Partial sacrectomy by single posterior approach

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Abstract

Introduction: Sacral tumors represent <7% of spinal tumors; the ones that prevail are those which are secondary to multiple myeloma or prostate, breast, lung or colon cancer. Chordoma is the most frequent malignant primary tumor, whereas giant cells tumor is the most frequent benign lesion. Due to natural history, involvement of soft structures and poor response to adjuvant treatments, surgery is the most frequently used treatment—surgical approach and instrumentation indication will depend on the type of tumor. The aims of this study are to evaluate the use of partial sacrectomy, to analyze surgical techniques and to acknowledge complications. .

Materials and Methods: Four patients with diagnosis of sacral tumor below S1 who consult for pain and whose images confirm the lesion. All of them receive block resection by posterior approach preserving S1. We describe the technique.

Results: Histological studies showed: one chordoma, one malignant tumor of the nervous sheath, one chondrosarcoma and one metastasis from prostate cancer. We preserved S1 function in all patients; one of them suffers permanent vescical dysfunction. We verified one wound dehiscence, one infection and one cerebrospinal fluid fistula. All the patients are free from disease after 6-to-24-month follow-up.

Conclusions: Partial sacrectomy by single posterior approach can be indicated when the lesion involves from S2 downwards and there is no sacroiliac involvement. Root preservation is of key importance so as to guarantee better post-operative results and lower infection rates.

Key words: Sacral tumor; sacrectomy; spinal surgery; surgical approach; bloc resection.
Level of evidence: IV

Sacrectomía parcial por abordaje posterior único

Resumen

Introducción: Los tumores del sacro representan <7% de los tumores espinales, prevalecen los tumores secundarios por mieloma múltiple o carcinomas de próstata, mama, pulmón o colón. El cordoma es el tumor maligno primario más frecuente y el tumor de células gigantes es la lesión benigna más común. Por su evolución, compromiso de estructuras extraóseas y la escasa respuesta a los tratamientos coadyuvantes, la cirugía es el tratamiento más utilizado, la vía de abordaje y la necesidad de instrumentación dependerán del tumor por tratar. Los objetivos de este trabajo son: evaluar el uso de la resección parcial del sacro, analizar la técnica quirúrgica y reconocer las complicaciones.

Materiales y Métodos: Cuatro pacientes con diagnóstico de tumor sacro ubicado por debajo de S1, que consultan por dolor y cuyas imágenes confirman la lesión. A todos se les realiza una resección en bloque por vía posterior preservando S1. Se describe la técnica.

Conflict of interests: The authors have reported none.

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Resultados: Los estudios anatomopatológicos revelaron: un cordoma, un tumor maligno de vaina nerviosa, un condrosarcoma y una metástasis de carcinoma prostático. Se preservó la función de S1 en todos los pacientes; uno tiene disfunción vesical permanente. Se observaron una dehiscencia de la herida, una infección y una fístula de líquido cefalorraquídeo. Todos permanecen sin la enfermedad tras un seguimiento de entre 6 y 24 meses.
Conclusiones: La resección parcial del sacro por abordaje posterior único se puede indicar cuando la lesión compromete desde S2 hacia distal y no hay compromiso sacroilíaco. La preservación de raíces es de vital importancia para garantizar mejores resultados posoperatorios y una menor tasa de infección.

Palabras clave: Tumor sacro; sacrectomía; cirugía espinal; abordaje quirúrgico; resección en bloque.
Nivel de Evidencia: IV

Introduction

Sacral tumors are low-frequency entities which represent about 1 to 7% of spinal tumors. Most of them are secondary to the spread of a multiple myeloma or prostate, breast, lung or colon cancer. The most frequent malignant sacral tumor is the chordoma, which stands for more than half the tumors, whereas the giant cells tumor is the most frequent benign lesion.[1] These tumors are invasive and, due to their utterly aggressive profile, they advance rapidly.[2-5]

Due to the low therapeutic response to chemotherapy and radiotherapy, surgery is the first option in the management of this type of lesions. Advances in surgical techniques have allowed surgeons to carry out block resections with high success rates and low morbidity and mortality rates. There are recent descriptions of new surgical approaches and techniques for sacral resection aimed at protecting nervous roots better and improving functional results, preserving surrounding structures and reducing intra-operative bleeding without involvement of the oncologic margins.[6]

The aim of this study is to evaluate the use of partial sacrectomy by a single posterior approach, to analyze the surgical technique and to acknowledge complications.

