

# RESULTS AND COMPLICATIONS OF VERTEBRECTOMY WITH POSTERIOR APPROACH AFTER 2-YEAR FOLLOW-UP

RESULTADOS E COMPLICAÇÕES DA VERTEBRECTOMIA POR VIA POSTERIOR APÓS 2 ANOS DE SEGUIMENTO

RESULTADOS Y COMPLICACIONES DE LA VERTEBRECTOMÍA POR VÍA POSTERIOR DESPUÉS DE 2 AÑOS SEGUIMIENTO

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## ABSTRACT

**Objective:** To describe the surgical technique for vertebrectomy by posterior single approach in the thoracic and thoracolumbar spine with circumferential reconstruction and arthrodesis, and evaluate retrospectively the results and complications after 2 years of follow-up in patients undergoing this technique. **Methods:** Retrospective analysis of medical records and imaging studies of 12 patients with vertebrectomy indication for various pathologies, undergoing this surgical technique. **Results:** Eight (66.67%) patients were male and four patients (33.33%) were females aged 13-66 years (mean 40 years). There were nine patients with involvement of the thoracic spine and three of the lumbar, and one patient with two consecutive vertebrae affected. All patients had improved or remained with the neurological condition. Surgical complications were two cases of hemothorax, two cases of loosening of the screws, one of them requiring surgical revision, and a case of material failure and pseudarthrosis. **Conclusion:** Vertebrectomy by posterior approach in thoracolumbar spine with circumferential reconstruction and fusion can be performed safely for a variety of indications.

**Keywords:** Spine/surgery; Spinal fusion; Spinal fractures; Spinal neoplasms; Arthrodesis; Fracture fixation.

## RESUMO

**Objetivo:** Descrever a técnica cirúrgica de vertebrectomia por acesso único posterior na coluna torácica e toracolombar com reconstrução circunferencial e artrodese e avaliar retrospectivamente os resultados e complicações após 2 anos de seguimento dos pacientes submetidos à técnica. **Métodos:** Análise retrospectiva de prontuários e exames de imagem de doze pacientes com indicação de vertebrectomia por diversas patologias, submetidos a essa técnica cirúrgica. **Resultados:** Oito (66,67%) pacientes eram do sexo masculino e quatro (33,33%) do sexo feminino, com idade variando de 13 a 66 anos (média de 40 anos). Nove pacientes com comprometimento da coluna torácica e três da lombar, sendo em um paciente, duas vértebras consecutivas afetadas. Todos os pacientes tiveram melhora ou permaneceram com o estado neurológico inalterado. As complicações cirúrgicas foram dois casos de hemotórax, dois casos de soltura dos parafusos, um deles necessitando de revisão cirúrgica e um caso de falha do material e pseudoartrose. **Conclusão:** A vertebrectomia por acesso único posterior da coluna torácica e toracolombar com reconstrução circunferencial e artrodese pode ser realizada de forma segura para uma variedade de indicações.

**Descritores:** Coluna vertebral/cirurgia; Fusão vertebral; Fraturas da coluna vertebral; Neoplasias da coluna vertebral; Artrodese; Fixação de fraturas.

## RESUMEN

**Objetivo:** Describir la técnica quirúrgica para la vertebrectomía por acceso posterior único de la columna torácica y toracolombar con la reconstrucción y artrodosis circunferencial y evaluar retrospectivamente los resultados y las complicaciones de los pacientes sometidos a la técnica después de dos años de seguimiento. **Métodos:** Análisis retrospectivo de las historias clínicas e estudios de imágenes de pacientes con indicación para vertebrectomía por diversas patologías. **Resultados:** Ocho (66,67%) pacientes eran varones y cuatro (33,33%) mujeres con edades entre 13 y 66 años (media 40 años). Había nueve pacientes con afectación de la columna torácica y tres de la lumbar siendo que un paciente tenía dos vértebras consecutivas afectadas. Todos los pacientes mejoraron o mantuvieron el estado neurológico. Las complicaciones quirúrgicas fueron dos casos de hemotórax, dos casos de aflojamiento de los tornillos, uno de éstos requiriendo revisión quirúrgica y un caso de falla del material y pseudoartrosis. **Conclusión:** La vertebrectomía por acceso único posterior de la columna dorsal o dorsolumbar con la reconstrucción y artrodosis circunferencial puede realizarse con seguridad para una variedad de indicaciones.

