Replantation of Spinous Process-lamina Complex in the Treatment of Cervical Spine Tumor : Two Cases Report and Literature Review

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Research article

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Abstract

Purpose: The primary aim of our study was to prove that the replantation of spinous process-lamina complex is beneficial to restore the anatomical structure and function of the spine, and to find if it can reduce postoperative complications.

Methods: We report two cases of cervical intraspinal tumor, whose postoperative pathological diagnosis, Respectively, are Neurilemmoma and meningioma. They all underwent the resection and replantation of spinous process-lamina complex, in which the resected spinous process-lamina complex was replanted at the end of the procedure, allowing a complete reconstruction of the posterior element of the spinal canal.

Results：After the surgery, the symptoms were relieved, and no dysfunction of upper limbs and sphincter was observed. The tumors were benign pathologically and were diagnosed as Neurilemmoma and meningioma. The patient recovered and at 6-month follow-up had no complaints and in good health.

Conclusion: After tumor resection, the replantation of spinous process-lamina complex is beneficial to restore the anatomical structure and function of the spine.

Introduction

Cervical intraspinal tumor is a common spinal disease. But due to the slow tumor growth, hidden onset and no specific symptoms and signs, its early diagnosis is difficult, and some patients are not seen until they are paralyzed. Especially, its initial manifestation in the early stage is the radiating pain caused by affecting the nerve root, so it is always misdiagnosed as other diseases, and patients even receive the wrong operation, seriously affecting the patient's operative prognosis. Prompt diagnosis and timely surgery in symptomatic patients are essential[1]. We aim to prove that the replantation of spinous process-lamina complex is advantageous to restore the anatomical structure and function of the spine, and to find if it can reduce postoperative complications.

Case Description

Case 1:

A case of 64-year-old male, who felt soreness in the dorsal neck for 2 years for no obvious inducement, and aggravated with left upper limb soreness and weakness in the last 1 month. On examination, he had tenderness over the upper cervical spine, even was forced to buckling. His left deltoid, biceps, triceps, wrist flexion, wrist extension were Grade IV, and hand intrinsics was Grade III (Lovett muscle grading standard).

Case 2:

A case of 60-year-old male, who felt soreness and weakness in both upper limb over the last 3 month. On examination, he had tenderness over the upper cervical spine. Superficial hypoesthesia of both upper limbs decreased. His key muscle strength was Grade V (Lovett muscle grading standard).His Babinski sign was positive and knee hyperreflexia.

Radiographic Studies

Case 1:

MR revealed an intraspinal space-occupying lesion in C5-6 level and osteolysis of C5-6 were seen, with mild disc bulging at the C2-3, C3-4, C4-5, C5-6 and C6-7 intervertebral disc levels. Enhanced MR confirmed C5-6 level space-occupying lesion and considered highly suggestive of Neurilemmoma. [Figure1]

Case 2:

MR revealed an intraspinal space-occupying lesion in C2-4 level, with mild disc bulging at the C2-3, C3-4 intervertebral disc levels. Enhanced MR confirmed C2-4 level space-occupying lesion. [Figure2]

Clinical and surgical course

After 3 days, the patient underwent posterior C4-6 tumor resection, C4-6 spinal canal decompression, and the resection and replantation of spinous process-lamina complex. All patients underwent general anesthesia, the patient was positioned in a prone position, the sterile towel was routinely sterilized, and the surgical space was determined by C-arm fluoroscopy. We made an incision of about 10cm via the posterior approach with surgical gap at the center, and incised the skin and subcutaneous tissue successively, retaining supranational and interspinous ligaments[10].Determine the C4-6 bilateral lamina. The bilateral laminae and caudal spinous processes were incised as a whole using an ultrasonic bone knife, grinding drill and gun forceps, removing the entire spinous process lamina complex. [Figure3] In case 1, we incised the bilateral laminae and caudal spinous processes perpendicular to the body. In case 2, we improved our method by inclining the section to increase contact area and stability. [Figure4] The dura mater was suspended under the operating microscope. The arachnoid on the surface of the tumor was cut, and the tumor was isolated and exposed, about 1*1.5*2cm. During the operation, it was found that the tumor was mainly located on the left ventral side of the spinal cord. The upper and lower poles of the tumor were connected to the spinal nerve and were not closely related to the dura mater. Resect tumor under operating microscope. Due to the large size of the tumor and Severe spinal cord compression, the tumor was performed piecemeal resection. Then replanting the autologous spinous process-lamina complex with 6 Arch steel plates fixing separated location of C4-6 lamina. We used some bone granule from patient replanting on contact area to improve bone fusion.

