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Research Article

Surgical treatment of spinal tumors with modified laminoplasty: Preliminary study

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Keywords: Spinal tumor; Surgery; Stabilization; Instrumentation; Laminoplasty

Abstract

Objective: We aimed to present our experience with a modified laminoplasty technique that allows stabilization of the spine without instrumentation during tumor surgery.

Methods: This retrospective study was performed in the neurosurgery department of a university hospital and data were collected from the medical files who were treated surgically for spinal tumors. The same surgical team operated on the patients using the same procedure without any instrumentation for stabilization of the spine. Demographic and clinical data were collected. It was checked whether radiological and clinical instability developed at the 6th and 12th months postoperatively.

Results: Our series comprised 41 patients (20 females, 21 males) with an average age of 47.122±20.33 (range: 11 to 86 years). The most common complaints detected in this series were diminution of motor power in lower extremities (20,47.62%), radicular pain (9,21.43%), and hypoesthesia (2,4.76%). The most frequent sites of involvement were L1-L2 (5,11.90%), L2 (4,9.52%), and T5-T6-T7 (2,4.76%), respectively. Histopathologically, schwannoma (8,19.94%), ependymoma (7,16.64%), meningioma (6,14.28%), and metastatic carcinoma (5,11.90%). The distribution of tumors was intradural and extramedullary (27,64.28%), intradural and intramedullary (13,30.95%), and extradural and extramedullary (2,4.77%), respectively.

Conclusion: Our results imply that stability of the spinal cord can be preserved without fixation or instrumentation during surgical procedures for spinal tumors. However, longer periods of follow-up, as well as prospective, controlled, multi-centric trials on larger populations, are warranted to evaluate the safety and efficacy of the novel technique.

Introduction

Surgery has significant benefits over other treatments to resolve spinal cord compression, alleviate pain, and improve quality of life while posing few risks in the management of primary and metastatic tumors of the spinal cord [1,2].

Decompression and stability are the main goals of spinal surgery [1]. Typically, the procedure serves only as a palliative measure [2]. Surgery is occasionally utilized for curative care of primary and, even more rarely, secondary tumors [1,2]. Surgery is preferred 1) when there are neurologic complications related to local tumor development with local compression or fracture, 2) when there is a mechanical complication with a fracture or axial destabilization, 3) when pain does not respond to medical treatment, surgical treatment of spinal metastasis is recommended, 4) in cases of radioresistant cancers (e.g., renal cell carcinoma that does not respond to chemotherapy or radiotherapy; tumor recurrence after prior radiotherapy) [2,3]. We must carefully consider suitable biomechanical qualities for the three columns during reconstruction [3].

In the treatment of spinal malignancies, ensuring spinal stability and mobility is a difficulty that typically necessitates

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meticulous surgical planning [4]. The treatment of spinal metastatic illness includes spinal stabilization surgery [4,5]. Because of their overall prognosis and concurrent therapy, patients with spinal oncology are unlikely to achieve bone fusion [5]. For these patients, stabilization surgery without fusion may be a viable option. There is a scarcity of research on the effectiveness of this strategy [5].

Although spinal tumors are treated using a variety of surgical procedures, the goal of each treatment, however, is the same: to restore spinal stability and decompress neural tissues, such as the spinal cord and nerve roots [6]. The traditional surgical approach in the treatment of spinal tumors was laminectomy, which can provide an adequate surgical field [6,7]. However, this surgical approach is associated with some complications such as spinal deformity and spinal instability [7]. Laminoplasty, which reconstructs the lamina using instruments such as a titanium plate, T-saw, or translaminar screw, is widely applied in patients with spinal tumors [8]. Some studies have shown that collapse and displacement of the laminae may occur in patients undergoing laminoplasty [8,9]. In osteoporotic or elderly patients, the fixed titanium screw may loosen easily and cause secondary spinal stenosis, resulting in spinal cord injury [9]. We aimed to share our experience with our novel operative technique that allows stabilization without instrumentation in the surgical management of spinal tumors together with a brief review of current literature.

