Preoperative Evaluation of Osteoporosis in Spinal Fusion Surgery: A Survey of Argentine and Latin American Surgeons

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ABSTRACT

Objective: To analyze the preoperative evaluation of osteoporosis during surgical planning for adult patients undergoing spinal fusion surgery, from the perspective of spine surgeons in Argentina and Latin America. **Materials and Methods:** A descriptive, cross-sectional study was conducted among orthopedic spine surgeons practicing in Argentina and other Latin American countries. A structured questionnaire based on a simulated clinical case was developed to explore preoperative management of a 70-year-old patient scheduled for elective spinal fusion surgery. **Results:** A total of 154 spine surgeons from Argentina, Brazil, Paraguay, and Uruguay were surveyed. Significant differences were found in the use of full-length spine radiographs ($p < 0.001$), dynamic radiographs ($p = 0.001$), computed tomography ($p = 0.002$), magnetic resonance imaging ($p < 0.001$), and Hounsfield unit assessment ($p = 0.014$). The use of bone density scans showed a marginal statistical trend ($p = 0.058$), with higher rates in Uruguay (52.4%) and Argentina (42.9%). Vitamin D testing was requested in 40.3% of cases, with no significant differences between countries ($p = 0.803$), highlighting the limited assessment of this marker related to bone metabolism. **Conclusions:** There is a clear trend toward underestimation of osteoporosis screening in the preoperative evaluation for spinal fusion surgery. Fewer than 50% of surgeons considered requesting a DEXA scan, Hounsfield unit assessment, or vitamin D measurement.

Keywords: Osteoporosis; preoperative evaluation; spine surgery; arthrodesis; spinal fusion.

Level of Evidence: IV

Evaluación preoperatoria de la osteoporosis en la cirugía de fusión vertebral: encuesta a cirujanos de la Argentina y America Latina

RESUMEN

Objetivo: Analizar la evaluación preoperatoria de la osteoporosis durante la planificación quirúrgica de pacientes adultos candidatos a una cirugía de fusión vertebral, según la perspectiva de cirujanos de columna de la Argentina y América Latina. **Materiales y Métodos:** Estudio descriptivo y transversal de médicos traumatólogos, cirujanos de columna, que se desempeñan en centros de la Argentina y otros países de América Latina. Se confeccionó un cuestionario estructurado basado en un caso clínico simulado, diseñado para explorar el manejo preoperatorio frente a un paciente de 70 años candidato a una cirugía de fusión vertebral programada. **Resultados:** Se encuestaron 154 cirujanos de columna de la Argentina, Brasil, Paraguay y Uruguay. Se detectaron diferencias significativas en la solicitud de espinogramas ($p < 0{,}001$), radiografías dinámicas ($p = 0{,}001$), tomografía computarizada ($p = 0{,}002$), resonancia magnética ($p < 0{,}001$) y valoración de las unidades Hounsfield ($p = 0{,}014$). La solicitud de densitometría mostró una tendencia estadística marginal ($p = 0{,}058$), con mayor solicitud por sujetos de Uruguay (52,4%) y Argentina (42,9%). La determinación de vitamina D fue solicitada en el 40,3% de los casos, sin diferencias significativas entre países ($p = 0{,}803$), lo

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How to cite this article: Bazán PL, Ricciardi GA, Calcagni E, Casco EA, Galli N, Fogaça Cristante A, et al, Grupo de Estudio de la Sociedad Argentina de Patología de la Columna Vertebral (SAPCV). Preoperative Evaluation of Osteoporosis in Spinal Fusion Surgery: A Survey of Argentine and Latin American Surgeons. *Rev Asoc Argent Ortop Traumatol* 2026;91(2):118-125. https://doi.org/10.15417/issn.1852-7434.2026.91.2.2214

que destaca una baja evaluación de este marcador relacionado con el metabolismo óseo. **Conclusiones:** Se observó una clara tendencia a la subestimación del cribado de osteoporosis en la evaluación preoperatoria para una cirugía de fusión vertebral. Menos del 50% de los cirujanos consideró solicitar una densitometría, unidades Hounsfield o medición de vitamina D.
Palabras clave: Osteoporosis; evaluación preoperatoria; cirugía de columna; artrodesis; fusión.
Nivel de Evidencia: IV