Pathology

The pathology of case 1: The frozen section diagnosis Neurilemmoma, immunohistochemically: GFAP(+),NSE(-),S100(+),P53(+),EMA(-),Desmin(-),SMA(+),PGP9.5(+),SOX- 10(+),Syn(-). Special staining results: AB(-)、PAS(-).And the pathology of case 2: The frozen section diagnosis meningioma, and immunohistochemically EMA (+), Vimentin (+), P53(+), Ki-67(2%+), STAT6 (-), S100(+), CD34(+), GFAP (-), SSTR2(meningioma) (+), PR (+). Special staining results: PAS(+)

Postoperative course

The two patients were followed up for at least 12 months. Data was recorded, including surgical time, blood loss, type of tumor, and any complications. To determine the level of internal fixation and spinal stability, frontal and lateral X-ray plain films of the spine were performed at 1, 3, 6, 12 months. Lumbar CT scans were carried out to evaluate the bone growth of the replanted spinous process-lamina complex at 3, 6, and 12 months postoperatively. At 6 months after the operation, MRI was performed to detect tumor recurrence and scar oppression in the vertebral canal, as well as the repair of the ligaments. Postoperatively, the patients underwent physiotherapy, rehabilitation. One year later, they fully recovered neurological function, and radiographs confirmed stability of the surgical construct [Figure 5-6]. Further, the CT scan showed no evidence of any other lesions.

Oswestry Disability Index (ODI) Scale

The neurological status was assessed using ODI scale preoperatively and at 1 month post-operation and the final follow-up. The ODI score system includes 10 sections: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. For each section of six statements the total score is five. If all 10 sections are completed the score is calculated as follows: total scored out of total possible score × 100. If one section is missed (or not applicable) the score is calculated: (total score / (5 Number of questions answered)) × 100%. Score of 0%–20% is considered mild dysfunction, 21%–40% is moderate dysfunction,41%–60% is severe dysfunction, and 61%–80% is considered as disability. The mean preoperative ODI score was 72.5%, while the mean last follow-up ODI score was 13.2% with statistically significant differences

Visual Analog Scale (VAS)

Low back and leg pain was assessed using VAS preoperatively, at 1 month post-operation, and at the final follow-up. VAS refers to a ruler about 10cm long, marked with 10 scales on one side. The two ends of the ruler are “0” and “10,” respectively. A score of “0” indicates no pain, and a score of “10” indicates the most severe pain. Patients were invited to mark the corresponding position on the ruler to represent the degree of their pain as the score. According to the clinical evaluation, “0–2” was classified as “excellent,” “3–5” as “good,” “6–8” as “poor,” and “>8” as “worst”[12]. VAS score of case 1 patient was reduced from 8 points to admission to 4 points at discharge. And the VAS score of the other patient with limb radiating pain was reduced from 9 points to admission to 4 points. Both of them had a continuous declination VAS score, even decreased to 1 point 12 months post-operation.

Discussion

Epidemiology of spinal

Intraspinal tumor is a common spinal disease, Upper cervical intraspinal tumors are rare, and few cases exist in the clinical literature. According to statistics, upper cervical spinal tumors account for18.0% to 39.5% of all cervical intraspinal tumors and only 5.0% to 14.4% of all intraspinal tumors[2].Neurilemmoma are the most common primary intraspinal tumor, accounting for 30% of primary spinal neoplasm and frequently observed in the cervical and lumbar regions[2-3].

Differential diagnoses

Differential diagnoses of cervical Neurilemmoma include giant cell tumor, aneurysmal bone cyst, Langerhans cell histiocytosis, vertebral hemangioma, chordoma, malignant lymphoma, metastatic embryonal rhabdomyosarcoma, neuroblastoma, and bacterial infection[3].