Materials and methods

Study design

This retrospective study was carried out in the neurosurgery department of a tertiary care center after the approval of the local institutional review board (2021/26/03). Data were gathered from the hospital database an average age of 47.122±20.33 (range: 11 to 86 years) treated surgically for spinal tumors. The baseline descriptives, clinical and radiological information, operative and histopathological data were recorded. The variables under investigation included age, sex, radiological data derived from Magnetic Resonance Imaging (MRI), neurological findings, the level of surgical procedure, histopathological diagnoses, and radiological instability. A single senior neurosurgeon (IA) carried out the consecutive spinal procedures in our center during a 3 year period (between 2017 and 2020). Strobe guideline was used in writing this manuscript.

Patients with spinal tumors who underwent laminectomy at level 2 or more were included in the study (Figure 1). Patients who had a single-level laminectomy, hemilaminectomy, or had significant preoperative instability were excluded from the study. Patients with multiple myeloma were excluded from this study because this disease has biological characteristics that differ from metastatic lesions and solid tumors, especially in terms of the probability of bone repair [6].

Surgical procedure

In our novel surgical method, we maintained stability without instrumentation during surgery for spine tumors. For this purpose, supraspinous ligament, interspinous ligament, and the upper part of the spinous process (1-1.5cm depending on the case) were preserved, and total laminectomy, as well as excision of the lower part of the spinous process and ligament flavum, were performed (Figures 1,2). A total laminectomy is performed by preserving the spinous process and ligaments on the laminae over the mass. The ligament was lateralized to provide wide exposure to the dura. In intradural lesions, the distal part of the preserved ligament was cut, and the proximal part was maintained (Figure 3). The lesion was excised by allowing a wide field of view for the dura and the distal part

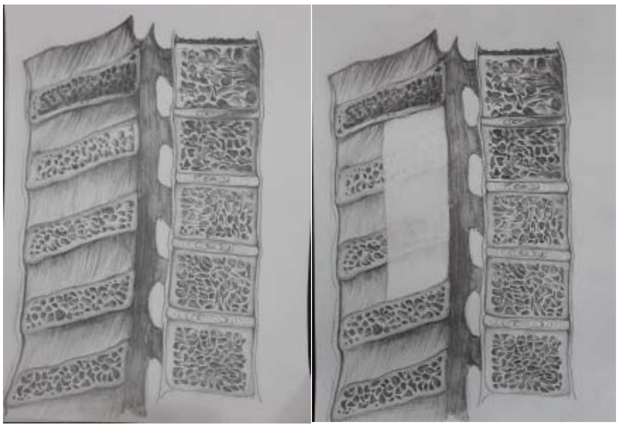

Figure 1a,b: Sagittal illustration of the area excised during surgery..

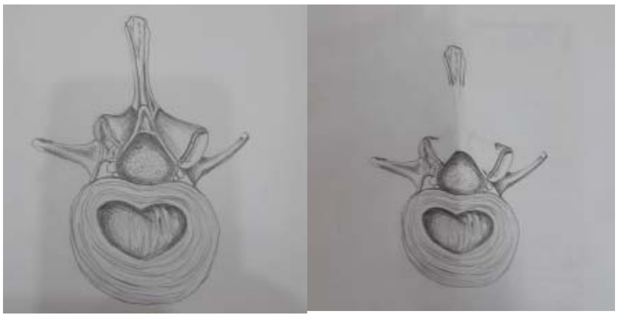

Figure 2a,b: Axial illustration of the area excised during surgery.

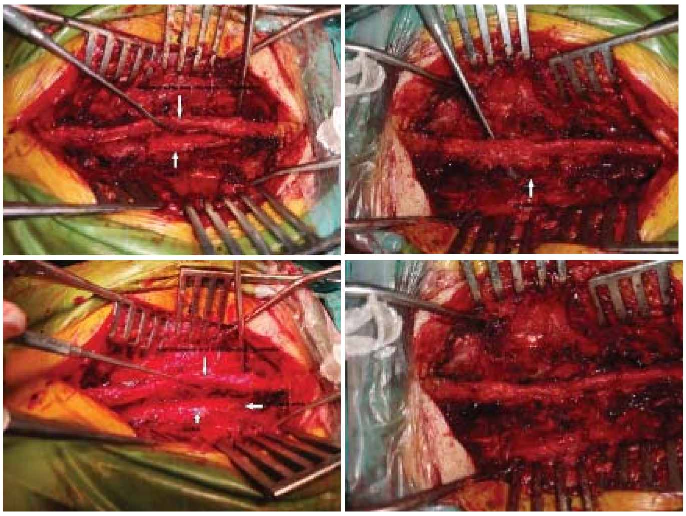

Figure 3a-d: Intraoperative views demonstrating our technique for stabilization of the spine without instrumentation after excision of tumor.

