follows the Magerl technique. **Conclusion:** The combined and complementary use of two stabilization techniques provides greater intraoperative safety and yields stable long-term outcomes.
Keywords: Children; C2-C3 dislocation; surgical stabilization.
Level of Evidence: IV

Estabilización quirúrgica de la luxación de C2-C3 en niños menores de 8 años

RESUMEN
Introducción: Las luxaciones traumáticas del segmento C2-C3 en niños conllevan un alto riesgo de daño neurológico e incluso de óbito debido a su inestabilidad. Una vez que se confirma el diagnóstico, el tratamiento indicado es la cirugía. Se detalla una técnica de doble fijación efectuada en el mismo acto quirúrgico. En primer lugar, se practica la reducción y la estabilización primaria mediante un cerclaje sublaminar o transfixión con hilo no absorbible del segmento C2-C3. Posteriormente, se realiza la osteosíntesis con tornillos facetarios. En niños pequeños, empleamos tornillos para minifragmentos y una placa *ad hoc*, en tanto que, en niños mayores, se puede utilizar material de adultos, en ambas situaciones, según la técnica de Magerl. **Conclusión:** El uso combinado y complementario de dos técnicas de estabilización proporciona más seguridad intraoperatoria y resultados estables en el tiempo.
Palabras clave: Niños; luxación de C2-C3; estabilización quirúrgica.
Nivel de Evidencia: IV

INTRODUCTION

According to statistics from the *National Pediatric Trauma Registry* of the United States, traumatic injuries of the cervical spine in children account for 1.5% of all trauma admissions.[1] This represents 60 to 80% of spinal traumatic conditions, including fractures, ligamentous injuries, and combined lesions.[2] These injuries are more prevalent in males, and the etiology includes, in decreasing order of frequency, traffic accidents, falls, sports-related activities, non-accidental trauma, and labor dystocia.[3-7] Upper cervical spine injuries are twice as frequent as those affecting the subaxial segment, following a bimodal distribution at 3 and 16 years of age. However, dislocations are five times more common, with a reported prevalence ranging from 25% to 40%.[1,2] Approximately one third of these children present partial or complete neurological involvement associated with SCIWORA (*Spinal Cord Injury Without Radiological Abnormalities*), with a reported frequency between 4.5% and 35%.[2] Mortality rates

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are significant in young children with complete neurological deficits, reaching up to 17%.[1] Several anatomical and physiological factors confer increased susceptibility to trauma in this region, including tissue hyperlaxity, particular configuration of the occipitoatlantal joint, reduced muscle tone, disproportion between cervical and cephalic volumes, and decreased inclination of the articular facets. The C2-C3 segment, which represents the transition zone between the mobile craniocervical and subaxial regions, is particularly prone to fractures, pathological subluxations, and dislocations, a phenomenon known as the *fulcrum effect*.[2]

The objective of this article is to describe the surgical strategy and technique used for the stabilization of C2-C3 dislocations in children younger than 8 years of age.

SURGICAL TECHNIQUE

The patient is placed in the prone position on a silicone mat with lateral supports. The arms are extended and secured to the trunk, and the head is positioned on a silicone headrest to protect pressure-sensitive areas. This position is secured with adhesive tapes fixed to the operating table, and the upper limbs are gently pulled caudally from the shoulders to improve exposure of the cervical region. The iliac crest must remain free and accessible for harvesting autologous bone graft. The entire surgical procedure is supervised by a neurophysiologist using multimodal intraoperative monitoring.

Once the surgical field has been prepared, the affected osseous segment is confirmed using an image intensifier, and the skin is marked with indelible ink. A posterior approach is used. After incision of the skin and fascia, the spinous processes of the axis and C3 are palpated to minimize the extent of surgical exposure. Subperiosteal dissection is extended to the articular processes, which is an important step to prevent unnecessary extension of the fusion area. The dislocation is reduced with extreme care using Backhaus forceps. When reduction is difficult, a small dissector or periosteal elevator may be used to mobilize the facet joints. Primary stabilization is achieved with a suture composed of two strands of non-absorbable Prolene® 2.0 using one of two techniques: 1) double sublaminar cerclage at the C2-C3 level, similar to the Brooks and Jenkins technique but applied at an infradjacent level (Figure 1)[8] or 2) osseous transfixion using a 2.5 mm diameter drill at the spinolaminar junction of the axis. The suture is passed through the drilled tunnel and then curved beneath the spinous process of C3 without crossing the midline (Figures 2 and 3).