Treatment options

The treatment of cervical intraspinal tumor must be individualized based on the age, location, and size of the tumor, neurological deficits, reconstruction options, and experience of the surgeon. The purpose of surgical management of cervical intraspinal tumors is to resect the tumor, relieve spinal cord compression, and restore spinal stability[4,6].At present, more and more surgeons are aware of the importance of reconstruction of spinal stability and reducing postoperative complications for postoperative recovery and quality of life of patients, and place great importance to the maintenance of spinal stability during operation. Following the introduction of lamina replantation by Raimondi in 1976, a series of laminoplasty has been developed for intraspinal tumor resection[7]. By preserving some or all of the posterior column elements, these techniques restore the stability and integrity of the posterior column structure of the spine and significantly reduce the complications of classical total laminectomy. In addition, replantation of spinous process-lamina complex makes revision surgery much easier and safer than classical total laminectomy, considering that intradural tumors may recur, because replantation of spinous process-lamina complex retains a relatively normal posterior skeletal structure without epidural scars. Therefore, laminoplasty may be a suitable choice for this kind of patient with intraspinal tumor.

Conclusion

After tumor resection, the replantation of spinous process-lamina complex is favorable to restore the anatomical structure and function of the spine. This decreased postoperative complications such as kyphosis, epidural fibrosis, and iatrogenic spinal canal stenosis.

Assessment of the Bony Fusion

Cervical CT scans were carried out to evaluate the bone growth of the replanted spinous process-lamina complex at 3, 6, and 12 months postoperatively.

Limitation

This study had several limitations. First of all, we did not evaluate patients with continuous CT scans. In order to verify the bone fusion, a series of CT scans should be performed on all patients. Therefore, this study had limitations in determining the bone fusion over time. In order to accurately assess the bone fusion over time, forward-looking design is required. After that, this study could not provide a direct comparison of ARCH plate with other fixation methods of laminoplasty, because this was a single cohort study. A comparative study or randomized controlled trial was needed in order to discuss the advantages or disadvantages of ARCH plates over other procedures. Besides, there continue to be some shortcomings in the fixation method of replanted spinous process-lamina complex. The strength of traditional surgical sutures and steel wire is not sufficient, and it is easy to cause replanted spinous process-lamina complex nonunion, displacement, and collapse. Auxiliary pedicle screw cannot directly fix the replanted spinous process-lamina complex, which leads to the rotation and nonunion of the replanted spinous process-lamina complex.

Abbreviations

VAS: Visual analog score

ODI：Oswestry Disability Index

Declarations

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None.

Authors’ contributions

MB and WCG contributed to the conception and design of the study; XJH collected and analyzed data , and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

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Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study protocol was approved by the tongji Hospital affiliated to tongji University. Written informed consent was obtained from all the study subjects before enrollment.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Table

Due to technical limitations, table 1 is only available as a download in the Supplemental Files section.

Figures

Figure 1

Radiographic studies of case 1 A,B:X-ray pre-operation. C,D:MRI pre-operation. E: Enhanced MR pre-operation