INTRODUCTION

Osteoporosis is the most common metabolic bone disease and represents a major global public health problem. It is characterized by reduced bone mass and deterioration of bone quality, leading to increased susceptibility to fractures.[1] Fragility fractures are its most relevant clinical outcome and have become a true global epidemic, with substantial health and economic impact.[2] It has been reported that the costs associated with hospitalizations for fragility fractures exceed those related to acute myocardial infarction, stroke, and breast cancer.[3]

Fragility fractures are not the only clinically relevant outcome in patients with osteoporosis. This is particularly evident in the context of spine surgery, where the prevalence of osteoporosis exceeds 30% in patients older than 50 years. In this setting, osteoporosis has been identified as a risk factor for multiple complications, extensively documented in both cervical and thoracolumbar procedures and across a broad spectrum of conditions (adult spinal deformity, unstable fractures, and degenerative disease).[4] Among the most common complications are implant loosening or failure, pseudarthrosis, proximal junctional kyphosis, interbody cage subsidence, and the development of new fractures.[5-9]

There is broad consensus on the importance of optimizing the patient's general condition prior to elective spine surgery in older adults. This includes correcting anemia, improving nutritional status, optimizing body mass index, managing pain, and promoting smoking cessation.[10] Within this comprehensive approach, optimization of bone metabolism has emerged as a key strategy to prevent complications associated with poor bone quality.[11] In line with current evidence, clinical guidelines recommend that preoperative osteoporosis assessment in adult patients undergoing surgery for spinal deformity be performed routinely.[12,13]

However, the rate of preoperative bone health assessment among spine surgeons remains low.[4] Several cross-sectional studies have highlighted variability in the diagnostic and therapeutic approaches adopted.[14,15] In light of the available evidence, we hypothesized that adherence among spine surgeons in Latin America to current recommendations for the preoperative evaluation of osteoporosis is low.

In this context, our objective was to evaluate preoperative osteoporosis assessment during surgical planning in adult patients undergoing spinal fusion, from the perspective of spine surgeons in Argentina and other Latin American countries.

MATERIALS AND METHODS

A descriptive, cross-sectional, exploratory study was conducted using a survey administered to orthopedic surgeons specializing in spine surgery, working at centers in Argentina and other Latin American countries, between April 1 and June 1, 2025.

A non-probability purposive sample was obtained from the database of spine surgeons of the Argentine Society of Spine Pathology, supplemented by snowball sampling through messaging applications and email.

Participants were selected according to predefined eligibility criteria. The study included orthopedic surgeons practicing as spine surgeons in Latin American centers who routinely perform spinal fusion procedures in adult patients and who agreed to complete the survey. Trainees (orthopedic residents and spine surgery fellows) and questionnaires with more than 50% missing responses were excluded.

Data Collection Instrument

A structured questionnaire based on a simulated clinical case was developed to assess preoperative management of a 70-year-old patient candidate for elective spinal fusion surgery. The questionnaire was designed by the research team and included items aimed at evaluating the use of imaging studies, laboratory tests, and other specific preoperative assessments for the diagnosis of osteoporosis and surgical planning. Responses were closed-ended (multiple choice).

The instrument was peer-reviewed to ensure clarity, relevance, and internal consistency. Prior to final administration, a pilot test was conducted on the first 20 responses to refine its format and content. The survey was distributed using Google Forms and remained open for a three-month period.

Statistical Analysis

Categorical variables are presented as absolute frequencies and percentages. Comparisons between groups were performed using the χ^2 test or Fisher's exact test, as appropriate based on sample size and expected frequencies. A p-value <0.05 was considered statistically significant. Statistical analyses were performed using SPSS Statistics version 25.

The study adhered to the principles of the Declaration of Helsinki for research involving human subjects, ensuring data confidentiality and participant anonymity. Informed consent was obtained from all participants upon agreeing to complete the survey, after receiving appropriate information regarding the study objectives and procedures. Collected data were coded, stored with restricted access, and used exclusively for the purposes of this study.

RESULTS

A total of 154 spine surgeons from Argentina, Brazil, Paraguay, and Uruguay were included (Figure).