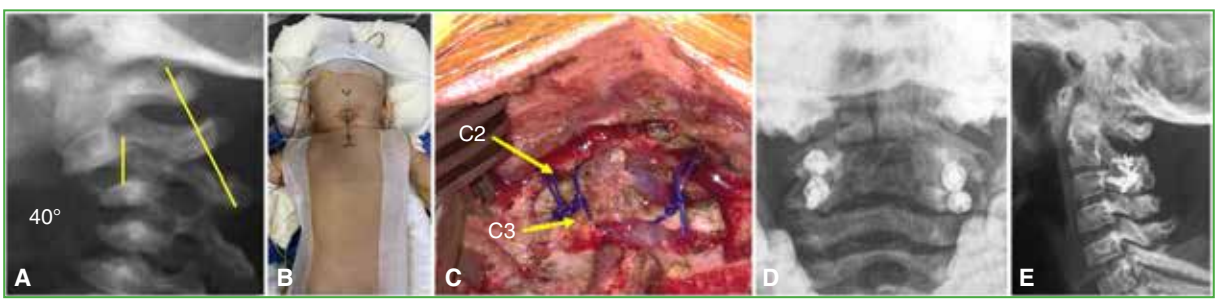

Figure 1. 9-month-old girl with a history of a traffic accident, presenting with central spinal cord syndrome and right hemidiaphragm paralysis. **A**. Lateral radiograph of the cervical spine showing unilateral C2-C3 dislocation with 40° kyphosis. **B**. Prone operative positioning and skin marking. **C**. Intraoperative image after reduction and double sublaminar cerclage of C2-C3 using Prolene® 2.0 suture (blue). **D and E**. Cervical spine radiographs, transoral anteroposterior and lateral views, obtained at 9 years of follow-up. Facet osteosynthesis using 2.0 mm diameter minifragment screws and a custom titanium miniplate.