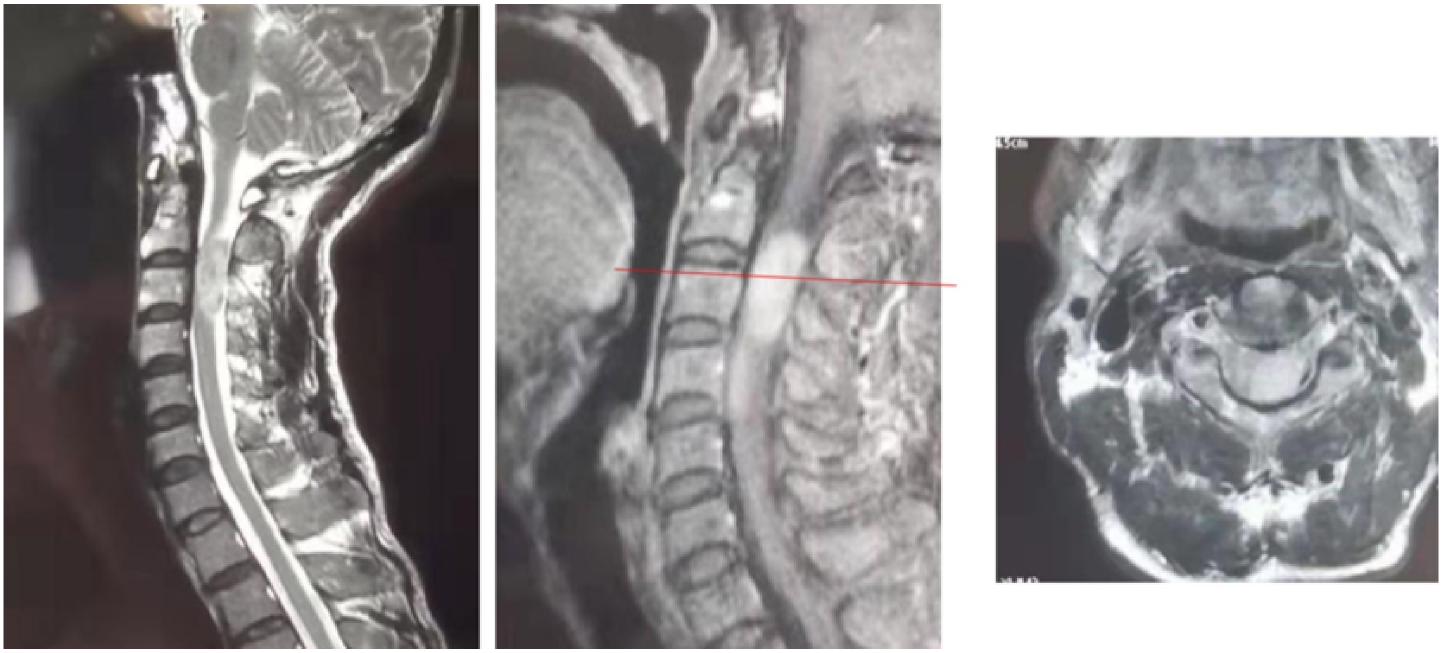

Figure 2

MRI of case 2 pre-operation

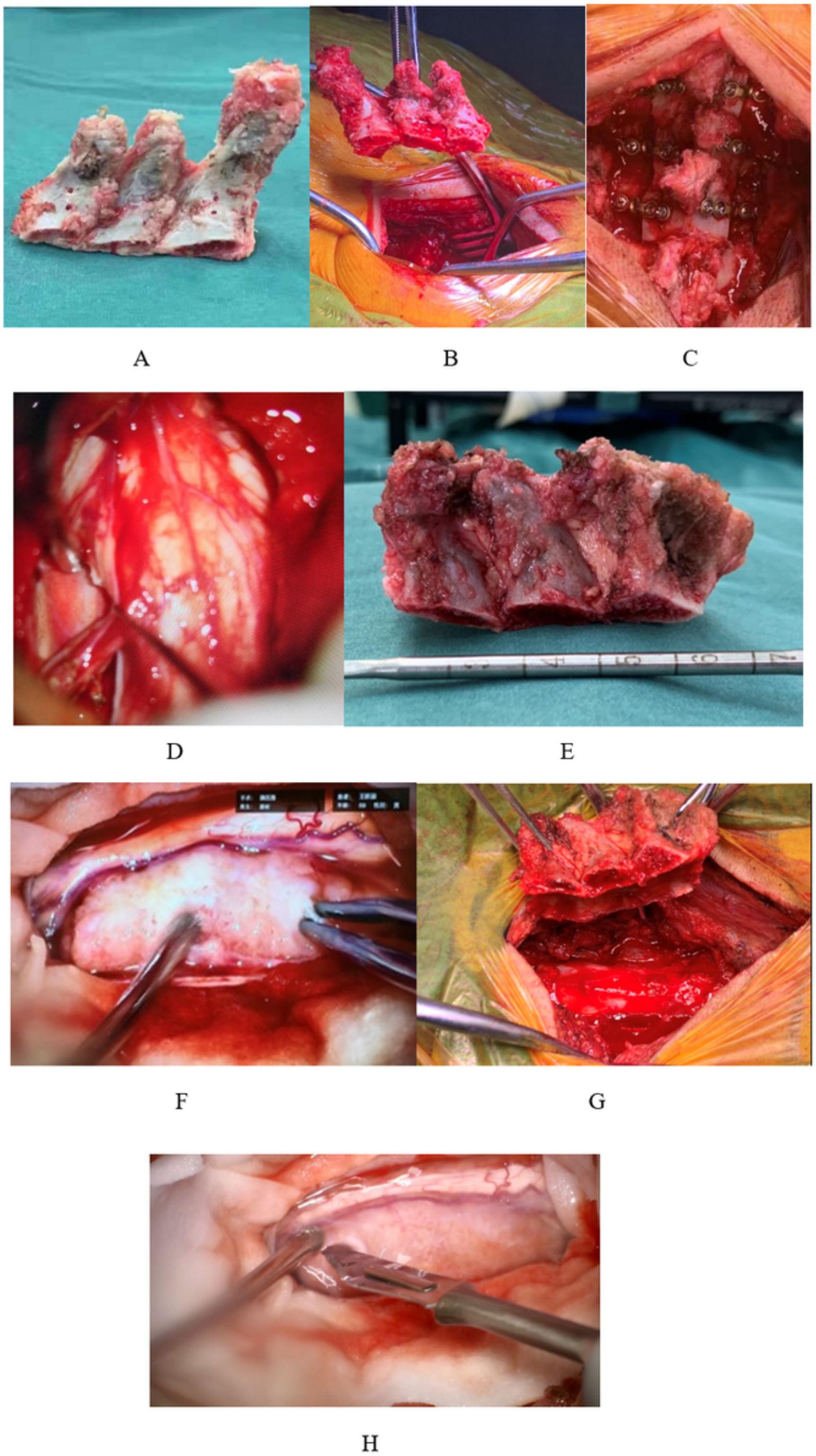

Figure 3

A: the entire spinous process lamina complex of case 1;B: replanting the autologous spinous process-lamina complex; C: 6 Arch steel plates fixing separated location; D: exposed tumor of case 1; E: the entire spinous process lamina complex of case 2; F,G: Resect tumor of case 2; G: replanting the autologous spinous process-lamina complex of case 2