**Descriptores:** Columna vertebral/cirugía; Fusión vertebral; Fracturas de la columna vertebral; Neoplasias de la columna vertebral; Artrodosis; Fijación de fractura.

## INTRODUCTION

Vertebral resection by the single posterior approach was described in the 1970s by Roy-Camille and Stener for the treatment of tumoral lesions,<sup>1-4</sup> and subsequently popularized by other authors.<sup>5</sup> This technique can be used to treat various diseases that affect

the spine, enabling decompression of the neurological structures, reconstruction of the anterior spine, correction of deformities, resection of pathological tissue (in cases of tumors or infections), and posterior segmental stabilization.<sup>6</sup>

This procedure was classically performed via a double approach,

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Study conducted at the Centro de Reabilitação e Readaptação Dr. Henrique Santillo (CRER) and the Department of Orthopedics and Traumatology of the Clinical Hospital of the Universidade Federal de Goiás (HC-DOT/UFG) Goiânia, GO, Brazil.

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with an anterior access (thoracotomy, thoraco-phreno-lumbotomy, or lumbotomy, depending on the level affected) to achieve decompression with reconstruction of the anterior spine and a posterior access for the segmental instrumentation, which may be performed during the same anesthesia or as a separate surgery.<sup>6</sup>

The double access approach enables good visualization of the anterior region, optimizing the neural decompression and the reconstruction of the region. However, it is associated, in some cases, with the need for an access surgeon, higher levels of bleeding, risk of lesions of the vascular structures, decreased lung capacity, and other complications.<sup>7,8</sup>

The single posterior approach has the advantage of being performed in a single surgical procedure, without penetrating the abdominal or thoracic cavities. Additionally, several studies show similar efficiencies from both techniques for some pathologies.<sup>6,8</sup>

Since it was first described, an increasing number of surgeons have been performing and modifying this procedure in order to improve the results. The technique, and also the types of reconstruction of the anterior spine have undergone changes during this period, from non-reconstruction, using only rigid posterior fixation, to the use of methylmetacrylate molds, and even cage-type vertebral replacements, which are now expandable.<sup>7,9-13</sup>

The objective of this article is to present the results and complications of the initial series of patients to undergo posterior vertebrectomy and circumferential reconstruction at a service, after two years of follow-up.

## MATERIALS AND METHODS

Following approval by the Institutional Ethics Committee, a retrospective evaluation was carried out of imaging exams and medical records of 12 patients who underwent posterior approach vertebrectomies with circumferential reconstruction with a cage, and posterior instrumented arthrodesis in a single surgery with more than two years of follow-up.

The patients were operated on during the period from January 2010 to February 2013 at the Dr. Henrique Santillo Center for Rehabilitation and Readaptation (CRER) and the Clinical Hospital of the Universidade Federal de Goiás (HC-UFG), located in Goiânia. These patients represent the first experience with the technique at these services.

The surgical indications were six patients with different neoplasias (four malignant and two benign), five patients with acute

fractures or sequelae from trauma with nerve compression, and one patient with spondylodiscitis. The patients had insufficiency of the anterior spine, neurological deficits and/or lesions with an indication of surgical resection. Cases of vertebrectomies to correct deformities in the coronal plane, resections of hemi-vertebrae, and cases in which anterior reconstruction with a cage were not performed, were excluded.

Eight (66.67%) patients were male and four (33.33%) were female, ranging from 13 to 66 years of age (average of 40 years). In just one patient (case 11), the pathology affected two vertebral bodies. (Table 1)

## Surgical technique

All the procedures were performed with the aid of intraoperative monitoring (motor and somatosensory evoked potentials and electromyography of the screws), except in cases with complete neurological lesion (Frankel A). The patients underwent general anesthesia, with the administration of standard prophylactic antibiotics, positioned in the prone position on a radiolucent table on pads, leaving the abdomen free. A centered median incision was performed at the level of the lesion, extending at least two levels above and two levels below the affected vertebra, with subperiosteal dissection of the muscles to expose the posterior elements.

Polyaxial pedicle screws were inserted, based on the vertebral anatomy,<sup>14</sup> at least two levels above and two levels below the lesion. The decision to further extend the arthrodesis depends on the degree of deformity to be corrected and on the degree of osteoporosis (usually two or three levels above and below). The dissection is widened laterally, exposing the transverse processes, and an electric monopolar scalpel is used in the thoracic spine to detach the tissues adjacent to the proximal portion of the ribs. In cases of partial resection of the vertebral body, the resection is made only of the costal arch at the level of the lesion. In cases requiring en bloc resection of the lesion, the two costal arches on the side where the cage is to be inserted are removed (at the level of the lesion and below it). The proximal portion of the rib is carefully removed with a cutting dissector, preserving the parietal pleura, then an osteotomy and disarticulation of the costovertebral joint are performed.

