

# CONSERVATIVE TREATMENT AND VITAMIN D LEVELS IN PATIENTS WITH SPINAL FRACTURES

TRATAMENTO CONSERVADOR E NÍVEIS DE VITAMINA D EM PACIENTES COM FRATURAS TORACOLOMBARES

TRATAMIENTO CONSERVADOR Y NIVELES DE VITAMINA D EN PACIENTES CON FRACTURAS TORACOLUMBARES

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## ABSTRACT

**Objectives:** Evaluate the evolution of pain, functional capacity, and vitamin D levels in conservatively treated patients with low-energy spinal fractures. **Methods:** Between January 2017 and March 2021, patients older than 40 years old affected by these fractures were selected and treated conservatively for six months. Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) scores and Cobb angle were evaluated pre- and post-treatment. Serum vitamin D levels were also measured at the first outpatient visit, and it was investigated whether the patient had a previous diagnosis of osteoporosis or previous fractures. **Results:** A total of 105 patients were analyzed, 70.5% of whom were women, with a mean age of 73.1 years. The average vitamin D level was 25.3 ng/mL, and hypovitaminosis was found in 75% of patients. Eight patients (7.62%) had a previous diagnosis of osteoporosis, and ten (9.52%) reported the occurrence of previous fractures. Regarding the VAS score, there was a mean reduction of 5.5 points of pain; for ODI, there was an average increase of 1 percentage point and an average increase of 4.3° of kyphosis in the fractured segment between pre- and post-treatment. **Conclusion:** The treatment improved pain, and patients maintained their functional capacity. Low levels of vitamin D were associated with more complex fractures. **Level of evidence III; Retrospective Study.**

**Keywords:** Spinal Fractures; Osteoporosis; Conservative Treatment; Vitamin D.

## RESUMO

**Objetivos:** Avaliar a evolução da dor, capacidade funcional e níveis de vitamina D em pacientes com fraturas toracolumbares por trauma de baixa energia tratados conservadoramente. **Métodos:** No período de janeiro de 2017 a março de 2021, pacientes com mais de 40 anos acometidos por estas fraturas foram selecionados e tratados conservadoramente durante 6 meses. As pontuações da Escala Visual Analógica (VAS), do Índice de Incapacidade de Oswestry (ODI) e o ângulo de Cobb foram avaliados no pré e pós tratamento. Dosagem sérica de vitamina D no primeiro retorno ambulatorial também foi realizada e o paciente foi questionado se tinha diagnóstico prévio de osteoporose ou fraturas prévias. **Resultados:** Foram avaliados 105 pacientes, sendo 70,5% mulheres, cuja idade média foi de 73,1 anos. O nível sérico médio de vitamina D foi de 25,3 ng/mL, sendo que uma hipovitaminose foi encontrada em 75% dos pacientes. Oito pacientes (7,62%) tinham diagnóstico prévio de osteoporose e dez (9,52%) relataram a ocorrência de fraturas prévias. Em relação à pontuação de VAS, observou-se uma redução média de 5,5 pontos da dor, para ODI houve um aumento médio de 1 ponto percentual e um aumento médio de 4,3° de cifose no segmento fraturado entre o pré e pós tratamento. **Conclusão:** O tratamento se mostrou eficaz na melhora da dor e os pacientes mantiveram sua capacidade funcional. Baixos níveis de vitamina D estavam associados a fraturas mais complexas. **Nível de evidência III; Estudo Retrospectivo.**