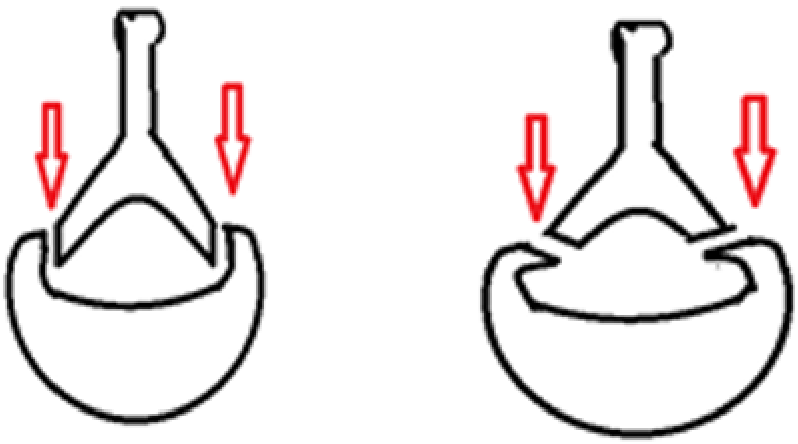

Figure 4

Two different contact area of two cases

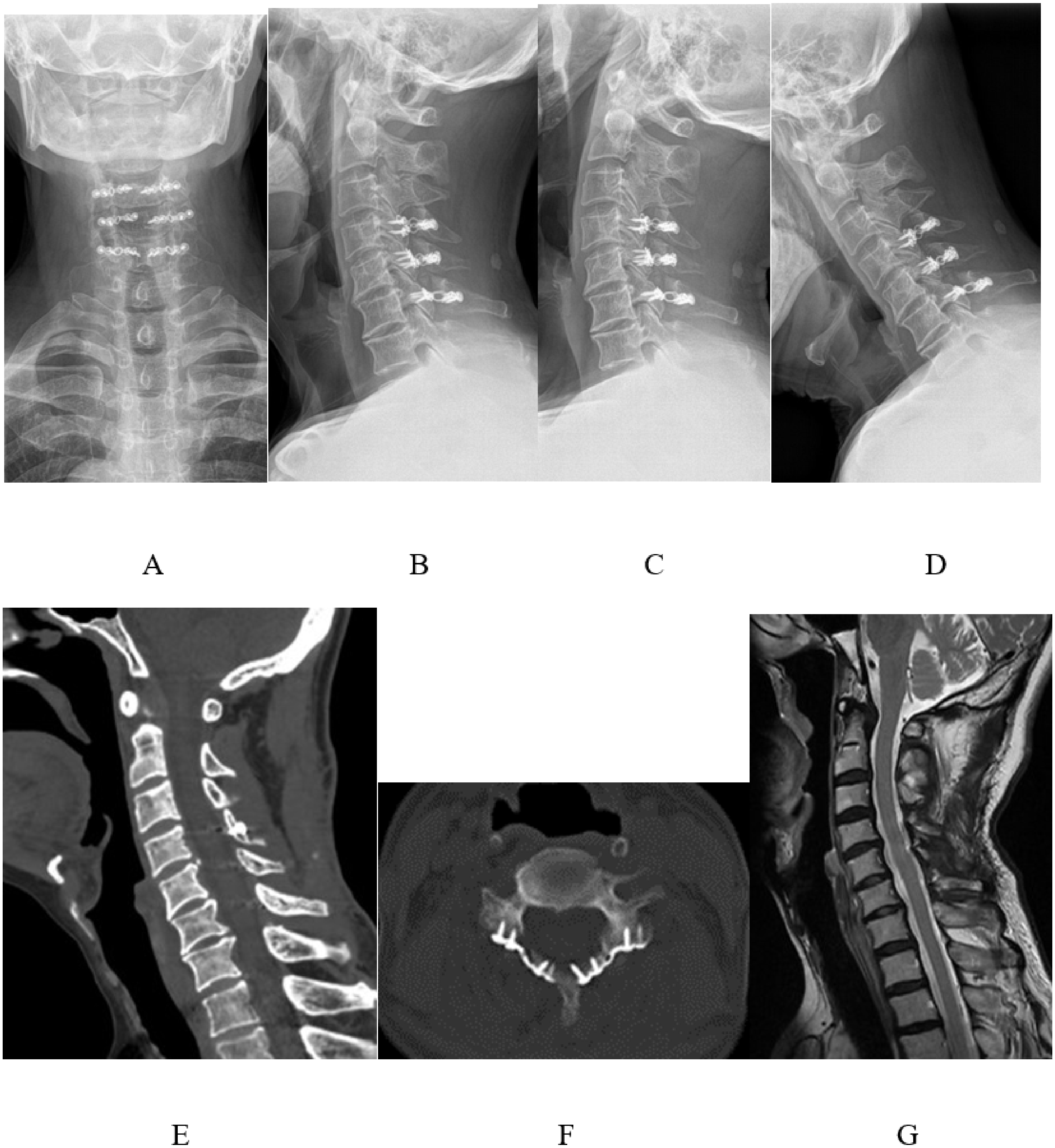

Figure 5

Post-operation of case 1

