KYPHOPLASTY AND VERTEBROPLASTY IN THE TREATMENT OF OSTEOPOROTIC VERTEBRAL FRACTURES

CIFOPLASTIA Y VERTEBROPLASTIA EN EL TRATAMIENTO DE FRACTURAS VERTEBALES POR OSTEOPOROSIS

ABSTRACT

Objective: To compare these procedures in the treatment of osteoporotic vertebral compression fractures. Methods: Patients who underwent vertebral augmentation procedures between March 2010 and October 2016 were selected for the study. Kyphosis, anterior vertebral height, Oswestry Disability Index (ODI), Visual Analog Scale (VAS), number of portals, cement volume, and complications were recorded. The results were analyzed by difference of the means. Results: Sixty-eight patients were selected, accounting for 105 procedures. A statistically significant improvement was observed in VAS and ODI with both procedures (p < 0.001) without statistically significant differences between them, regardless of the number of portals or cement applied. There was a high correlation between kyphosis correction and ODI improvement (p = 0.012). Conclusions: Both vertebroplasty and kyphoplasty are effective procedures for the treatment of vertebral compression fractures. We found no significant difference between both procedures. The high correlation between improvement of kyphosis and ODI suggests that these procedures are better than conservative treatment to improve the quality of life of patients, however more studies are required to reach a final conclusion. Level of Evidence III; Retrospective comparative study.

Keywords: Kyphoplasty; Vertebroplasty; Spinal fractures; Osteoporosis; Osteoporotic fractures.

RESUMO

Objetivo: Comparar esses procedimentos no tratamento de fraturas de compressão secundárias à osteoporose. Métodos: Foram selecionados os pacientes que foram submetidos a procedimentos de reforço vertebral no período de março de 2010 a outubro de 2016. Foram registrados angulações, cunhões, índice de incapacidade de Oswestry (ODI), escala visual analógica (VAS), número de portais, volume de cimento e complicações. Os resultados foram analisados por diferenças médias. Resultados: 68 pacientes foram selecionados com 105 procedimentos. Observou-se uma melhoria estatisticamente significativa no EVA e ODI em ambos os procedimentos (p < 0.001), sem diferenças estatisticamente significativas entre eles, independentemente da quantidade de portais ou cimento aplicado. Uma correlação alta foi encontrada entre a correção da angulação cifótica e a melhora do ODI (p = 0.012). Conclusões: Tanto a vertebroplastia quanto a cifoplastia são procedimentos efetivos para o tratamento de fraturas de compressão. Não encontramos diferenças significativas entre os dois procedimentos. A alta correlação entre a melhora da cifose e o ODI sugere que esses procedimentos são superiores ao tratamento conservador para melhorar a qualidade de vida do paciente, porém são necessários mais estudos para chegar a uma conclusão final. Nível de Evidência III; Estudo retrospectivo comparativo.

Descritores: Cifoplastia; Vertebroplastia; Fraturas da coluna vertebral; Osteoporose; Fraturas por osteoporose.

RESUMEN

Objetivo: Comparar estos procedimientos en el tratamiento de fracturas por compresión secundarias a osteoporosis. Métodos: Se seleccionaron pacientes a quienes se realizaron procedimientos de refuerzo vertebral en el periodo de Marzo de 2010 a Octubre de 2016. Se registró la angulación, acunamiento, Oswestry Disability Index (ODI), Escala Visual Analógica (EVA), cantidad de portales, volumen de cemento y complicaciones. Se analizaron los resultados por diferencia de las medias. Resultados: Se seleccionaron 68 pacientes con 105 procedimientos. Se observó una mejora estadísticamente significativa en el EVA y ODI en ambos procedimientos (p < 0.001), sin diferencias estadísticamente significativas entre estos, independientemente de la cantidad de portales o cemento aplicado. Se encontró una alta correlación entre la corrección de la angulación cifótica y la mejora del ODI (p = 0.012). Conclusiones: Tanto la vertebroplastia como la cifoplastia son procedimientos eficaces para el tratamiento de las fracturas por compresión. No encontramos diferencias significativas entre ambos procedimientos. La alta correlación entre la mejora de la cifosis y el ODI sugiere que estos procedimientos son superiores al tratamiento conservador para mejorar la calidad de vida del paciente, sin embargo se requieren más estudios para llegar a una conclusión final. Nivel de Evidencia III; Estudio retrospectivo comparativo.