Materials and Methods

We evaluated four patients who had first consulted for low back pain of infiltrative type and dysesthesia in the perineal area, which was associated with sphincter disorders in patient #1 (Table). We carried out imaging studies (X-ray, MRI and CT scan) and studies of sphincter functionality (patient #1). In patients #1 and #2's images we saw tumor involvement from S2 to S4—a malignant tumor of the nervous sheath and a chordoma, respectively (Figures 1 and 2). In patient #3 we saw tumor involvement from S3 up to proximal S4 (Figure 3); later on we diagnosed isolated metastasis from prostate cancer. Patient #4 had tumor involvement from S4 downwards, with a lesion that resulted to be a chondrosarcoma.

Due to imaging characteristics, we planned to carry out partial sacrectomy by a single posterior approach using an incision with the shape of an inverted goblet and without pre-operative biopsy.

Surgical technique

Partial sacrectomy by posterior approach with inverted goblet incision

Before antibiotic induction with cefazolin, the patient should be situated on ventral position with thoracic and bilateral iliac support. The skin should be incised in the shape of an inverted goblet (Figure 4), with the vertex at L5-S1 level spreading 5 cm below and away from the posterior-superior iliac spines. Then the incision should be extended from the vertex on upon the middle line up to L4. What follows is careful subperiosteal dissection of paravertebral muscles, detaching the bone from the L4 lamina and transverse processes to the whole sacrum, and retracting laterally the major gluteus muscle. Then L5 and S1 laminectomy should come (S2 as needed), trying to follow the S1 root up to its foraminal emergence and, de-

Table. Patients' demographic characterisitcs

Patient	Sex	Diagnosis	Age	Resection level	Complications
1	F	Nervous sheath tumor	56	S1-S2	Wound dehiscence
2	M	Chordoma	65	S1-S2	Cerebrospinal fluid fistula
3	M	Prostate cancer metastasis	49	Proximal to S2-S3	Wound infection
4	M	Chondrosarcoma	38	Proximal to S3	None

F = Female, M = Male.

Figure 1. Fifty-six year-old female who consults for low back pain and urinary dysfunction; T2 paramedian sagittal MRI section which shows a lesion involving the spinal canal from S3 to S4, with no cortical spread. Histological diagnosis: Malignant tumor in the nervous sheath.

Figure 2. Sixty-five year-old male who consults for low back pain and urinary dysfunction; T1 paramedian sagittal MRI section which shows a lesion involving bone structures from S1 downwards, with cortical spread. Histological diagnosis: Chordoma.

Figure 3. Forty-nine year-old male who consults for low back pain; T1 paramedian sagittal MRI section which shows an intra-canal lesion distal to S3 and spreading to the body and the posterior arch. Histological diagnosis: Isolated metastasis from prostate cancer.

Figure 4. Pre-operative patient's situation and planning, with projection of the sacral tumor to the skin.

pending on S2 involvement being unilateral or bilateral, it is advisable to respect it. Then it is necessary to suture and section the dural sac. Afterwards, major and minor sacrosciatic ligaments and the pyramidal muscle should be sectioned. Then it is necessary to carry out digital dissection of all pre-sacral structures crossing vaseline impregnated gauze in front of the sacrum, what helps in pre-sacral dissection and intra-pelvic structures protection at the time of the osteotomy. Under direct vision of the S1 root and with fluoroscopic guidance, osteotomy should be carried out with wide chisel as of the upper level selected for resection and, then, osteotomy should follow through the lateral edge of S1 in the direction of the greater sciatic notch. The surgical piece should then be removed exposing tissues laterally on the side with lesser tumor involvement, dissecting rectum and vascular structures from the pre-sacral fascia. Those roots which are not affected by the tumor should be preserved. The surgical piece should then be carefully analyzed to evaluate both soft tissues and bone (Figure 5). It should then be subject to histological analysis. In these cases, since there is no sacro-iliac involvement, pelvic ring reconstruction will not do. It is necessary to carry out appropriate removal of non-vital tissues with periodic abundant irrigation throughout the surgery. The wound should be closed by planes with drainage at least 48 hours (Figure 6). Surgery lasted about 5 hours. Post-operative check-ups confirm the removal of the surgical piece (Figure 7).