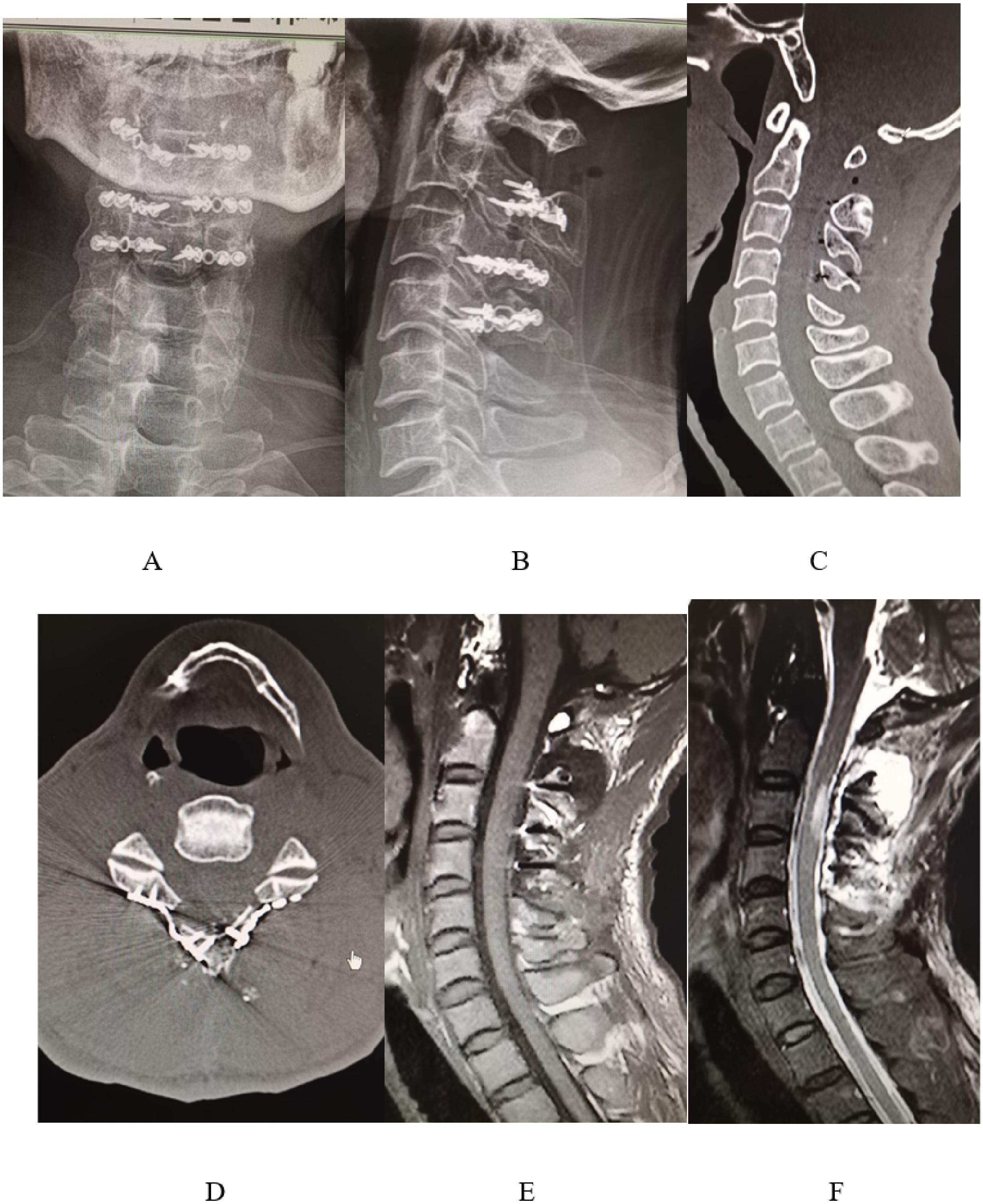

Figure 6

Post-operation of case 2

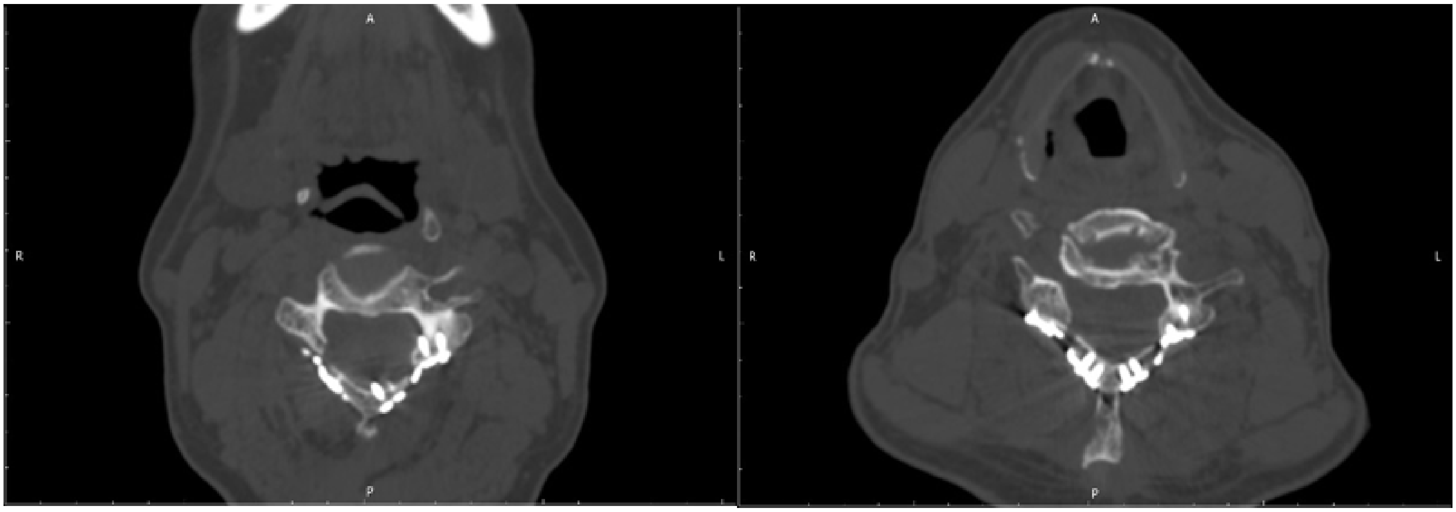

Figure 7

12 months postoperatively of case 1