Descritores: Cifoplastia; Vertebroplastia; Fracturas de la columna vertebral; Osteoporosis; Fracturas osteoporóticas.
INTRODUCTION

Osteoporosis is a health issue of global importance. It is esti-

METHODS

Patients

METHODS

Methods

INTRODUCTION

Osteoporosis is a health issue of global importance. It is estima-
ted, currently there are approximately 10 million people affected
in the United States, which will increase to 14 million by 2025. One
of the principal complications is osteoporotic vertebral fractures
(OVF), 17 with a reported incidence of 117 cases per 100,000 inhab-
habitants, representing 1.4 million patients annually.4–7 Unlike other
types of osteoporotic fractures, OVFs are usually not associated
with trauma.9 Nonetheless, OVFs are associated with a significant
worsening of the morbidity and mortality of patients.5,10 Over time,
the patients with OVF can suffer from chronic pain, reduced quality
of life and functionality, low self-esteem, risk of other fragility fractures,10
medullary compression, and changes in pulmonary function.11 As
regards mortality, an increase of 32% has been reported, adjusted
for the age of the patients with OVF.12

Currently, the gold standard in treatment of OVFs remains conser-
ervative based on analgesics, rest, and immobilization,8,13 however,
conservative treatment with long periods of inactivity in the elderly
patient can produce pneumonia, bed sores, venous thromboembolism,
new OVFs, and even death.13,14 Coupled with this, in some cases the patients
continue to have pain, as well as a reduction in the quality of life despite having undergone appropria-
tive treatment.8,15 It is for these patients that vertebroplasty
augmentation procedures have appeared as an useful alternative
in the treatment of OVFs.6,8,15,16

Among vertebral augmentation procedures, two have shown to
be more effective: vertebroplasty and balloon kyphoplasty (Figure 1).5,8,15 Vertebroplasty was first described for the treatment
of aggressive vertebral hemangiomas of the lumbar spine.1 Cer-
ment is injected into the vertebra via a transpedicular approa-
ch, which helps to stabilize the vertebral fracture, improving both
strength and stability. In balloon kyphoplasty, a cavity is created in
the vertebra using an inflatable balloon, thus reducing the pressure
from the injection and restoring vertebral height.9

Vertebroplasty and kyphoplasty have been shown to be
more effective in improving both pain and the quality of life of patients
with OVF, even when compared to conservative treatment.6,15,16

However, there is still controversy around whether any of these
treatments is more effective or safer in terms of the incidence
of complications.6,13,15,16,18 Another controversy revolves around
comparing the effectiveness of and complications resulting from
the use of one versus two portals.5,6,16,19 For this reason, the
objective of this study is to compare the results obtained and the
incidence of complications from these two procedures in patients

treated in our facility.

KYPHOPLASTY AND VERTEBROPLASTY IN THE TREATMENT OF OSTEOPOROTIC VERTEBRAL FRACTURES

Figure 1. Patient with osteoporotic vertebral fractures at multiple levels treated by vertebroplasty.

RESULTS

Of the 99 patients treated during the period, 68 met the study
criteria. During follow-up 10 cases of new fractures were encoun-
tered, giving a total of 105 vertebral augmentations performed
during the period. The average age of the patients was 76.3
years ± 11.3, with a predominance of females. The demographic
characteristics of the patients, including age, sex, number of
affected levels, and the appearance of new fractures are pre-
sented in Table 1. The general procedure, including the number
of kyphoplasties and vertebroplasties, the number of portals,
and the occurrence of cement leakage are found in Table 2. The
most often used technique was kyphoplasty with one portal. In
terms of the fracture levels, we observed that the vertebrae with
the highest incidence of fracture were L1, L2, and T12 (T1=1,
T2=3, T3=5, T4=3, T10=5, T11=5, T12=13, L1=27, L2=20,
L3=8, L4=8, L5=7).

We observed improvements for both kyphoplasties and verte-
broplasties from the preoperative ODI (51.6%±16.7% vs 56.7%±15.3%)
to the postoperative ODI (27.5%±19.9% vs 24.6%±18.8%)
(p<0.001), from the preoperative VAS for pain (7.7±2.2 vs 8.2±2.8)
to the postoperative VAS for pain (2.9±2.4 vs 2.8±2.6) (p<0.001),
from the preoperative kyphotic angle (9.7°±11.6° vs 13.1°±13.1°)
to the postoperative kyphotic angle (4.71°±11.3° vs. 7.6°±12.9°)