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was sutured. The patients were given a corset or cervical collar for 2 months in the postoperative period.

Outcome parameters

It was checked whether radiological and clinical instability developed at the 6th and 12th months postoperatively (Figures 4-6). Postoperatively, patients were asked whether they had low back and foot pain, and it was checked whether additional neurological deficits developed. In controls, it was checked whether instability developed in the spine in radiological imaging.

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences program version 20.0 for Windows (*SPSS, Inc., Chicago, Illinois, USA*) program. Descriptive data were expressed as mean, standard deviation, minimum, and maximum values for quantitative variables, while categorical variables were shown as numbers and percentages.

Figure 4a,b: Contrast-enhanced sagittal, t2 sagittal and axial MRI images of the patient before surgery.

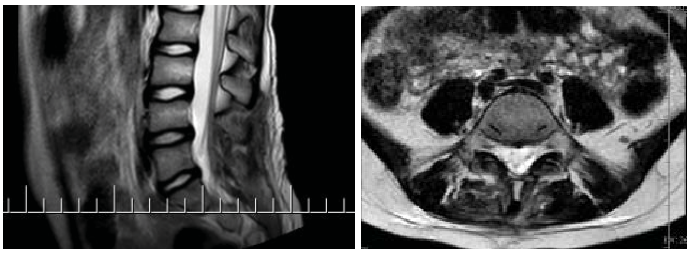

Figure 5a,b: Early postoperative sagittal and axial MRI images of the patient.

Figure 6a,b: First-year postoperative sagittal and axial MRI images of the patient.

Results

Our patient population consisted of n=41 patients (n=20 females, n=21 males) with an average age of 47.122±20.33 (range: 11 to 86 years). The most common complaints detected in this series were diminution of motor power in lower extremities (n=20, 47.62%), radicular pain (n=9, 21.43%), and hypoesthesia (n=2, 4.76%). The most frequent sites of involvement were L1-L2 (n=5, 11.90%), L2 (n=4, 9.52%), and T5-T6-T7 (n=2, 4.76%), respectively. Histopathologically, schwannoma (n=8, 19.94%), ependymoma (n=7, 16.64%), meningioma (n=6, 14.28%), and metastatic carcinoma (n=5, 11.90%). The distribution of tumors was intradural and extramedullary (n=27, 64.28%), intradural and intramedullary (n=13, 30.95%), and extradural (n=2, 4.77%), respectively. In 6 patients, the medial facet was removed on the side of the tumor. Bilateral facetectomy was not performed in any of the patients. Tension bands were preserved in all patients, no instability was detected during follow-up on the 6th and 12th months after surgery. Magnetic resonance imaging was performed routinely to evaluate the extension of spinal tumors. An overview of detailed demographic, clinical, radiological, and histopathological data is demonstrated in Table 1.

Discussion

This study describes the patient group in which spinal stability is preserved without instrumentation in patients who were operated on for a spinal tumor. Analysis of data collected from our patients yielded promising results with this novel procedure. The significance and worth of this procedure will become obvious as we gather further knowledge and competence about the indications and efficacy of our unique way of surgery for tumors of the spine through larger research. This method allows avoidance of instrumentation failure and associated morbidity due to additional interventions for fusion and instrumentation on spinal bones that are already fragile due to adverse effects of chemotherapy and corticosteroids on bone mineral density. In our series, the minimum duration of follow-up was 12 months.

Postoperative radiation and chemotherapy are commonly given to patients with spinal metastatic illness, which can hinder new bone development [10]. Corticosteroid therapy can lower bone mineral density and impair osseous healing potential [11]. The dietary deficiency seen in cancer patients

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Table 1: Overview of descriptive, radiologic, clinical, and histopathological data in our series (n=41).