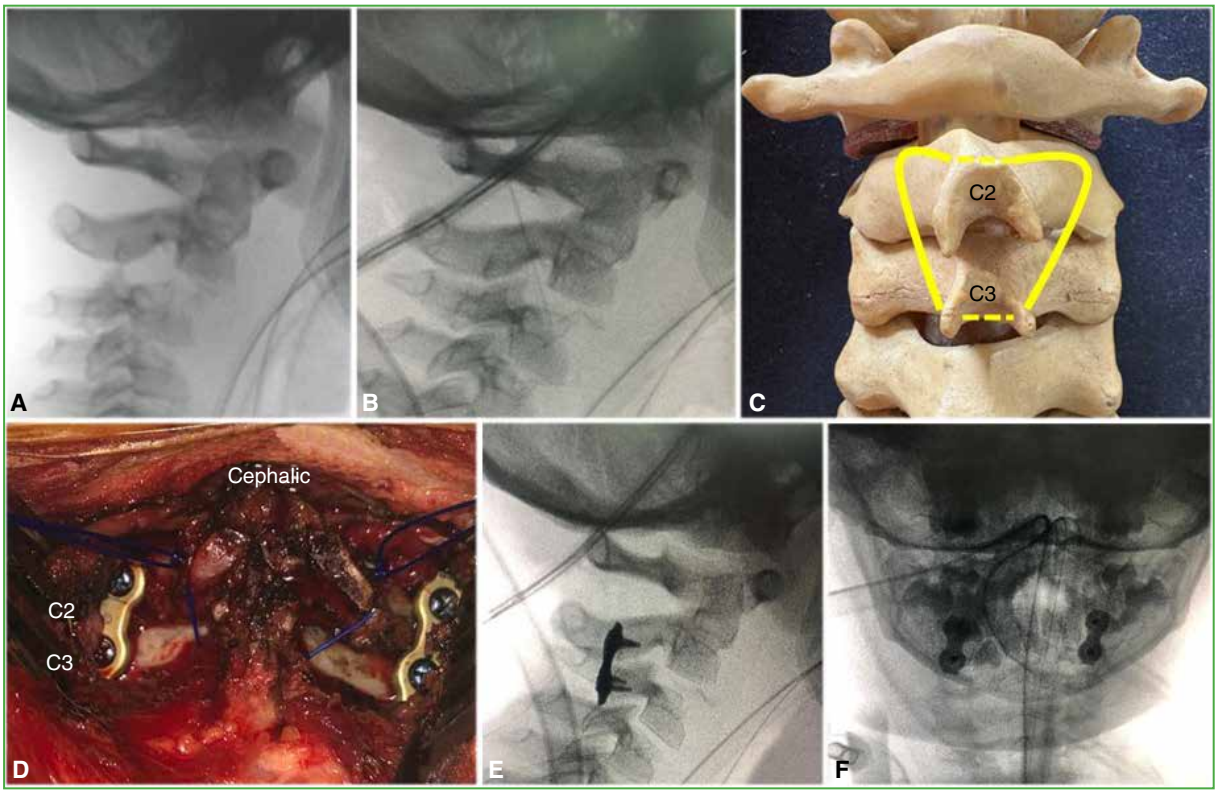

Figure 2. 4-year-old boy with traumatic brain injury secondary to deployment of the front airbag during a frontal collision. **A**. Lateral radiograph of the cervical spine showing C2-C3 dislocation. Note that, in this case, as in Figure 1, the Swischuk line was not sensitive for the diagnosis of significant instability. **B**. Intraoperative radiographic image obtained after reduction. **C**. Plastic model of the cervical spine illustrating the transosseous suture technique at the axis and fixation to the C3 spinous process using a double strand of Prolene® 2.0 suture (yellow). **D**. Intraoperative image showing osteosynthesis similar to that in Figure 1. **E and F**. Anteroposterior and lateral radiographs of the cervical spine.

Both techniques provide sufficient stability to prevent any inadvertent movement during the remainder of the procedure. Osteosynthesis is then performed using C2-C3 facet screws with a diameter of 3.5 mm and standard adult instrumentation or, in patients with very small anatomical dimensions, 2.2 mm diameter mini-fragment screws, combined with a custom plate, according to the Magerl technique. Final radiographic control is obtained, followed by placement of an autologous iliac crest bone graft impregnated with vancomycin. Postoperatively, the patient is fitted with a soft cervical collar or a Philadelphia collar for a period of 8 weeks.