Coluna/Columna. 2018;17(2):124-8
Table 1. Demographic data.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patients</td>
<td>68</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>48-97 years</td>
</tr>
<tr>
<td>&lt;= 50</td>
<td>1 (1.5%)</td>
</tr>
<tr>
<td>51 - 60</td>
<td>5 (7.4%)</td>
</tr>
<tr>
<td>61 - 70</td>
<td>14 (20.6%)</td>
</tr>
<tr>
<td>71 - 80</td>
<td>22 (32.4%)</td>
</tr>
<tr>
<td>81 - 90</td>
<td>22 (32.4%)</td>
</tr>
<tr>
<td>91+</td>
<td>4 (5.9%)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>54 (79.4%)</td>
</tr>
<tr>
<td>Male</td>
<td>14 (20.6%)</td>
</tr>
</tbody>
</table>

Number of fractures treated per patient 105

<table>
<thead>
<tr>
<th>Number of portals</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyphoplasty</td>
<td>45 (66.2%)</td>
<td>22 (32.4%)</td>
<td>0 (0%)</td>
<td>1 (1.5%)</td>
</tr>
<tr>
<td>Verteoplasty</td>
<td>38 (36.2%)</td>
<td>30 (28.6%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appearance of new fractures 10 (14.7%)

Table 2. Characteristics of the performed procedures.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of procedures</td>
<td>105</td>
</tr>
<tr>
<td>Kyphoplasty</td>
<td>68 (64.8%)</td>
</tr>
<tr>
<td>Verteoplasty</td>
<td>37 (35.2%)</td>
</tr>
<tr>
<td>Number of portals</td>
<td></td>
</tr>
<tr>
<td>Kyphoplasty</td>
<td></td>
</tr>
<tr>
<td>1 Portal</td>
<td>38 (36.2%)</td>
</tr>
<tr>
<td>2 Portals</td>
<td>30 (28.6%)</td>
</tr>
<tr>
<td>Verteoplasty</td>
<td></td>
</tr>
<tr>
<td>1 Portal</td>
<td>21 (20%)</td>
</tr>
<tr>
<td>2 Portals</td>
<td>16 (15.2%)</td>
</tr>
<tr>
<td>Volume of cement applied</td>
<td></td>
</tr>
<tr>
<td>Kyphoplasty</td>
<td>4.8cc±2.02</td>
</tr>
<tr>
<td>Verteoplasty</td>
<td>4.2cc±1.74</td>
</tr>
<tr>
<td>Cement leakage</td>
<td></td>
</tr>
<tr>
<td>Disc</td>
<td>12 (11.4%)</td>
</tr>
<tr>
<td>Canal</td>
<td>6 (5.7%)</td>
</tr>
<tr>
<td>Paravertebral</td>
<td>4 (3.8%)</td>
</tr>
<tr>
<td>Venous</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Other complications</td>
<td></td>
</tr>
<tr>
<td>Hemothorax</td>
<td>1 (1%)</td>
</tr>
</tbody>
</table>

DISCUSSION

OVFs are a worldwide health problem, associated with chronic pain, increased morbidity, decreased quality of life, and even an increase in mortality among the patients who suffer from them. Even though conservative treatment continues to be the gold standard in many centers, several studies have reported that vertebral augmentation procedures have shown to be an effective treatment, and even superior to conservative treatment in some studies.

In this study, we observed a significant improvement in the patients who were submitted to vertebral augmentation procedures, both in terms of their functionality (ODI) and pain (VAS), which coincides with other similar studies that have been conducted. It is important to note that there is still controversy around the superiority of either of the vertebral augmentation procedures (kyphoplasty or vertebroplasty). Multiple studies have reached the conclusion that there is no difference between the two procedures in terms of improvement in pain and functionality, which is in agreement with the results obtained in our study. As regards correction of the angle of kyphosis and of vertebral height, we did not find any statistically significant differences in our study, while other studies favor kyphoplasty over vertebroplasty in order to achieve greater correction of the kyphotic angle. It is possible that this finding is due to the fact that the radiographic measurements of the patients were made by long-term radiographic evaluations and not with a non-standardized technique, as well as because of the lack of homogeneity in the population and the retrospective study design. Thus, a new prospective study in which vertebral height...
and kyphotic angle are measured serially, comparing both procedures, would be useful.

Another important controversy is the comparison between the use of 1 or 2 portals in vertebral augmentation treatments. Although this controversy is mainly focused on kyphoplasty, in our study we did not find any significant differences between the use of 1 or 2 portals in either vertebroplasty or kyphoplasty, which coincides with multiple previously conducted studies. Therefore, from our point of view, a decision will depend on the surgeon’s experience, as well as on the situation and the quantity of fractures to be treated.