**Descritores:** Fraturas da Coluna Vertebral; Osteoporose; Tratamento Conservador; Vitamina D.

## RESUMEN

**Objetivos:** Evaluar la evolución del dolor, capacidad funcional y los niveles de vitamina D en los pacientes con fracturas toracolumbares por trauma de baja energía tratados conservadoramente. **Métodos:** Entre enero de 2017 y marzo de 2021, los pacientes con más de 40 años afectados por estas fracturas fueron seleccionados y tratados de forma conservadora por 6 meses. Las puntuaciones de la escala analógica visual (VAS), el índice de discapacidad de Oswestry (ODI) y el ángulo de Cobb antes y después del tratamiento fueron evaluados. También se realizó la determinación del nivel sérico de vitamina D en la primera consulta y se preguntó al paciente si tenía diagnóstico previo para la osteoporosis o fracturas previas. **Resultados:** 105 pacientes fueron evaluados, de los cuales 70,5% eran mujeres, con edad promedio de 73,1 años. La media del nivel sérico de vitamina D fue de 25,3 ng/mL y la hipovitaminosis fue encontrada en 75% de los pacientes. Ocho pacientes (7,62%) tenían diagnóstico previo de osteoporosis y diez (9,52%) reportaron la ocurrencia de fracturas previas. Cuanto a la puntuación VAS, hubo una reducción promedio de 5,5 puntos en el dolor, para ODI hubo un aumento promedio de 1 punto porcentual y un aumento promedio de 4,3° de cifosis en el segmento fracturado entre pre y post tratamiento. **Conclusión:** El tratamiento demostró ser efectivo para mejorar el dolor y los pacientes mantuvieron su capacidad funcional. Los niveles bajos de vitamina D se asociaron con fracturas más complejas. **Nivel de evidencia III; Estudio Retrospectivo.**

**Descriptores:** Fracturas de la Columna Vertebral; Osteoporosis; Tratamiento Conservador; Vitamina D.

Study conducted by Orthopedic Service of the Hospital do Trabalhador, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

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## INTRODUCTION

Osteoporosis is a disease characterized by low bone density and microarchitectural deterioration of this tissue, which determines its fragility and directly relates to thoracolumbar spine fractures. Osteoporotic vertebral fractures represent a serious public health problem with socioeconomic effects, worsening quality of life, and increased long-term mortality.<sup>1,2</sup>

As life expectancy has increased, osteoporotic fractures have become more frequent, generating higher costs. In the United States, the amounts spent are on the order of US\$20 billion/year due to 1,300,000 fractures attributed to osteoporosis, half of which are located in the spine.<sup>3</sup> The presence of a spine fracture is a risk factor for fractures in other regions of the skeleton and segments of the spine itself.<sup>4</sup> Some consequences of these fractures include pain, loss of sagittal balance, and functional limitation.<sup>5</sup> In Brazil, data on the prevalence of osteoporosis and the incidence of associated fractures are scarce.<sup>6</sup>

In women, bone loss during menopause is ten times faster and is a risk factor for fractures due to osteoporosis. Other associated factors are: early menopause, oophorectomy, hypercortisolism, gastrectomy, excess corticosteroids, use of medications such as neuromodulators that cause bone demineralization, and vitamin D deficiency.<sup>7,8</sup>

The plasma concentration of vitamin D can be evaluated by the dosage of 25 hydroxyvitamin D - 25(OH)D. Values below 20 ng/mL (50 nmol/L) are classified as deficient for the general population, and values between 20 and 29 ng/mL (50 and 74 nmol/L) are still considered insufficient for individuals at risk for osteoporosis according to criteria established by the Brazilian Society of Endocrinology and the *Endocrine Society*.<sup>9,10</sup>

The treatment of vertebral fractures is mostly conservative and has as its main objective the consolidation of the fracture and aid in rehabilitation.<sup>2</sup> Conservative treatment includes short rest periods, followed by immobilization with external orthoses, which can facilitate neuromuscular re-education and provide patient comfort.<sup>5,11</sup> The drugs used in the treatment of osteoporosis include calcitonin, calcium and vitamin D replacement, parathyroid hormone, bisphosphonates, and hormone replacement. Physiotherapy and motor rehabilitation can assist in treatment.<sup>5,12</sup> Cases that do not progress favorably, with inadequate pain control or significant sagittal imbalance, may undergo surgical interventions, such as kyphoplasty or vertebroplasty.<sup>13,14</sup>

The primary objective of this study is to evaluate the pain evolution and functional capacity of patients with thoracolumbar fractures resulting from low-energy trauma treated conservatively for six months. As a secondary objective to evaluate vitamin D levels in this population.

## METHODS

This is a retrospective, longitudinal study carried out in a tertiary hospital specialized in trauma care and approved by the CEP under CAAE number 35754620.8.0000.5225. Patients were evaluated from January 2017 to March 2021, and all participants signed the Informed Consent Form.

Inclusion criteria were individuals over the age of 40 years with thoracolumbar fracture secondary to low-energy trauma and treated conservatively. The cases were followed up on an outpatient basis, with returns within 15 days and six months after the post-fracture conservative treatment was instituted. Patients with fractures secondary to high-energy trauma, pathological fractures, and patients undergoing surgical treatment initially were excluded from the study. In addition, patients who did not have a minimum follow-up of 6 months and/or did not have the available imaging or vitamin D lab tests were also not part of the study.