Subsequently, a laminectomy is performed at the level of the lesion and the lower and upper halves of the adjacent levels, exposing the dura mater and nerve roots. In order to maintain stability during anterior decompression, a rod is positioned on the contralateral side and locked into the screws. The lateral mass of the facet joints,

**Table 1.** Characterization of the 12 patients analyzed.

Case	Age/Sex	Diagnosis	Level	Procedure	Follow-up
1	55/F	Osteoporotic fracture with medullary compression	T5	Fixation of T2 to T8, root amputation, vertebrectomy of T5	5 years and 1 month
2	13/M	Osteoblastoma	T7	Fixation of T4 to T9, vertebrectomy of T7	5 years and 1 month
3	20/M	Post-traumatic deformity with medullary compression	T4	Fixation of T2 to T6, vertebrectomy of T4	4 years and 6 months
4	52/M	Schwannoma with medullary compression	T10	Fixation of T8 to T12, root amputation, vertebrectomy of T10	4 years and 4 months
5	66/F	Osteoporotic fracture with deformity and medullary compression	L1	Fixation of T10 to L3, vertebrectomy of L1	3 years and 8 months
6	64/M	Chordoma	L2	Fixation of T11 to L4, without root amputation, vertebrectomy of L2	2 years and 11 months
7	37/F	Osteoporotic fracture with deformity and medullary compression	T8	Fixation of T5 to T10, root amputation, vertebrectomy of T8	Death after 3 months (HIV and CRF)
8	46/M	Plasmacytoma with medullary compression	T4	Fixation of T1 to T7, root amputation, vertebrectomy of T4	2 years and 8 months
9	18/M	Ewing sarcoma with medullary compression	T9	Fixation of T6 to T12, root amputation, vertebrectomy of T9	2 years and 8 months
10	52/F	Plasmacytoma with medullary compression	T11	Fixation of T8 to L2, root amputation, vertebrectomy of T11	2 years and 7 months
11	34/M	Spondylodiscitis with kyphotization and medullary compression	T11 and T12	Fixation of T9 to L2, root amputation, removal of devitalized tissue, corpectomy of T11 and T12	2 years and 4 months
12	20/M	Fracture with medullary compression	L2	Fixation of T12 to L4, vertebrectomy of L2	2 years and 3 months

F = Female; M = Male.

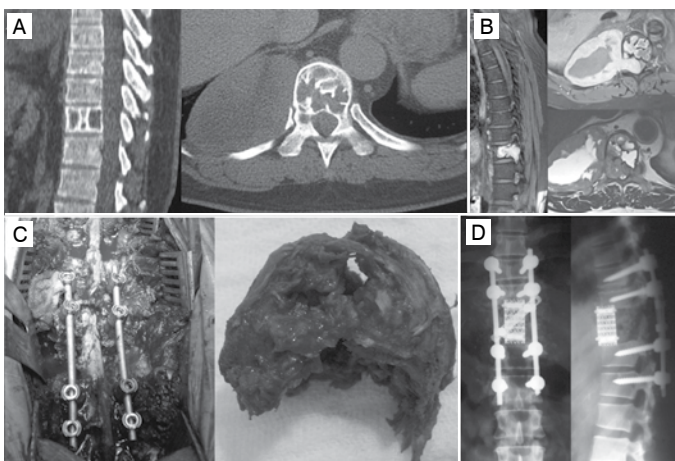
transverse processes, and pedicles is removed, together with the resection of any tumoral or infectious epidural or paraspinal mass, finalizing the complete resection of the posterior elements.

Obviously, an effort is made to preserve the lumbar nerve roots, given their importance for motor functions, because the lumbar region permits manipulation of the dural sac and has more space between the roots. When the thoracic spine is affected, the nerve root of the compromised level is sacrificed unilaterally or bilaterally. Before performing the root ligation, the nerve root is always clamped for a period of five minutes, to assess whether there is any change in the motor evoked potential.