Another important point in the controversy is the ideal amount of cement that should be administered to achieve a satisfactory outcome, and whether the volume is related to cement leakage or the appearance of new OVFs. In our study, we did not observe any relationship between the volume of cement applied and the development of complications with cement leakage or the appearance of new OVFs, or between the volume of cement and both radiographic and clinical improvement. These results are consistent with those reported in the literature, so we are not able to recommend the ideal volume of cement for obtaining a satisfactory result or minimizing the occurrence of complications.

A relevant result in this study was the high correlation found between the correction of the kyphotic angle and the patient’s functional improvement as evaluated by the ODI, which according to the Pearson correlation coefficient was very high (0.905). Currently, there are few studies that have established a correlation between correction of kyphosis and improvement in the quality of life, and there are contradictory results on this point. Unfortunately, as previously mentioned, in our study we did not find any significant differences between vertebroplasty and kyphoplasty for the correction of kyphotic angle. However, several studies agree that the advantage of kyphoplasty over both vertebroplasty and conservative treatment lies in the possibility of a greater correction of the kyphosis. There are, however, studies that indicate excessive correction of kyphotic angle as a risk factor for the development of new OVFs adjacent to the treated segment. Despite this, in our study, we did not find any significant differences between vertebroplasty and kyphoplasty in the correction of kyphotic angle and kyphoplasty for the correction of kyphotic angle. However, several studies agree that the advantage of kyphoplasty over both vertebroplasty and conservative treatment lies in the possibility of a greater correction of the kyphosis.

These results are consistent with those reported in the literature, so we are not able to recommend the ideal volume of cement for obtaining a satisfactory result or minimizing the occurrence of complications.

Our study included patients treated by Dr. Hugo Santos at the Ruber Quirón Juan Bravo Hospital. The fact that the patients were attended by a single surgeon allowed us to reduce the bias in the procedure results. It is important to note that the patients treated in this facility are not covered by the social security system, but rather by private medical insurance companies. This allowed us to give more timely attention to the patients, obtaining adequate results with shorter wait times. In our experience, we have observed that timely attention with shorter wait times to patients with OVFs allows a better postoperative prognosis. Timely patient care has improved through the training of human resources in health for adequate diagnosis and timely referral to the proper patient study protocol. Several examples of these human resources in health are services like the Pain Unit, First Contact Physicians, and Rheumatology, among others. Another important factor that has allowed us to improve patient care is the ability to receive laboratory tests and image studies in short periods of time, such as STIR-sequence magnetic resonance being available within 2 to 48 hours. This permits timely programming and rapid care for patients with this condition. Our patient care protocol can be summarized as follows: 1) preferential consultation appointment, generally referred by other patient cares services; 2) magnetic resonance in the STIR sequence to identify the acute-phase levels affected in order to make a surgical decision (Figure 2); 3) preoperative radiographic control study one day prior to surgery to assess the possible increase in the deformity of the patient; 4) timely surgical treatment; 5) follow-up by the bone pathology unit using the study complete protocol, as well as follow-up by our service.

CONCLUSIONS

In this study, we concluded that both kyphoplasty and vertebroplasty are useful tools in the treatment of OVFs, achieving significant improvement in the quality of life and pain of the patients. In addition, we found a high correlation between improvement of the kyphotic angle and improvement in the ODI, which represents a better quality of life for patients, with procedures that correct kyphotic angle. It should be noted that, despite the fact that our study did not observe any significant differences between the two procedures, other studies found that balloon kyphoplasty enabled better correction of the kyphotic angle, which is why in our experience it is the most recommendable procedure if improvement in the quality of life of the patient is expected. However, more studies must be conducted to reach a final conclusion. The treatment of these patients must be prioritized to obtain a better patient prognosis. In addition to the initial medical visit, magnetic resonance in the STIR sequence, and radiographic studies should be conducted and surgical treatment should be performed in a timely manner.

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

CONTRIBUTION OF THE AUTHORS: Each author made significant individual contributions to this manuscript. GOUN (0000-0002-6565-8984)* and FRMA (0000-0001-7011-2479)* were the main contributors to the preparation of the manuscript. SBHA (0000-0002-4106-5527)* performed the surgical procedures and patient follow-up. GOUN performed data collection. GOUN, FRMA, and GMA (0000-0003-1745-0334)* evaluated the statistical analysis data. GOUN, FRMA, GMA, and SBHA conducted the bibliographical research, wrote the article, and contributed to the intellectual concept of the study. ORCID (Open Researcher and Contributor ID).
REFERENCES