No	Sex	Age	Magnetic resonance findings	Neurological examination	Level of pathology	Histopathological diagnosis
1	F	59	Intramedullary, contrast enhancing lesion	Right foot, dorsiflexion: 0/5	T9-T10-T11-T12	Low grade astrocytoma
2	M	56	Intradural, extramedullary contrast-enhancing lesion on the right lateral side of the spinal cord	Right plant arflexion: 4/5 Babinski extensor	T11-T12-L1	Myxopapillary ependymoma (WHO Grade I)
3	F	18	A 5X3 cm lesion at para vertebral region at the level of T6-7 para vertebral region	Bilateral hypoesthesia and loss of motor power at lower extremities	T4-T5-T6	Small round blue cell tumor
4	M	46	A 25X12 mm lesion without contrast enhancement in the spinal canal at the level of T4	Bilateral lower extremities, motor power 1/5	T4	Fibrous meningioma
5	M	42	Intradural, extramedullary lesion with contrast enhancement in the spinal canal at the levels of T4-T5	Bilateral motor power at lower extremities: 2/5	T4-T5	Meningioma (Grade 1)
6	M	42	Intradural, extramedullary lesion of 1.5X1.5 cm at the levels of T12-L1	Radicular pain at right lower extremity	T12	Myxoid schwannoma
7	F	63	Intradural, extramedullary lesion with contrast enhancement at the level of T7 on right side	Neurogenic claudication	T7	Meningioma (WHO Grade 1)
8	F	39	Extradural lesion or disc at the levels of T10-T11	Bilateral motor power at lower extremities: 3-4/5	T10-11	Hyalinized, ischemic chondroid tissue fragments
9	F	41	A lesion of 18X13 mm without contrast enhancement at the level of L2 vertebra	Constipation and urinary retention	L1-2	Mature cystic teratoma
10	M	37	Intradural, extramedullary lesion of 11X7 mm at L1 vertebra body with heterogeneous contrast enhancement	Bilateral motor power at lower extremities: 3-4/5	L1-2	Mature cystic teratoma
11	F	63	Intradural, intramedullary lesion with contrast enhancement at the levels of T10-T11	Right foot dorsiflexion: 2/5	T10-T11	Low grade astrocytoma
12	M	29	Six extramedullary lesions (the large stone with a size of 21X14 mm) with homogeneous contrast enhancement	Bilateral motor power at lower extremities 2/5, hypoesthesia	T3-T7	Meningoteliomatous meningioma (WHO Grade 1)
13	F	58	Intra-axial lesion of 13X7 mm in the spinal cord of at the level of T2-T3 with moderate and heterogenous contrast enhancement	Radicular pain, anthalgic gait	T2-T3	Ependymoma (WHO Grade II)
14	F	43	Intradural, extramedullary lesion of 47X20X15 mm in spinalcord with hypointense contrast enhancement at T1A and mild hyperintense contrast enhancement at T2A sections at the level of L4 vertebral body.	Hypoesthesia at right lower extremity	L3-L4	Myxopapillary ependymoma
15	M	69	A soft tissue mass that extends to pedicle and transverse process on left and towards pedicle on the right leading to fracture and loss of height at the level of L2 vertebra body with contrast enhancement and hypointense T1A, isointense T2A and hyperintense STIR sequences.	Bilateral motor power at lower extremities : 3/5	L2	B-cell lymphoid neoplasia
16	M	42	Intra-axial lesion in the spinal cord with moderate heterogeneous contrast enhancement at the levels of T3-T4.	Bilateral motor power at lower extremities: 1/5	T3-T4	Ependymoma (WHO Grade II)
17	F	23	A lesion of 27x24x19 mm at the level of T1 vertebra with contrast enhancement.	Bilateral motor power at lower extremities: 2/5	T2-T3	Meningotheliomatous/ psammomatous meningioma (WHO Grade 1)
18	F	19	Intramedullary cysticlesion displaying compression on the junction of cauda and spinal cord at the level of L1-L2 without contrast enhancement	Bilateral motor power at lower extremities: 3/5	L1-L2	Neuro enteric cyst
19	M	40	Intramedullaryl esion of a sagittal diameter of 10 mm at the level of L1 vertebra with remarkable contrast enhancement	No motor deficit	L1-L2	Myxopapillary ependymoma (WHO Grade 1)
20	M	45	Intramedullary lesion of 26X17X14 mm at the level of L2 adjacent to the posterior of vertebra body and displaying compression on the spinal cord	Constipation, urinary retention, left dorsiflexion: 4/5	L2	Benign epithelial cyst
21	F	72	A lesion of 10x8 mm at the level of L2	Left lower extremity motor power and dorsiflexion: 0/5	L2	Schwannoma
22	M	45	Intradural, extramedullary lesion of 8X5X6 mm at the level of L2 at right posterior neighbourhood of vertebra with contrast enhancement	Radicular pain at the left lower extremity	L2	Schwannoma
23	F	53	Intradural, extramedullary lesion at thelevel of L1-L2, extending to left neuralforamen and causing scalloping in bony tissue	Radicular pain	L1	Schwannoma
24	M	69	L4-5 An intradurallesion of 14X10X9 mm within spinal canal with smooth margins at the level of L4-L5 lesion displaying in tense contrast enhancement	Radicular pain	L4	Schwannoma
25	M	39	Intramedullary lesion at levels of C2-3	Motor power at bilateral upper and lower limbs: 4/5	C2-C3	Ependymoma (WHO Grade II)