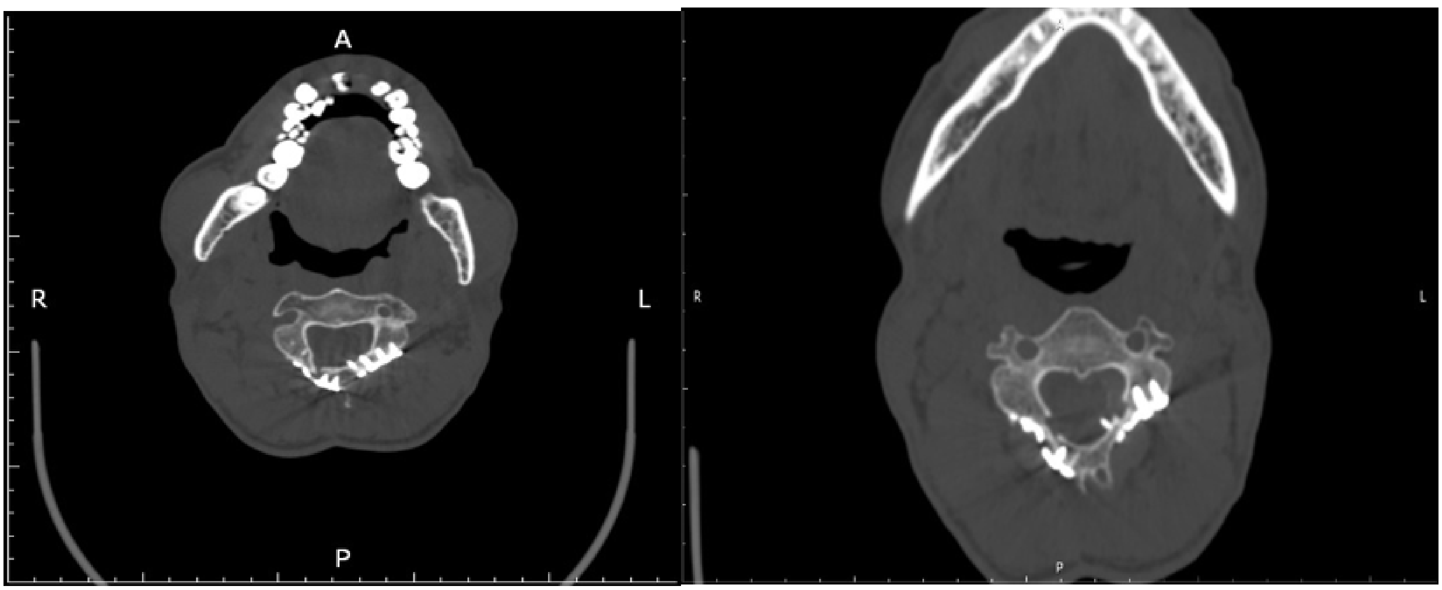

Figure 8

12 months postoperatively of case 2

Supplementary Files

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- Table1.png