Patient data such as age, gender, whether they regularly used and which orthoses, and the evolution of pain and quality of life during treatment were analyzed. Clinical evaluation was based on data recorded in the medical records and on the visual analog scale (VAS)<sup>15</sup> and Oswestry 2.0 disability index scores,<sup>16</sup> performed at the first outpatient visit at 15 days and after six months of treatment.

A single vitamin D dosage was taken on the first outpatient visit, and its values were interpreted according to criteria established by the Brazilian Society of Endocrinology and the *Endocrine Society*.<sup>9,10</sup> A questionnaire was also used to determine whether the patient had been previously diagnosed with osteoporosis and to check whether he or she had ever had a distal radius, spine, or proximal femur fracture.

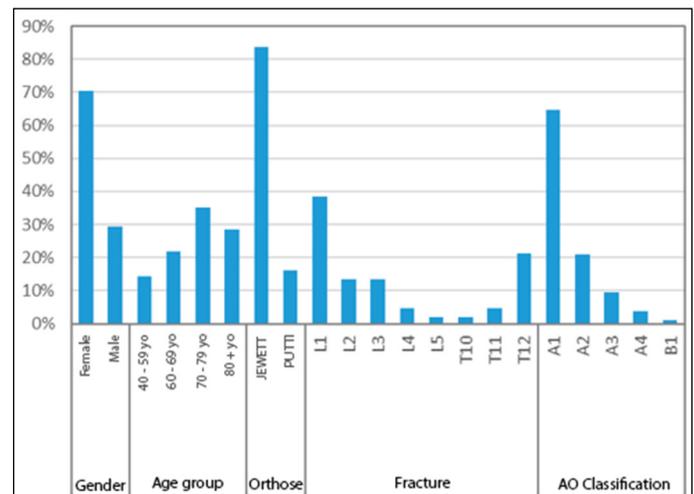
The radiographs were taken in the anteroposterior and lateral views, with the patient standing at an ampulla distance of 230 cm. Radiographic evaluation was performed upon admission to the emergency room after completing six months of treatment by measuring the Cobb angle at the fractured vertebral segment. For this measurement, lines were drawn along the upper plateau of the uppermost inclined vertebra and the lower plateau of the lowermost inclined vertebra. The resulting angle was then measured through two other lines perpendicular to these.

As part of conservative treatment, thoracolumbar orthoses with *Jewett-type3*-point stabilization were used for fractures at (T10-L2), and lumbar Putti brace for fractures at lower lumbar levels (L3-L5). Thoracolumbar fractures were also categorized by the *AOSpine* classification system.<sup>17</sup>

In the statistical analysis, to check whether the mean changes in VAS and ODI scores were significant or not between the groups, an analysis of variance for a fixed factor or *Student's t-test* was employed. A significance level of 0.05 was considered, which equates to a 95% confidence level for the analysis.

## RESULTS

This study was conducted with 105 patients, 74 (70.5%) women, and 31 (29.5%) men. The average age of these patients was 73.1 ± 12.4 years, ranging from 42 to 97 years. The 70 to 79 age group had the highest concentration of patients (35.2%). Regarding the fracture region, a greater involvement of the lumbar vertebrae (72%) than of the thoracic vertebrae (28%) was observed. As for the AO classification of the fractures, most patients (64.8%) had fracture type A1, followed by type A2 (21%), and fracture type B1 was the least prevalent (only one patient) (Figure 1). The serum vitamin D level ranged from 11.7 to 42.5 ng/mL, and the mean was 25.3 ± 5.9 ng/mL. Serum levels of this vitamin below normal, according to criteria established by the Brazilian Society of Endocrinology and the *Endocrine Society*,<sup>9,10</sup> was found in 75% of patients, with 19% classified as vitamin D deficient and 56% as vitamin D insufficient. Furthermore, 7.62% (8/105) of the patients had a previous diagnosis of osteoporosis, and 9.52% (10/105) reported the occurrence of previous fractures, two of which were hips, four spines, and four distal radius fractures.



**Figure 1.** Frequencies/percentages and mean ± standard deviations for the demographic characteristics of the patients.