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26	F	44	Extradural, extramedullary lesion of 25X15 mm at the level of L5 at posterior vertebra with poor contrast enhancement		Bilateral motor power at lower extremities: 2/5	L5	Chronic active inflammation with foci of microabscesses
27	M	46	Intradural, extramedullary bilobulated and communicating lesions with the largest size of 47X13 mm at the level of C2-C3 with significant contrast enhancement and isointense appearance at T1 and T2A.		Neckpain	C2	Transitional meningioma (Grade 1)
28	M	79	Cysticlesion of 8 mm in the posterior part of spinal cord at thelevel of T7-T8 without contrast enhancement and hyperintensity at intradural T2A views.		Bilateral radicular pain, bilateral motor power at lower extremities: 3/5	T7-T8	Hyalinized fibrocollagenous connective tissue with focalde position of calcified hemosider in pigment
29	F	69	A lesion of 40X37X35 mm extending fromright posterior part of vertebra body to right pedicle, laminae and transverse process at the level of T9-T10 within tense contrast enhancement.		Bilateral motor power at lower extremities: 2/5	T9	Metastatic carcinoma
30	M	11	A lesion of 16X10 mm at thelevel of T4 on the right posterior part of vertebra body with mild and heterogeneous contrast enhancement.		Bilateral motor power at lower extremities: 2/5	T4-T5	Metastatic carcinoma
31	M	86	A lesion of 23X20X16 mm at the level of T2 verterbra body with contrast enhancement.		Bilateral motor power at lower extremities: 2/5	T2-T3	Meningotheliomatous / psammomatous meningioma (WHO Grade 1)
32	F	46	Intradural, extramedullary lesion of 15X7X75 mm at the level of T1-T7 extending from lower margin of vertebra body posteriorly with contrast enhancement.		Paraparesia	T5-T6-T7	A typical lymphoid proliferation
33	F	58	Lesion at the levels of T5-T7 extending toward sribs on the right side and posteriorly to para spinal muscles.		Bilateral motor power at lower extremities: 1/5	T5-T6-T7	Malignant epithelial tumor infiltration
34	M	15	Intradural, intramedullary lesion of 3X1 cm within spinalcord causing remarkable dilatation of thespinal canal at the levels of C3-C5 without contrast enhancement and isointensity at T1A sequences, mild hyperintensity at STIR A sequences.		Motor power at bilateral uppe rand lower extremities: 3/5	C4-C5	Ependymoma (WHO Grade II)
35	M	68	Lesion of 18X8 mm at thelevel of T5 posterior to the right side of vertebra body with mild contrast enhancement and heterogeneous nodularity.		Motor power at right lower extremity: 1/5, left lower extremity: 2/5	T4-T5	Metastati ccarcinoma
36	F	70	Lesion compressing spinal cordanteriorly on both sides causing narrowing of the spinal canal. Spinal cord segment between superior and inferior margins of compression leading to edema and myelomalacia resulting in increased signal intensity at T2A sequences.		Bilateral motor power at lower extremities: 2/5	T6-T7	Monoclonal plasmacellin filtration
37	F	70	Well-circumscribed intradural lesion of 16X12x8 mm in spinal canal at the level of L4-L5 with homogeneous and intense contrast enhancement.		Radicular pain	L4	Schwannoma
38	M	39	Intraspinal and posterior extradural lesion of 53X18X14 mm at the level of T12-L1 with minimum contrast enhancement.		Radicular pain, urinary incontinence	T12-L1	Small cell lymphoma
39	F	68	Bi lobulated and communicating intradural, extramedullary lesions of 47X13 mm remarkable contrast enhancement and isointensity at T1 and T2A sequences.		Radicular pain	T11-T12	Schwannoma
40	F	9	Intradural, extramedullary lesion of 38 mm diameter at the level of L1-L2 extending to left neural foramen causing scalloping at bone tissue		Bilateral radicular pain, bilateral motor power at lower extremities: 3/5	L1-L2	Schwannoma
41	M	67	Lesion extending to ribs on the right side and para spinal muscles posteriorly at the levels of T4-T7 with heterogeneous contrast enhancement.		Bilateral motor power at lower extremities: 3/5	T4-T5-T6-T7	Metastatic carcinoma