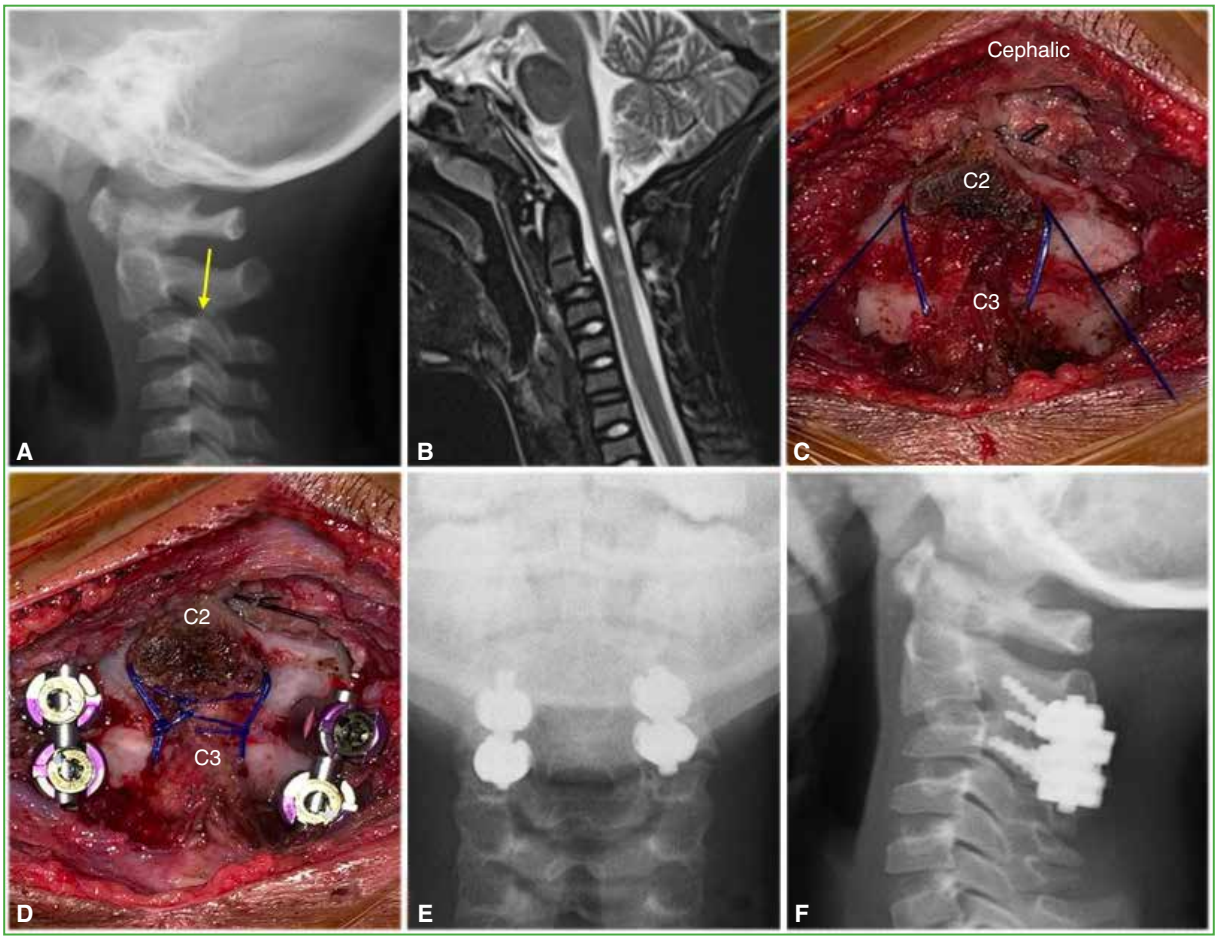

Figure 3. 8-year-old boy, victim of a frontal motor vehicle collision, presenting with pneumothorax, traumatic brain injury, mechanical ventilation for 2 weeks, and central spinal cord syndrome. Referred with a 2-month history. **A**. Lateral radiograph of the cervical spine showing pathological C2-C3 subluxation with minimal facet contact (yellow arrow). **B**. Magnetic resonance imaging showing perivertebral and intramedullary hyperintense signal on T2-weighted sequences. **C**. Intraoperative image showing suture technique as in Figure 2, using blue suture material. **D**. Intraoperative image showing facet osteosynthesis. **E and F**. Radiographic follow-up images obtained 2 years after surgery.

DISCUSSION

Dislocations of the C2-C3 segment are rare and only sporadically mentioned in the literature. Even in publications based on case series derived from database searches in PubMed and Excerpta Medica Database (EMBASE), there are no reports specifically describing C2-C3 dislocation.[1,2,9,10] We identified nine published cases, whose main common feature was marked therapeutic heterogeneity (Table).

Several authors have reported their experiences. Jones and Hensinger performed C2-C3 wire cerclage in a 20-month-old child.[3] Sakayama et al. used an identical technique combined with halo vest immobilization for 8 weeks.[11] Hamoud and Abbas performed a transosseous suture using absorbable material through the spinous process of the axis, linking it to that of C3 in a 23-month-old child. They did not add arthrodesis and prescribed immobilization with a Philadelphia collar for 8 weeks.[12] Sellin et al. stabilized the C2-C3 segment using facet screws in an adolescent.[13] O'Neill et al. performed reduction under general anesthesia and indicated halo vest immobilization in a 6-year-old child.[14] Finally, Zeng et al. used facet osteosynthesis with screws and minifragment plates, combined with autologous bone grafting, in an 8-year-old child.[15] Chen et al. placed small-fragment osteosynthesis material in the subaxial spine of a 22-month-old child.[16] We agree with other authors who recommend selecting the type of osteosynthesis based on tomographic measurement of the facet joints.[17]

Table. Case series, epidemiological and clinical variables, and treatments reported in the literature.

Author (year)	Cases	Age/Sex	Lesion of C2-C3	Cause	Neurological status	Treatment
Jones and Hensinger[3] (1981)	1	20 months/M	Chronic bilateral dislocation	Obstetric trauma	Severe hypotonia, flaccidity	Sublaminar-spinous wire cerclage C2-C3
Sakayama et al.[11] (2005)	1	4 years/F	Bilateral dislocation	Traffic accident	Frankel B	Sublaminar cerclage C2-C3
Hamoud and Abbas[12] (2014)	1	23 months/M	Bilateral dislocation	Traffic accident	Traumatic brain injury, central deficit	Intervertebral suture C2-C3 Vicryl® 2.0
Sellin et al.[13] (2014)	1	13 years/F	Subluxation + facet fracture	Fall	Normal	Facet osteosynthesis C2-C3
O'Neill et al.[14] (2021)	1	6 years/F	Unilateral subluxation	Sports accident	Normal	Reduction under general anesthesia + halo vest
Zeng et al.[15] (2022)	1	8 years/M	Bilateral dislocation	Traffic accident	Central deficit, vertebral artery stenosis	Facet osteosynthesis C2-C3 mini-fragment instrumentation
Fernández et al. [6,7] (2023)	1	9 months/F	Unilateral dislocation + C2 fracture	Traffic accident	Central spinal cord syndrome, diaphragm paralysis	C2-C3 sublaminar cerclage Prolene® 2.0 and mini-fragment facet osteosynthesis
Fernández et al.[5] (2024)	1	4 years/M	Bilateral dislocation	Traffic accident	Frankel A	C2 spinous suture and C3 cerclage Prolene® 2.0, 2 mm diameter mini-fragment facet osteosynthesis
Fernández et al.[5] (2024)	1	8 years/M	Bilateral subluxation	Traffic accident	Central spinal cord syndrome	C2 spinous suture and C3 cerclage Prolene® 2.0 and facet osteosynthesis diameter 3.5 mm

M = male; F = female.

The technique used in our cases follows a defined surgical strategy consisting of the following steps: 1) limited exposure of the affected segment; 2) reduction; 3) primary stabilization using non-absorbable suture material; and 4) facet osteosynthesis combined with bone grafting for definitive segmental stabilization.