A discectomy is performed immediately proximal and distal to the lesion, avoiding excess curettage of the vertebral plateaus, so as not to expose the spongy bone of the vertebrae. The tissues in front of the vertebral body are carefully displaced, pushing them aside by blunt dissection and protecting them with malleable retractors to increase the exposure of the vertebral body and facilitate its resection.

The vertebral body is resected using curettes, osteotomes, pituitary forceps, punch cutters, and Kerrinson® rongeurs. In cases where complete resection of the vertebral body is not necessary, the anterior and lateral walls are preserved, decreasing the risk of damage to the vascular structures. In cases where a radical resection is required, the pericardium and the posterior wall of the aorta may be palpable. The lateral margins are usually the parietal pleurae in the thoracic region and the psoas muscles in the lumbar region. Special attention is given to the dissection and separation of the posterior longitudinal ligament of the dura mater, preserving the integrity of the dura mater anteriorly. The same decompression and resection procedure is performed on the other side, always keeping the rod locked into the contralateral screws.

Once the vertebrectomy is complete, a distractor is placed on the terminal plates, the locking screws are carefully loosened, restoring the height of the vertebral body and correcting the kyphotic deformity. The height of the cage is measured, filling it with bone graft. The cage is inserted into the space of the resected vertebral body, supporting it on the plateaus and confirming the placement by fluoroscopy. Compression of the instrumentation is performed. In some cases, the reconstruction is completed by placing one or two transverse connectors to increase the rotational stability of the system. The surfaces of the facet joints and the transverse processes are shaved to seed the local bone graft for the postero-lateral arthrodesis. In cases where there is damage to the parietal pleura, it is sealed with a damp collagen sponge and thoracic drainage is not necessary. Finally, the muscle, fascia, subcutaneous layer, and skin are sutured, leaving a vacuum drain in place. (Figure 1)



**Figure 1.** Case 4. Patient with large paravertebral tumoral mass on the right and lytic lesion of the vertebral body of T10, with diagnosis of Schwannoma. Normal neurology despite significant medullary compression. A) Computed tomography image; B) Magnetic Resonance image; C) Intraoperative image; D) Postoperative radiography.

The drain is removed within 48 hours following surgery. The use of polyethylene vests, designed in accordance with the level of the lesion, is maintained for four to six months following surgery. Mobilization of the patient is initiated as soon as possible. Chest x-rays are always taken as control to assess the presence of pneumothorax in the postoperative period.

## RESULTS

The level of the lesions is reported in Table 1, with nine patients presenting impairment of the thoracic spine and three of the lumbar spine; only one patient underwent resection of two consecutive vertebrae (spondylodiscitis – case 11).

Of the twelve patients (Table 2), two were classified as ASIA A and maintained this rating post-operatively. Two other patients, previously bedridden, classified as ASIA B (cases 1 and 8), made post-operative progress to the point of being able to walk with support, and were reclassified as ASIA D. The patient of case 12, classified as ASIA C, evolved following surgery and returned to being able to walk with support, classified as ASIA D. Only two patients (cases 2 and 9), previously bedridden, with ASIA C and ASIA B ratings, respectively, made post-operative progress to the point of being able to walk without support, and were classified as ASIA E. The neurological profiles of the four patients classified as ASIA E (cases 4, 5, 6, and 10) did not worsen postoperatively. It was not possible to evaluate the neurological improvement of the patient in case 7, classified as ASIA B, because she died three months following surgery as a result of complications from preexisting diseases (HIV and chronic renal failure). Only three patients maintained their prior neurological status of not being able to walk, remaining with ASIA A and ASIA B ratings. There were no cases of neurological worsening. (Figure 2)

The number of fixated levels varied from 4 to 6, with an average of 5.1. Four patients (33.33%) had surgical complications: two cases of hemothorax (cases 4 and 10) on the first and second days following surgery and two cases of loosening of the synthesis materials (cases 1 and 5). Case 1 was a patient with lupus, a smoker, and a frequent user of glucocorticoids and case 5, also a smoker, had very advanced osteoporosis. In both cases, there was a loosening of the distal screws and loss of correction of the kyphosis, requiring an extension of the arthrodesis to be performed in case 1. In cases with significant osteoporosis, performing an extension of the arthrodesis by at least three levels above and three levels below is recommended. Case 4 also presented pseudoarthrosis with subsidence of the cage and failure of the rods after 4 years and 4 months of follow-up. There were no cases of liquoric fistulae, post-surgical infection, migration of the cage, or the need for an anterior approach.

The patient of case 2 had a local recurrence of the tumor, requiring a new surgical resection procedure and complementary radiotherapy.