F: Female; M: Male; WHO: World Health Organization; C: Cervical Vertebrae; T: Thoracic Vertebrae; L: Lumbar Vertebrae

may enhance the occurrence of complications associated with instrumentation and fusion more likely [10].

The utility of our technique, which avoids instrumentation, may diminish the operative time and amount of blood loss. Moreover, the risk of destabilization of the spinal column due to posterolateral decortication as a part of fusion will be omitted [12]. The likelihood of stimulation of tumor cells by instruments or fusion substrate may be avoided. The lack of instrumentation will save an important cost and decrease the financial burden [13]. The implementation of surgical outcome studies can be difficult when studying a condition with a low survival rate [14]. Although there is a growing tendency toward minimally invasive and short-segment constructions, such surgical procedures can lead to failure of instrumentation [15].

Patients with spinal metastatic illness are diverse. Because of their unique features, such as pathophysiology, chemotherapy regimens, and metastasis, they constitute a tough population to examine. The goals of treatment vary remarkably in these patients [5].

When there is progressive discomfort owing to spinal instability, or when either vertebral collapse or metastatic development produces spinal cord compression, surgical therapy is recommended [16]. Instability-related pain and loss of motor power are the most common presenting symptom, and it was noted in the vast majority of our patients[12].

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As a result, when considering whether surgery is the best treatment, the realistic aim of pain control must be considered. The second major purpose of surgery is to decompress neural tissues so that neurologic function can be restored or preserved [6]. In patients with spine tumors, the more intensive treatment seems not to have much effect on survival [6].

Thus, less invasive, safer, and more practical procedures may be more suitable in this selected group. The expected survival rate is critical during the selection of the surgical intervention in patients with metastases. In comparison to conservative care, various studies have shown that even palliative surgery can improve the prognosis in such individuals [17]. When compared to the radiation monotherapy group, a higher percentage of operated patients kept or regained their ability to walk and required lower corticosteroid and analgesic doses, shifting the therapeutic paradigm for spinal tumors [18]. Patients with spinal tumors may have various primary pathologies, shorter survival times, and inconsistent follow-up due to morbidities or debilitation, as well as exposure to a variety of pharmacologic drugs [18]. Therefore, surgical techniques, instruments, and radiation protocols differ significantly in this subgroup [18].

Primary Spinal Cord Tumors ((SCT) are relatively uncommon in adulthood, accounting for just 2% to 4% of all primary central nervous system cancers [19,20]. Extradural SCTs account for 60% of all SCTs, 30% of intradural SCTs, and 10% of SCTs with both intradural and extradural components [4]. Within the intradural space, SCT can be divided into two types: intradural extramedullary (70%) and intradural intramedullary (30%) [19,20]. The distribution of our series was similar to these aforementioned reports.