Due to the lack of specific pediatric instrumentation, osteosynthesis systems designed for minifragment fixation were used. These systems are commonly employed in adult surgery of the long bones of the hand or foot. This approach was applied in a 9-month-old girl and a 4-year-old boy. In an 8-year-old patient, osteosynthesis material designed for adults was used. Double sublaminar cerclage at the C2-C3 level was performed in a 9-month-old girl with a lacerating soft tissue injury that facilitated passage of the suture material (Figure 1). However, for primary stabilization purposes, transfixion suturing through the spinous process of the axis, with the suture curved beneath the C3 spinous process and secured with an appropriate knot, is sufficient and safe. Regardless of the treatment modality, all authors reported stable long-term outcomes. Finally, McGrory and Klassen reported extension of the fusion mass in 38 percent of 42 children who underwent cervical spine arthrodesis for fractures and dislocations.[18]

In summary, we consider C2-C3 dislocation to be an unstable injury with a potential risk of neurological compromise and death. The sequential and combined use of two stabilization techniques provides greater intraoperative safety and yields stable outcomes over time.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Patel JC, Tepas JJ III, Mollitt DL, Pieper P. Pediatric cervical spine injuries: defining the disease. *J Pediatr Surg* 2001;36(2):373-6. https://doi.org/10.1053/jpsu.2001.20720
2. Gopinathan NR, Viswanathan VK, Crawford AH. Cervical spine evaluation in pediatric trauma: A review and an update of current concepts. *Indian J Orthop* 2018;52(5):489-500. https://doi.org/10.4103/ortho.IJOrtho_607_17
3. Jones ET, Hensinger RN. C2-C3 dislocation in a child. *J Pediatr Orthop* 1981;1(4):419-22. https://doi.org/10.1097/01241398-198112000-00011
4. Eljure G, Tello CA, Corrado R, Remondino R, Galaretto E, Noel M, et al. Parto distócico asociado a luxofractura cervical y compromiso neurológico. Reporte de cuatro casos. *Rev Asoc Argent Ortop Traumatol* 2015;80(3):207-16. Available at: https://www.scielo.org.ar/scielo.php?pid=S1852-74342015000300010&script=sci_arttext
5. Fernández CA, Miranda MG, Moreiro ME. Una discusión sobre la línea espinolaminar de Swischuk: revisión bibliográfica. *Rev Asoc Argent Ortop Traumatol* 2024;89(4):393-402. https://doi.org/10.15417/issn.1852-7434.2024.89.4.1897
6. Fernández CA, Moreiro ME, Miranda MG. Instrucción ortopédica de posgrado - imágenes: presentación del caso. *Rev Asoc Argent Ortop Traumatol* 2023;88(6):592-3. https://doi.org/10.15417/issn.1852-7434.2023.88.6.1827
7. Fernández CA, Moreiro ME, Miranda MG. Instrucción ortopédica de posgrado - imágenes: resolución del caso. *Rev Asoc Argent Ortop Traumatol* 2023;88(6):692-3. https://doi.org/10.15417/issn.1852-7434.2023.88.6.1828
8. Vaccaro AR, Todd JA. Posterior cervical arthrodesis and instrumentation. In: Vaccaro AR, Todd JA. *Spine Surgery*. 3.ª ed. New York: Thieme Medical Publishers; 2016. p. 16-40.
9. Zhang JK, Hongsermeier-Graves N, Savic B, Nadel J, Sherrod BA, Brockmeyer DL, et al. Pediatric cervical spine trauma: a narrative review. *Clin Spine Surg* 2024;37(9):416-24. https://doi.org/10.1097/BSD.0000000000001708
10. Haddad E, Al Khoury Salem H, Dohin B. Diagnosis and treatment of cervical spine injuries in children. *Orthop Traumatol Surg Res* 2024;110(1S):103762. https://doi.org/10.1016/j.otsr.2023.103762
11. Sakayama K, Kidani T, Matsuda Y, Sugawara Y, Shibata T, Yamamoto H. A child who recovered completely after spinal cord injury complicated by C2-3 fracture dislocation: case report. *Spine (Phila Pa 1976)* 2005;30(10):E269-71. https://doi.org/10.1097/01.brs.0000162533.02807.c9
12. Hamoud K, Abbas J. A new technique for stabilization of injuries at C2-C3 in young children. *Injury* 2014;45(11):1791-5. https://doi.org/10.1016/j.injury.2014.05.027
13. Sellin JN, Shaikh K, Ryan SL, Brayton A, Fulkerson DH, Jea A. Clinical outcomes of the surgical treatment of isolated unilateral facet fractures, subluxations, and dislocations in the pediatric cervical spine: report of eight cases and review of the literature. *Childs Nerv Syst* 2014;30(7):1233-42. https://doi.org/10.1007/s00381-014-2395-6
14. O'Neill C, Wenzel A, Walterscheid Z, Carmouche J. Distinguishing pseudosubluxation from true injury: a case of C2-3 and C3-4 subluxation in a pediatric patient. *J Am Acad Orthop Surg Glob Res Rev* 2021;5(12). https://doi.org/10.5435/JAAOSGlobal-D-20-00238
15. Zeng J, Jiang H, Zhuo Y, Xu Y, Deng Z. A case report on a child with fracture and dislocation of the upper cervical spine accompanied by spinal cord injury. *Medicine (Baltimore)* 2022;101(30):e29717. https://doi.org/10.1097/MD.0000000000029717