As for the conservative treatment of the fractures, 88 patients (83.8%) used Jewett's orthosis. About the Cobb angle, we observed a value of  $12.6 \pm 9.1^\circ$  pre-treatment and  $16.9 \pm 9.6^\circ$  post-treatment; that is, there was a mean increase of  $4.3^\circ$  of kyphosis in the fractured segment, but with a large variation ( $p < 0.0001$ ). (Figure 2)

Regarding VAS scores, a mean 5.5-point reduction in pain was observed between pre ( $7.0 \pm 1.3$ ) and post-treatment ( $1.6 \pm 1.3$ ) ( $p < 0.0001$ ). For the ODI score, a mean increase of 1 percentage point was observed, ranging from  $19.8\% \pm 16.7\%$  pre-treatment to  $20.8\% \pm 17.6\%$  post-treatment ( $p < 0.0001$ ). (Figure 3)

Regarding serum vitamin D level and fracture type, we observed that type A3 and A4 fractures were mostly found in patients with critical levels of this vitamin.

During patient selection, we had 13 lost to follow-up due to difficulty scheduling scheduled appointments in the middle of the Covid-19 pandemic. As for the clinical outcome, from the total of 105 patients analyzed, 15 (14.3%) died, of which two were due to SARS-CoV-2 and only 2 (1.9%) patients required surgery (arthrodesis), one due to accentuated vertebral kyphotization in a recent return, demonstrating fracture instability with medullary compression (T12 fracture) and the other due to kyphotization associated with intense pain without improvement with analgesia and orthosis. Eighty-eight patients (83.8%) completed conservative treatment over six months. No neurological deficit was evident.

**DISCUSSION**

This study observed a predominantly female population affected by vertebral fractures, corroborating the results obtained in other studies.<sup>18-21</sup> According to Warming et al.<sup>22</sup>, bone loss is accelerated after menopause in females. Pinheiro et al.<sup>23</sup> also stated that menopause is the main factor associated with low-energy trauma fracture.

As for the region of the fractures, our findings showed a greater involvement of the lumbar vertebrae (72%), similar results to those found by Balkhari et al.<sup>19</sup> (73%) and by Hoshino et al.<sup>18</sup> (63%). In the study by Shah et al.,<sup>2</sup> lumbar vertebrae (76.6%) were also more involved than thoracic vertebrae (36.6%), and thoracolumbar involvement was seen in six patients (20%). In the study by Martikos et

al.,<sup>24</sup> the involvement of the lumbar vertebrae was somewhat lower (49%) than that of the thoracic vertebrae.

Zhang et al.<sup>25</sup> demonstrated that the serum 25(OH)D level ( $54.53 \pm 28.11$  nmol/L) of 534 patients with osteoporosis is inversely proportional to the risk of thoracolumbar vertebral fractures, especially in female patients aged 60 to 80 years. The authors report no significant correlation between serum vitamin D levels and the sites of spinal fractures or deformities, including scoliosis and kyphosis. However, there was a significant association between serum levels of this vitamin and the number or severity of vertebral fractures, indicating that patients with hypovitaminosis D are more likely to suffer more severe fractures or refractures. Comparatively, in our study, the mean serum vitamin D level was  $25.3 \pm 5.9$  ng/mL, and those with critical levels of this vitamin (75%) had more type A3 and A4 fractures, highlighting the need for more effective public measures in the follow-up/treatment in these cases.

In the study by Lee et al.,<sup>21</sup> 149 patients completed conservative treatment for one year. As a primary endpoint, the authors found a VAS score of  $7.2 \pm 0.9$  and  $1.7 \pm 0.6$  for pre-treatment and after six months of treatment, respectively. These results were similar to our study, whose VAS scores were  $7.0 \pm 1.3$  and  $1.6 \pm 1.3$  for pre-treatment and after six months of treatment. Du et al.<sup>26</sup> evaluated the ODI score of 228 patients undergoing conservative treatment, which reduced from  $69.6 \pm 7.5$  pre-treatment to  $43.6 \pm 4.4$  after one year of treatment. According to Shah et al.,<sup>2</sup> the functional disability of patients through ODI can be classified into minimal disability (0-20%), moderate disability (20-40%), severe disability (40-60%), crippled (60-80%), and bedridden (> 80%). However, in our study, the ODI score remained almost constant, ranging from  $19.8 \pm 16.7$  pre-treatment to  $20.8 \pm 17.6$  after six months of treatment, i.e., functional disability still remained minimal to moderate.