The guidelines for fixation and instrumentation in the management of patients with spinal tumors do not currently exist. Total surgical excision is the chosen treatment for SCT because it has the best long-term results [21]. Some surgical interventions such as facetectomy [22,23] and surgery involving a spinal junction [24], are well documented to cause instability after spine surgery. Minimally invasive surgery for spinal tumors is a valuable procedure that can successfully generate good clinical results while reducing non-surgical costs when appropriate surgical indications exist [20,25]. It's crucial to achieve a balance between the short-term morbidity risks of vigorous resection and the long-term recurrence risks of incomplete resection.

Patients with spinal tumors need a careful surgical technique and patient-specific evaluation based on cost-effectivity and minimizing risks associated with additional morbidity due to malignancy. Resection of the lesion and preservation or restoration of the structural integrity of the spine must be taken into account during tailoring the treatment plan [4].

Instrumentation, fusion, and other interventions may bring about additional risks for the fragile structure of the spine in patients with tumors[10]. Thus, we speculate that our method can be a safe and straightforward surgical alternative in selected cases with spinal tumors.

The most prevalent location of metastatic bone disease is the spinal column[19]. More than 90% of spinal cancers are metastatic lesions, with the most common sources of metastasis being the lung, breast, prostate, and kidney [26-28]. The thoracic and thoracolumbar spines are the most common sites for metastases inside the spinal neural axis (70%), followed by the lumbar spine and sacrum (20%), and the cervical spine is the least common [29]. Our results are in parallel with this report.

Neural compression and spinal fracture can occur as a result of spinal metastases, resulting in excruciating pain and neurologic impairment[28]. Decompression surgery and spinal stabilization are crucial in the treatment of spinal metastatic disease [28].

Attributed to their overall prognosis and concurrent medications, the goals of care for spinal oncology patients may differ from those for non-oncology patients [30,31]. Patients with spinal metastatic disease may not live long enough to achieve bone fusion or experience hardware failure [32,33]. As a result of constant chemotherapy, radiation therapy, and low nutritional status, their bone's healing potential is frequently impaired [34].

Pain reduction, neurologic function preservation, prevention of progressive spinal deformity, and improved overall survival and quality of life are all goals of spine stabilization in oncology patients[26]. Fusion may not be necessary to achieve these aims in patients with spinal metastatic disease [26]. While the spine is being fused, instrumentation can only stabilize and maintain its alignment. Therefore, the implanted hardware cannot replace bony parts of the spine [35]. Instrumentation for the establishment of stability may result in loosening or fracture due to the amount of stress at the bone-screw interface, which may lead to instrument loosening or fracture [36]. There is a scarcity of research on the effectiveness of spinal stabilization without fusion or instrumentation in individuals with tumors of the spine [5].

Spinal instability was not observed in patients who underwent laminectomy at 2 levels or more with the surgical technique we applied. We anticipate that our technique will pave the way for more research into better surgical planning, care safety, patient outcomes, and cost-cutting in the medical treatment of patients with spinal tumors. However, some limitations of the current study must be remembered during the extrapolation of our results to larger populations. Retrospective and single-center design, single surgeon, heterogeneous type of tumors, Lack of clinical data such as outcomes and radiographic parameters, lack of a control group and evaluation of the quality of life after surgery, relatively short duration of follow-up, and possible impacts of socioenvironmental factors and ethnicity are weaknesses of this study.

Conclusion

To conclude, surgical management of spinal tumors is difficult, although it can provide positive, even good results.

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Complications and recurrence must be minimized to the greatest extent feasible, emphasizing the importance of thorough preoperative evaluations, precise surgical techniques, and knowledge-based on previous resections or surgical procedures. Our preliminary results with a novel technique that allows maintenance of stability without instrumentation yielded promising outcomes in selected patients. However, further multi-centric trials on larger series are warranted to achieve more accurate conclusions.

Statement of ethics

We declare that this research complies with the guidelines for human studies and it was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Author contributions

İdiris Altun: Design of the study, collection of data, statistical analysis, writing, critical revision, and approval of the final version of the manuscript.

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