16. Chen Y, Wang X, Chen D, Liu X. Surgical treatment for unilateral cervical facet dislocation in a young child aged 22 months: a case report and review of the literature. *Eur Spine J* 2013;22(Suppl 3):S439-42. https://doi.org/10.1007/s00586-012-2590-7
17. Sotomayor HE, Remondino R, Tello C, Galaretto E, Francheri I, Bersusky E, et al. Instrumentación cervical en pacientes menores de 10 años. *Rev Asoc Argent Ortop Traumatol* 2017;82(3):220-3. https://doi.org/10.15417/616
18. McGrory BJ, Klassen RA. Arthrodesis of the cervical spine for fractures and dislocations in children and adolescents: a long-term follow-up study. *J Bone Joint Surg Am* 1994;76(11):1606-16. https://doi.org/10.2106/00004623-199411000-00003

Case Resolution

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Case Presentation on page 4.

Acute Spinal Cord Infarction after Spinal Surgery

ABSTRACT
Spinal cord infarction is an infrequent neurosurgical complication but is associated with extremely high morbidity. We report the case of a 68-year-old man with multiple cardiovascular and oncological comorbidities (active lung and prostate cancer) who developed rapidly progressive acute paraplegia following percutaneous bone biopsy, percutaneous fixation, and bipedicular kyphoplasty at L1. Although computed tomography ruled out mechanical causes and cement leakage, magnetic resonance imaging confirmed spinal cord ischemia extending from T9 to L4. This report analyzes the multifactorial etiology of the event, highlighting the interaction between paraneoplastic hypercoagulability and the surgical technique as key factors to be considered during preoperative planning.
Keywords: Spinal cord infarction; ischemic stroke; ischemia; kyphoplasty; paraplegia.
Level of Evidence: IV

Infarto medular agudo después de una cirugía espinal

RESUMEN
El infarto medular es una complicación neuroquirúrgica infrecuente, pero con una morbilidad extremadamente alta. Se presenta el caso de un hombre de 68 años con múltiples comorbilidades oncológicas (cánceres de pulmón y próstata en actividad) y cardiovasculares que desarrolló una paraplejía aguda rápidamente progresiva, tras una biopsia ósea por punción, fijación percutánea y cifoplastia bipedicular en L1. A pesar que, con la tomografía computarizada, se descartaron causas mecánicas o fuga de cemento, la resonancia magnética confirmó una isquemia medular desde T9 a L4. Este reporte analiza la etiología multifactorial del evento, destacando la interacción entre el estado de hipercoagulabilidad paraneoplásica y la técnica quirúrgica, como puntos clave por tener en cuenta en la planificación prequirúrgica.
Palabras clave: Infarto medular; accidente cerebrovascular; isquemia; cifoplastia; paraplejía.
Nivel de Evidencia: IV

DIAGNOSIS: Acute spinal cord infarction after spinal surgery.

DISCUSSION

Forty-eight hours after the initial surgery, an emergency spinal magnetic resonance imaging study revealed non-compressive intramedullary hyperintensity consistent with extensive spinal cord ischemia extending from T9 to L4 (Figure 3). The condition was considered a spinal cord injury not amenable to surgical management; therefore, anticoagulation therapy was restarted and the patient was referred to an intensive rehabilitation center.