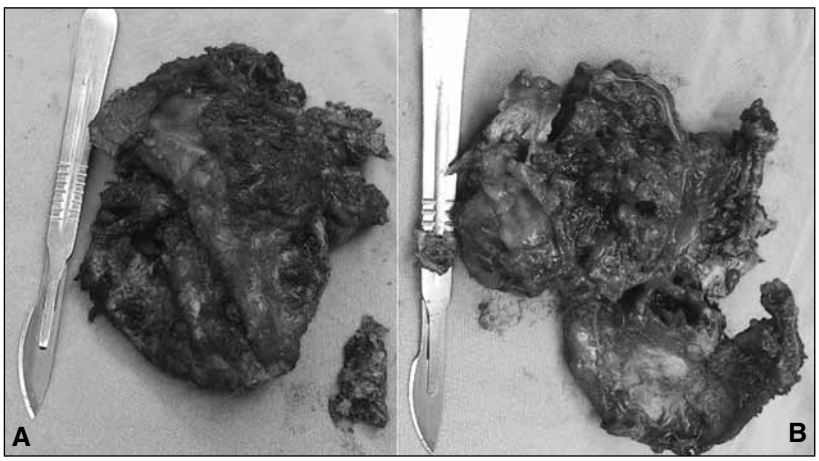

Figure 5. Surgical piece in a case of block resection from the sacrum, with histological diagnosis of chordoma. **A.** Sacral posterior aspect. **B.** Sacral anterior aspect.

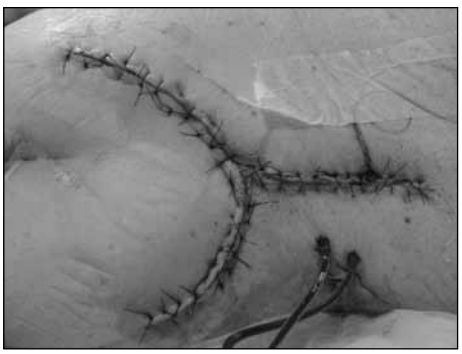

Figure 6. Image of block resection of a chordoma. It shows the inverted goblet incision extended upwards, with the two drainage tubes and the intra-dural catheter.

Figure 7. Post-operative studies showing the absence of the distal end of the sacrum due to surgical resection.

Results

We carried out partial sacretomy by a single posterior approach in the four cases. This technique was implemented by the same surgical team. In no case did we take pre-operative biopsy. Histological diagnoses were: Malignant tumor in nervous sheath (patient #1), chordoma (patient #2), metastasis from prostate cancer (patient #3) and chondrosarcoma (patient #4). The common symptom was pain. Only patient #1 had symptoms of sphincter dysfunction, whereas patient #2 suffered bilateral sciatic pain associated with perineal dysesthesia. No patient received chemotherapy or radiotherapy before the surgery.

The level of resection was S1-S2 in two cases (patients #1 and #2), proximal to S2-S3 in one case (patient #3), and proximal to S3 in the remaining case (patient #4). It was possible to carry out ample block resection with normal tissues margin in the four cases.

Complications were: a surgical wound dehiscence (patient #1), which was treated by closure by second intention and sugar dressing; a methicillin-sensitive *Staphylococcus aureus* infection of the surgical wound, which took surgical toilet and a six-month antibiotic treatment to heal, with no major complications (patient #3) (Figure 8). One patient had a cerebrospinal fluid fistula (case #2) that was solved using drainage and compression bandaging.

Functional results were secondary and were related to the level of the sacrificed root: one case of definite vescical dysfunction (patient #2), which is treated by intermittent catheterism since in this patient it was necessary to section both S2 roots. In the other case, it was possible to preserve one S2 root (patient #3) generating a neurogenic bladder, which recovered only partially three months later. The rest of the patients have normal vescical and intestinal functions. No patient is affected by motor dysfunction.

With respect to the patients' follow-up, we detected recurrence neither at one-year follow-up year (patients #1 and #4) nor at two-year follow-up (patient #2), nor at six-month follow-up (patient #3).

Figure 8. Erythema in wound borders in a patient with wound infection.

Discussion

Surgical treatment of sacral tumors is one of the great challenges for every spinal surgeon. The complexity of the pelvic anatomy and the advance of the disease many times require a multidisciplinary approach. This procedure is determined by a number of factors, such as the patient's pre-operative status, the anatomic characteristics of the lesion, the sacral zone that is involved, and the biology of the tumor itself. Patients should be carefully selected on these criteria bases, since sacral resections are procedures associated with high morbidity and mortality rates, with sensitive and motor losses and vescical, intestinal and sexual dysfunctions.[7]

In the case of metastasis, there are several staging systems that help in the correct selection of the patient. In general, patients with multiple vertebral metastases, in different organs and a poor health condition are not the candidates for this type of surgeries. The patients with favorable tumor conditions, such as those ones secondary to breast or prostate cancer, can be good candidates for surgical treatment, even if they have multiple metastases. On the other hand, those with very aggressive metastases, such as lung cancer', do not result to be good candidates for the surgery even though they have isolated lesions.[8-10] In the case of our patient, he had an isolated sacral metastasis from prostate cancer with no involvement of any other organ, with a very good health condition and high life expectancy, what led us to carry out surgery plus urologic follow-up due to his underlying condition.