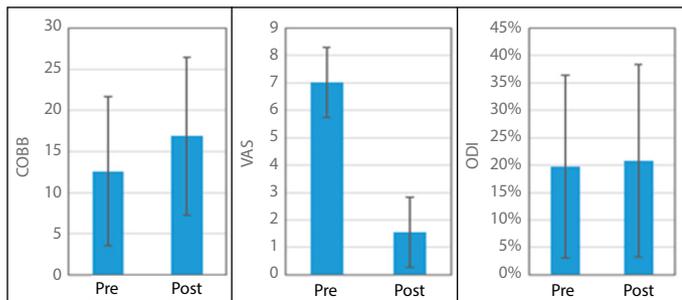
Balkhari et al.<sup>19</sup> found a Cobb angle increase of  $19.1^\circ$  after conservative treatment for six months, whereas in our study, this increase was  $4.3^\circ$ . However, the kyphosis angle after treatment ( $16.9^\circ \pm 9.6^\circ$ ) still remained at a mild degree of kyphotization (mild:  $10-30^\circ$ , moderate:  $30-45^\circ$ , and severe  $> 45^\circ$ ). Du et al.<sup>26</sup> reported difficulties in getting elderly patients to adhere to conservative treatment because, according to the authors, patients start activities prematurely under partial pain relief or even reject the use of orthoses due to the discomfort generated, culminating in vertebral collapse, thoracolumbar kyphosis, and chronic low back pain. However, in our study, it is believed that this kyphotization remained mild after conservative treatment because 64.8% of the patients had type A1 fractures.

As for the clinical outcome, some studies have also reported cases of patients treated conservatively, with subsequent evolution to surgery. In the study by Du et al.,<sup>26</sup> for example, of the 277 patients selected for conservative treatment, 39 progressed to surgery. Of these, 13 patients underwent surgery because they could not remain confined to bed with an increased chance of complications such as pneumonia, or their symptoms after conservative treatment were not relieved. For the remaining 26 cases, surgery was justified by loss of height of the injured vertebra with thoracolumbar kyphosis and persistent low back pain affecting the patient's quality of life. Lee et al.<sup>21</sup> prospectively analyzed 259 patients with one or more osteoporotic vertebral compression fractures confirmed by MRI. All patients were treated conservatively during the initial three weeks (rest, orthosis, and analgesics). After this period, kyphoplasty was performed on 91 patients who complained of permanent pain and functional disability. The authors noted that the risk factors for three-week failure of conservative treatment were advanced age (greater than 78.5 years), severe osteoporosis (T-score  $< -2.95$ ), overweight (BMI  $> 25.5$ ), and vertebral body collapse greater than 28.5%. Compared to the results of Lee et al.,<sup>21</sup> in our study, the patients who progressed to surgery were 64 and 74 years old, with the spinal collapse of 26.3% and 24.2%, respectively.

As for the presence of previous fractures, in our study, of the patients with acute osteoporosis fracture in the spine, two had a simultaneous hip fracture. According to the work of Sebben et al.,<sup>4</sup> the literature already shows an important correlation between these fractures, which was also evidenced in Dawson-Hughes et al.<sup>27</sup>



**Figure 2.** Thoracolumbar orthosis with Jewett-type 3-point stabilization and radiographs showing an example of a Cobb angle of  $6.89^\circ$  pre-treatment and  $12.60^\circ$  post-treatment.



**Figure 3.** Mean  $\pm$  deviation average for Cobb angle, VAS, and ODI values at pre- and six months after conservative treatment.

An evaluation for a longer period and with a more significant number of patients is necessary to evaluate the morbidity, the mortality and understand how these fractures affect the quality of life of these patients in the long term, compared to surgical treatment.

## CONCLUSION

Conservative treatment of thoracolumbar fractures improved pain, and patients maintained their functional capacity. Most patients

had critical vitamin D levels, and more complex fractures were identified in these patients.

New debates involving the assessment of vitamin D are needed on osteoporosis. The low cost of the test may favor its use as a possible indicator of severity and prognosis.

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

**CONTRIBUTIONS OF THE AUTHORS:** Each author has contributed significantly to this manuscript. BPR, ALS, and ALK were the main contributors to the writing of the manuscript. ALK, MLB, PGS, and XSG performed the surgeries. BPR, ALS, ALK, and PGS monitored the patients and collected clinical data from the medical records. MLB and XSG evaluated the data from the statistical analysis. BPR, ALS, and ALK conducted the literature survey and reviewed the manuscript. ALS, ALK, and XSG contributed to the intellectual concept of the study.

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