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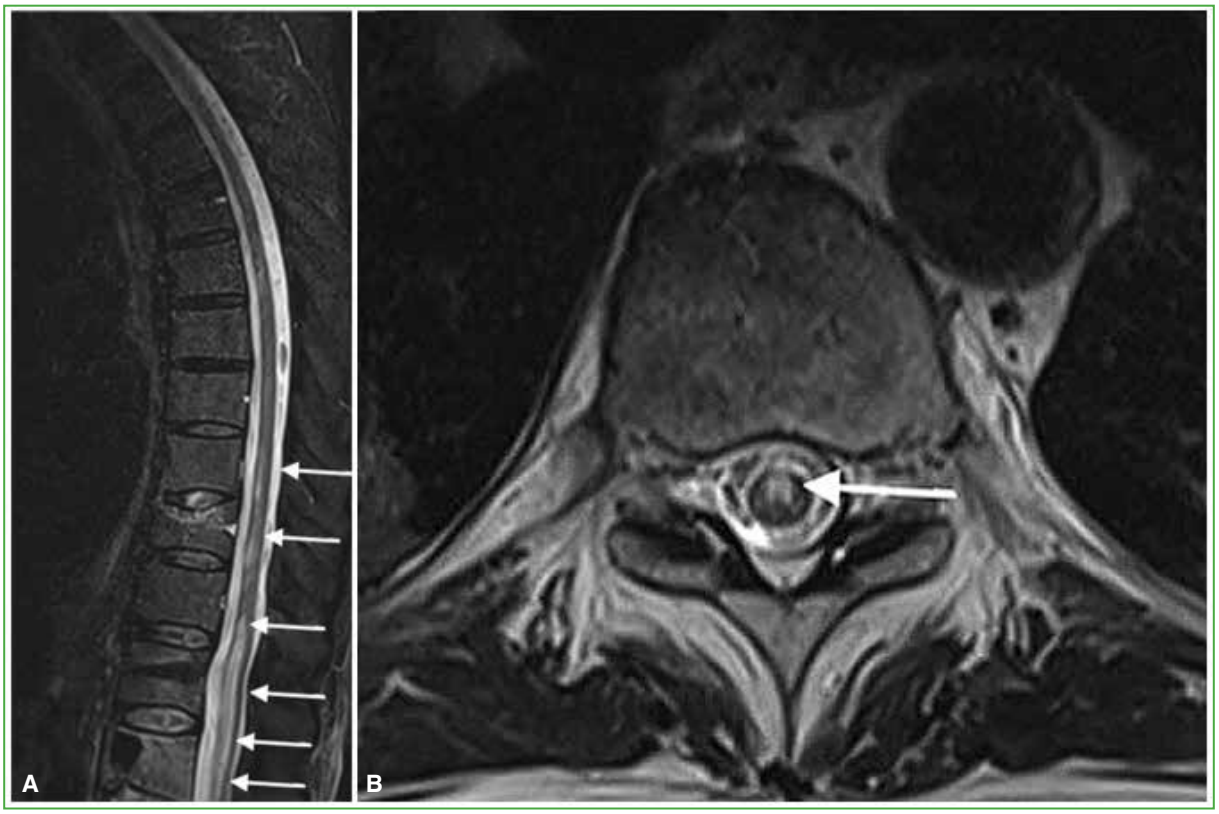

Figure 3. Postoperative magnetic resonance imaging of the spine showing a non-compressive intramedullary hyperintense signal, consistent with vascular injury. **A.** Mid-sagittal T2-weighted sequence. **B.** Axial T2-weighted sequence.

Spinal cord infarction accounts for approximately 0.3%–1% of all ischemic events affecting the central nervous system.[1] Unlike cerebral stroke, the diagnosis of acute spinal cord ischemia represents a significant clinical challenge due to its heterogeneous presentation and the fact that imaging studies may be normal during the hyperacute phase.[2]

In the context of spinal surgery, certain procedures, such as vertebroplasty and kyphoplasty, have been reported as potential iatrogenic causes of spinal cord ischemia, mainly through embolic phenomena or local hemodynamic alterations.

Spinal cord ischemia can be classified as spontaneous or periprocedural.[2,3] In the periprocedural setting, multiple etiopathogenic factors may converge:

Kyphoplasty-related mechanisms: These may be direct or indirect. A direct mechanism includes intracanal cement migration (Figure 4), which may injure neural structures through mass effect or thermal damage. A critical increase in intravertebral pressure has also been described, particularly in bipedicular techniques.[4] Indirect mechanisms include arterial embolism caused by cement microparticles occluding the anterior spinal artery or the artery of Adamkiewicz, congestion of the Batson venous plexus, and thermal injury related to cement polymerization.[5] In our patient, postoperative imaging ruled out cement leakage into the spinal canal (Figure 4).

Figure 4. Computed tomography of a lumbar vertebra, axial view. This is an illustrative case, distinct from the case presented, showing intracanal cement migration (white arrows) with spinal canal involvement.

Oncological prothrombotic state: Patients with active malignancy present a chronic hypercoagulable condition. Discontinuation of rivaroxaban may generate a "rebound effect" with a transient increase in thrombin activity; when combined with the release of tissue thromboplastin during bone manipulation, this facilitates in situ thrombosis of radiculomedullary arteries.[6,7] In this case, the patient was receiving rivaroxaban, whose suspension was managed by the appropriate service, and was under active follow-up for two malignancies.