Partial or total sacrectomy are considered to be the treatment of choice for primary malignant conditions, because they allow the surgeon to control the lesion locally and increase survival rates. It is necessary to carry out resection with ample margins, since this is the most important predictive factor to decrease recurrence and increase survival rates in these patients.[11-12]

Therapeutic difficulties in this type of condition stem from the large size of these tumors, which make it difficult to get acceptable margins free from disease and, sometimes, local control can be difficult due to pre-operative biopsies.[13] Even though CT scan-guided biopsy is a safe and exact procedure and, in most cases, it is sufficient to get satisfactory bone sample, we believe that if the image is characteristic, pre-operative biopsy is not necessarily required and, this way, the possibility of cancerous cells colonizing the needle pathway decreases. If differential diagnosis is doubtful and it is necessary to carry out CT scan-guided percutaneous biopsy, the surgeon should plan the entry spot and the pathway for them to be removed during the surgery. There are reports on >90º success rates in diagnosis-making by CT scan-guided biopsy in sacral lytic lesions and metastasis.[14]

Literature offers different suggestions and experiences with respect to the best surgical approach, but no one has resulted to be the golden pattern due to tumor heterogeneity, size and involvement of different pelvic organs. The location of the tumor within the sacrum determines whether resection should be partial or total so as to get margins free from disease. Resections proximal to S2 many times require anterior/posterior combined approaches both for resection and pelvic ring resolution, , whereas for distal resection the posterior approach is the favorite one.[15] When sacrectomy does not affect S1, pelvic stability is not affected; if it eventually is, it should be necessary to carry out lumbopelvic instrumentation with pelvic ring reconstruction.[16]

In our patients, a posterior lumbosacral approach with the shape of an inverted goblet allowed us to get excellent exposure of the structures involved and perform margin resection in the four cases with no tumor rupture. A flap that can be folded over the intergluteal cleft allows us to get away from a likely infectious source and better care of the post-operative wound.

In most patients with malignant sacral tumors, piece-to-piece resection will generate extensive contamination of the tissues and a higher-than-70% increase in recurrence rates. This can be fatal, because the possibility to carry out marginal resection in the next surgery will be null.[17]

As the rectal fascia and the pre-sacral periosteum represent barriers to tumor infiltration and invasion, the rectal wall is hardly affected. However, pre-sacral tissues can be vast and displace the vital pelvic structures causing adherence. Digital dissection and the possibility to cross vaseline impregnated gauze from side to side are of key importance to decrease the risk of major complications, such as vascular and rectal injuries.

Surgical approaches in this kind of tumors are associated with great damage of soft tissues, bleeding, root injury and infection. When tumor resection is distal to S2, laminectomy is carried out from L5 and S1 on, so as to visualize and follow the S1 root pathway and avoid injuring it. The preservation of this root represent great benefits for the patient's post-operative walking.[18] This type of surgeries is associated with unavoidable neurologic consequences in intestinal, vescical and sexual function, which can be satisfactorily dealt with if it is possible to preserve both S1 roots. Both S1 roots preservation determines normal vescical function in 25% of the patients and normal intestinal function in 40%. If it is possible to preserve one S3 root, these results improve to 60% for vescical function and to 67% for intestinal function. If both S3 roots are preserved, improvement goes up to 69 and 100% for vescical and intestinal functions, respectively. If sacral root section is uniltareral, then vescical and intestinal functions remain normal in more than 80% of the cases.[19]

According to Sciuba et al.,[20] the risk of infection in this type of surgeries is much higher than it is in the rest of the spinal surgeries, most probably because of long surgical time, great damage to soft tissues, and the closeness of the rectum. There are reports on 26-46% infection rates, and some of the potential risk factors associated with the increase in infection are: diabetes mellitus, smoking, corticoid therapy, obesity, <3.5 g/dl levels of albumin, and history of surgery and pre-operative radiation, together with the number of surgeons that participate in the surgery, since usually these ones are multidisciplinary procedures involving spinal surgeons, plastic surgeons, urologists, general surgeons, etc. In our case, the surgical team was made up of three spinal surgeons and one instrumentation technician in three cases and, in the remaining one, we also included a neurosurgeon. With this said, we believe that it is utterly important to try as hard as possible to control all these factors so as to decrease the risk of infection.

Conclusions

Sacral tumors are conditions that come as a diagnostic and therapeutic challenge. Partial sacrectomy by single posterior approach can be indicated when the lesion involves from S2 downwards as long as there is no sacroiliac involvement and can it be carried out by experimented spinal surgeons. Preservation of nervous roots is of key importance so as to guarantee better post-operative results and lower infection rates.

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