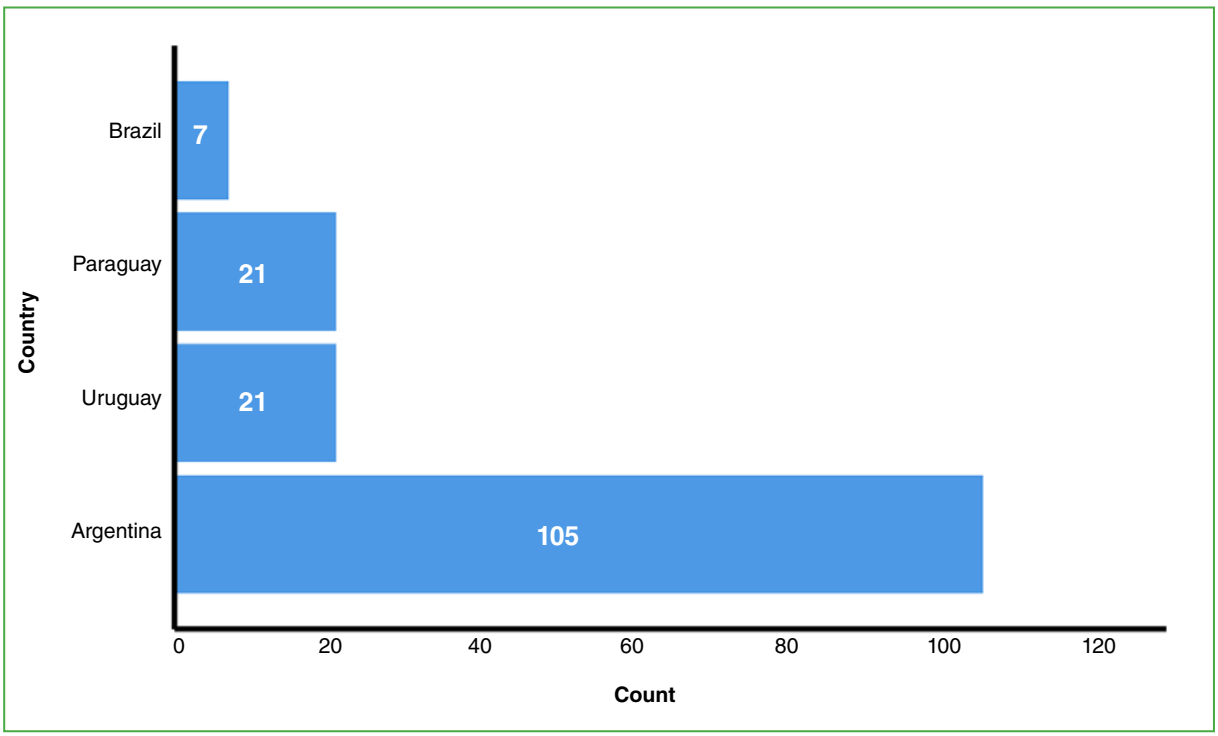

Figure. Bar chart showing the distribution of patients by country.

Imaging Studies

The most frequently requested studies were magnetic resonance imaging (MRI) (92.9%), dynamic radiographs (78.6%), full-spine radiographs (75.3%), and computed tomography (CT) (67.5%). Specific screening for osteoporosis using bone density scan and Hounsfield units was less frequent (40.3% and 37.7%, respectively).

When comparing by country, significant differences were observed in the use of full-spine radiographs ($p < 0.001$), dynamic radiographs ($p = 0.001$), CT ($p = 0.002$), MRI ($p < 0.001$), and Hounsfield unit assessment ($p = 0.014$). Bone density scan showed a marginal statistical trend ($p = 0.058$), being more frequently requested in Uruguay (52.4%) and Argentina (42.9%) (Table 1).

Table 1. Distribution of requested tests and comparison by country of origin.