Hemodynamic compromise: Chronic pericardial effusion limits cardiac reserve.[8] Episodes of perioperative hypotension may lead to infarction in spinal cord "watershed zones," where vascular supply is particularly vulnerable—especially between T4 and T9.[6] The image of intramedullary injury, in our case, began at T9.

Fat and tumor embolism: The pressure exerted by kyphoplasty balloons may force fat or tumor debris into the epidural venous circulation, resulting in venous spinal cord ischemia due to impaired venous outflow.[9]

Postoperative spinal cord ischemia is frequently a diagnosis of exclusion, in which clinical findings outweigh initial imaging results.[4] The absence of abnormalities on computed tomography ruled out direct mechanical compression from cement leakage or bone displacement, but not systemic vascular insufficiency. In oncological patients, the risk is not solely technical but also systemic, as vascular compromise results from the combination of reduced cardiac output and a prothrombotic state exacerbated by anticoagulation withdrawal.[10,11]A thorough evaluation of patients with active cancer or those receiving oral anticoagulants is essential to reduce the risk of this adverse event. Preventive strategies may include the use of a unipedicular technique, modification or bridging of anticoagulation therapy, among others.

Optimal spinal cord perfusion should be prioritized by maintaining a mean arterial pressure greater than 85 mmHg.

In the presence of any sudden neurological deficit following kyphoplasty, urgent magnetic resonance imaging with diffusion-weighted sequences is mandatory, as this is the most sensitive modality for detecting restricted diffusion associated with spinal cord infarction during the hyperacute phase.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Ros Castelló V, Sánchez Sánchez A, Natera Villalba E, Gómez López A, Parra P, Rodríguez Jorge F, et al. Spinal cord infarction: aetiology, imaging findings, and prognostic factors in a series of 41 patients. *Neurologia* (Engl Ed) 2023;38(6):391-8. https://doi.org/10.1016/j.nrleng.2020.11.004
2. Caton MT, Huff JS. Spinal cord ischemia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [actualizado 2023 Ago 14]. Available at: https://www.ncbi.nlm.nih.gov/books/NBK539870/
3. Zalewski NL, Rabinstein AA, Krecke KN, Brown RD Jr, Wijdicks EFM, Weinshenker BG, et al. Characteristics of spontaneous spinal cord infarction and proposed diagnostic criteria. *JAMA Neurol* 2019;76(1):56-63. https://doi.org/10.1001/jamaneurol.2018.2734
4. Zhan Y, Jiang J, Liao H, Tan H, Yang K. Risk factors for cement leakage after vertebroplasty or kyphoplasty: A meta-analysis of published evidence. *World Neurosurg* 2017;101:633-42. https://doi.org/10.1016/j.wneu.2017.01.124
5. Li S, Lemon J, Ibrahim M, Mi K, Ferguson S, Rust K, et al. Post-kyphoplasty myelopathy, an unusual presentation of post-operative anterior spinal cord infarct: A case report. *Interv Pain Med* 2023;2(3):100267. https://doi.org/10.1016/j.inpm.2023.100267
6. Puente-Hernandez M, Rivero-de-Aguilar A, Varela-Lema L. Cancer-associated spinal cord infarction: A systematic review and analysis of survival predictors. *J Neurol Sci* 2023;446:120580. https://doi.org/10.1016/j.jns.2023.120580
7. Frydrych M, Janeczek M, Małyszek A, Nelke K, Dobrzyński M, Lukaszewski M. Prothrombotic rebound after discontinuation of direct oral anticoagulants therapy: A systematic review. *J Clin Med* 2024;13(21):6606. https://doi.org/10.3390/jcm13216606
8. Porto GBF, Jeffrey Wessell D, Alvarado A, Arnold PM, Buchholz AL. Anticoagulation and spine surgery. *Global Spine J* 2020;10(1_suppl):53S-64S. https://doi.org/10.1177/2192568219852051
9. Lim BG, Lee JY, Lee MK, Lee DK, Kim JS, Choi SS. Kyphoplasty for the treatment of vertebral compression fractures in a cancer patient with neurological deficits and anterior vertebral wall destruction. *Pain Physician* 2011;14(6):539-44. PMID: 22086095
10. Matouk CC, Krings T, Ter Brugge KG, Smith R. Cement embolization of a segmental artery after percutaneous vertebroplasty: a potentially catastrophic vascular complication. *Interv Neuroradiol* 2012;18(3):358-62. https://doi.org/10.1177/159101991201800318
11. Dokponou YCH, Ontsi Obame FL, Takoutsing B, Mustapha MJ, Nyalundja AD, Elmi Saad M, et al. Spinal cord infarction: A systematic review and meta-analysis of patient's characteristics, diagnosis accuracy, management, and outcome. *Surg Neurol Int* 202413;15:325. https://doi.org/10.25259/SNI_477_2024