The clinical follow-up ranged from 2 years and 3 months to 5 years and 1 month (average of 3 years and 5 months), with only one patient dying from complications of pre-existing diseases (CRF and HIV) during this period.

## DISCUSSION

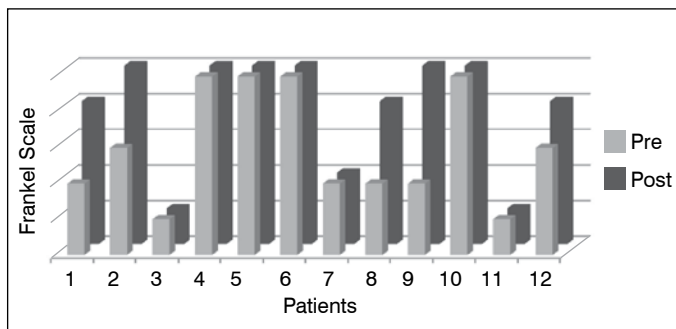
Oda *et al*<sup>15</sup> concluded that in the presence of compromise of the anterior spine, isolated fixation with pedicle screws provides insufficient stability, and is associated with high rates of implant failure. In these cases, the addition of anterior spinal support increases rigidity, decreasing the failure rates.

Pflugmacher *et al*<sup>6</sup> concluded that single anterior fixation with cages in combination with plates should not be used following vertebrectomies of the thoracolumbar spine, as they are not capable of restoring the normal stability of the segment.

Faced with the need for anterior and posterior fixation, the surgeon has the possibility of using a double anterior and posterior approach or only posterior access. Despite the ease of neural decompression and reconstruction of the vertebral body, the double approach is associated with numerous complications.<sup>7,10,17</sup>

**Table 2.** Postoperative characterization.

Case	Preoperative ASIA	Postoperative ASIA	Type of Cage	Vertebral Bodies	Fixed Levels	Complications
1	B	D	Cage	01	06	Loosening of the distal screws, requiring two arthrodesis extension surgeries
2	C	E	Cage	01	05	Local recurrence requiring new surgical resection
3	A	A	Cage	01	04	Without complications
4	E	E	Cage	01	04	Hemothorax and Pseudoarthrosis, subsidence of the cage, and failure of the material (after 4 years and 4 months)
5	E	E	Cage	01	05	Loosening of distal screws
6	E	E	Expandible	01	05	Without complications
7	B	B	Expandible	01	05	Death (HIV and CRF)
8	B	D	Cage	01	06	Without complications
9	B	E	Cage	01	06	Without complications
10	E	E	Cage	01	06	Hemothorax
11	A	A	Cage	02	05	Without complications
12	C	D	Cage	01	04	Without complications

**Figure 2.** Pre- and postoperative comparisons (ASIA) of the 12 patients.

Although it was the first experience in our service, vertebrectomy via the unique posterior approach, demonstrated satisfactory results and improved the neurological symptoms in most of the cases. Crocker *et al*<sup>9</sup> described eight cases with medullary compression from tumors, infection, or trauma who underwent posterior approach vertebrectomy; in each case, the prior neurological status was improved or maintained. Our cases series, with three cases who returned to normalcy with a rating of ASIA E, corroborates these results.

During cage placement, an accidental lesion of the dura mater can occur, causing a liquoric fistula, usually in the region in front of

the dural sac, making both its detection and repair difficult. Fourney *et al*<sup>2</sup> reported a 7.7% incidence of liquoric fistulae and Nogueira *et al*<sup>1</sup> reported 33.33%. There were no cases in our study.

The cage was filled using an autologous graft in all cases, as the use of methylmetacrylate is associated with thermal lesions and the possibility of cement leakage,<sup>11</sup> before performing intersomatic arthrodesis.

Shen *et al*<sup>11</sup> reported an average of 5.3 fixed segments, while in our study it was 5.1 levels, with a minimum of 4 and a maximum of 6 levels.

The incidence of complications ranges from 11 to 48% in the literature,<sup>19</sup> and was 33.33% (4 patients) in our case series, although they were all treatable complications.

## CONCLUSION

Vertebrectomy by single posterior access with circumferential reconstruction and arthrodesis can be performed safely, even in the initial cases. It can be performed for a variety of indications, enabling efficient neurological decompression and reconstruction of the anterior and posterior spine.

All authors declare no potential conflict of interest concerning this article.

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