Stydy		Total		Argentina		Brazil		Paraguay		Uruguay		p
		n	%	n	%	n	%	n	%	n	%	
Full-spine radiograph		116	75.3	92	87.6	5	71,4	4	19.0	15	71.4	<0.001
Dynamic radiograph		121	78.6	89	84.8	7	100.0	10	47.6	15	71.4	0.001
CT		104	67.5	79	75.2	4	57.1	7	33.3	14	66.7	0.002
MRI		143	92.9	103	98.1	0	0.0	19	90.5	21	100.0	<0.001
PET		3	1.9	1	1.0	0	0.0	2	9.5	0	0.0	0.06
Bone scintigraphy		1	0.6	1	1.0	0	0.0	0	0.0	0	0.0	0.925
Osteoporosis screening	Bone density scan	62	40.3	45	42.9	0	0.0	6	28.6	11	52.4	0.058
	HU	58	37.7	33	31.4	4	57.1	7	33.3	14	66.7	0.014

CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography; HU = Hounsfield units.

Laboratory Parameters

Overall, no significant differences were observed between countries in most laboratory tests requested as part of the preoperative evaluation of the clinical case. The most frequently requested tests were complete blood count (98.1%), blood glucose (93.5%), and renal function assessment (92.9%), followed by glycated hemoglobin (74.7%), serum protein electrophoresis (66.2%), and acute-phase reactants (48.7%). Vitamin D was requested in 40.3% of cases, with no significant differences between countries ($p = 0.803$), highlighting the low rate of assessment of this marker related to bone metabolism. Statistically significant differences between countries were observed only for blood glucose testing ($p < 0.001$) and serum protein electrophoresis ($p = 0.017$), the latter being more frequently requested in Paraguay and Argentina (Table 2).

Table 2. Distribution of laboratory parameters by country.

Laboratory parameters	Total		Argentina		Brazil		Paraguay		Uruguay		p
	n	%	n	%	n	%	n	%	n	%	
Complete blood count	151	98.1	103	98.1	7	100.0	20	95.2	21	100.0	0.699
Blood glucose	144	93.5	102	97.1	6	85.7	16	76.2	20	95.2	0.004
Renal function	143	92.9	100	95.2	7	100.0	19	90.5	17	81.0	0.107
Serum protein electrophoresis	102	66.2	73	69.5	4	57.1	17	81.0	8	38.1	0.017
HbA1c	115	74.7	79	75.2	7	100.0	17	81.0	12	57.1	0.100
Acute-phase reactant	75	48.7	56	53.3	2	28.6	11	52.4	6	28.6	0.135
Vitamin D	62	40.3	41	39.0	2	28.6	10	47.6	9	42.9	0.803

Preoperative Risk Assessment

Regarding preoperative cardiovascular and respiratory tests, no statistically significant differences were observed between countries. Electrocardiography was the most frequently requested test (97.4% of the total sample), followed by spirometry (42.2%), lower-limb Doppler ultrasound (29.9%), and exercise stress testing (16.2%) (Table 3).

Table 3. Distribution of cardiorespiratory studies by country.

Studies	Total		Argentina		Brazil		Paraguay		Uruguay		p
	n	%	n	%	n	%	n	%	n	%	
ECG	150	97.4	103	98.1	6	85.7	20	95.2	21	100.0	0.177
Spirometry	65	42.2	48	45.7	1	14.3	10	47.6	6	28.6	0.202
Lower extremity Doppler ultrasound	46	29.9	35	33.3	3	42.9	5	23.8	3	14.3	0.265
Exercise testing	25	16.2	17	16.2	1	14.3	4	19.0	3	14.3	0.977

DISCUSSION

Osteoporosis is a critical factor in the preoperative evaluation of patients undergoing instrumented spine surgery, as it is a major predictor of mechanical complications, particularly those related to implant failure and sagittal imbalance. Its impact is especially relevant in complex procedures, such as adult spinal deformity surgery, which typically require long constructs and involve greater biomechanical demands.[5-9]

In a cross-sectional study of 349 spine surgeons in Latin America, Pantoja and Molina reported the regional clinical scenario, in which 79.6% indicated having managed osteoporosis-related complications and 71.6% reported having revised instrumentation due to failures associated with this condition.[16]

Recent AOSpine clinical recommendations on osteoporosis in adults with spinal deformity highlight the importance of systematic evaluation of osteoporosis in these patients. Although high-quality evidence is still needed, these recommendations emphasize that all clinicians treating adults with scoliosis should consider bone health as a key component for improving surgical outcomes and minimizing complications.[15] Nevertheless, and in line with previous cross-sectional studies, we identified a low level of awareness regarding the preoperative evaluation of osteoporosis.[14-16] Compared with the frequent use of initial imaging studies, such as full-spine radiographs (75.3%) and magnetic resonance imaging (92.9%), fewer than half of respondents used specific methods to detect osteoporosis, such as bone density scan (40.3%) and Hounsfield unit measurement (37.7%). No significant differences were found in the use of density scan according to country of origin, whereas a higher proportion of surgeons in Uruguay reported using Hounsfield unit measurement (66.7%; $p = 0.014$).

It should be noted that, although bone density scan has traditionally been the gold standard for diagnosing osteoporosis, it has limitations in patients with spondylarthrosis, in whom bone quality may be overestimated.[17] This has led to the investigation of additional methods for assessing bone health, such as Hounsfield unit measurement, the trabecular bone score, and fracture risk calculators, such as the FRAX® tool.[18-20] St. Jeor et al. evaluated 140 patients undergoing spinal fusion to compare preoperative assessment methods and reported a 32% rate of osteoporosis-related complications. Multivariable binary logistic regression analysis showed that lower mean Hounsfield unit values were an independent predictor of osteosynthesis-related complications. The odds of developing a complication increased 1.7-fold for every 25-unit decrease in mean Hounsfield values.[19]

Considering the best available evidence together with accessible resources for evaluating osteoporosis in vulnerable patients, routine clinical practice should include a bone density scan of the spine and wrist as an additional anatomical site, as well as analysis of Hounsfield units obtained from preoperative CT, to achieve a more accurate assessment of osteoporosis.[15,20]

In a systematic review of nine studies, Bazán et al. concluded that Hounsfield unit measurement may optimize surgical planning and reduce osteoporosis-related complications, with a low level of evidence but promising perspectives.[20]

On the other hand, although Hounsfield unit-based assessment is increasingly used, it has important limitations. Hounsfield unit values may be influenced by multiple technical factors, including CT acquisition parameters, scanner calibration, reconstruction algorithms, and region-of-interest selection, which affect reproducibility and interinstitutional comparability.

According to the evidence-based guidelines of the *Congress of Neurological Surgeons* on the preoperative evaluation of osteoporosis in patients undergoing spinal surgery, at least one of the following assessments is recommended, each with its corresponding cutoff value associated with a high risk of complications: bone density scan with a T-score < −2.5; CT with Hounsfield units <97.9; or serum vitamin D3 levels <20 ng/mL.[12]

Vitamin D deficiency is extremely common, with prevalence rates ranging from 40% to 90% in adults.[21] Patients >50 years of age, smokers, and individuals with obesity are at higher risk of hypovitaminosis D.[21-23] It is estimated that more than 25% of adults scheduled for spinal surgery have this deficiency.[22] Preoperative measurement of vitamin D and calcium provides valuable information on bone metabolism.[20] Furthermore, patients undergoing spinal fusion may benefit from correction of this deficiency.[23] In our study, fewer than half of the surgeons requested vitamin D testing as part of the preoperative workup. Although higher-quality evidence is needed, the available data suggest that spine surgeons should consider the increased risk of adverse outcomes in patients with preoperative vitamin D deficiency.[24]

Our study has several limitations, including a small sample size, a limited number of preoperative and demographic variables assessed, and the recall bias inherent to cross-sectional survey-based designs. In addition, the overrepresentation of Argentina compared with other countries limits the generalizability of the results.

Nevertheless, a clear trend was identified that may help guide future strategies to optimize the implementation of recommendations from international publications and guidelines regarding the preoperative evaluation of patients undergoing spinal surgery who are at risk of osteoporosis. Further multinational studies with greater regional representation are needed.

CONCLUSIONS

A clear tendency to underestimate osteoporosis assessment during preoperative evaluation in the surgical planning of adult patients undergoing spinal fusion was observed.

Fewer than half of the surgeons considered ordering bone density scan (40.3%), Hounsfield unit measurement (37.7%), or vitamin D testing (40.3%).

The low proportion of surgeons from other Latin American countries represents a limitation of the study and restricts the direct generalization of the results to the entire region.

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

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