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Inadequacy of anterior-only fixation for reducible three-column injury of the subaxial cervical spine: case report

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Abstract:	Introduction: Managing three-column injuries in the subaxial cervical spine in patients with prior spinal fusion surgery is complex. Current treatment algorithms generally advocate that an anterior-only approach is adequate for reducible subaxial cervical spine injuries. However, comprehensive studies on cervical trauma in patients with previously fused spines are lacking. Case presentation: We report a case of a 62-year-old male with a history of C4 to C6 anterior cervical spine fusion. The patient sustained a C6–C7 translational injury from a fall. Despite successful intraoperative reduction and anterior instrumentation, instrument failure occurred within a month without further trauma. This complication may be due to increased mechanical load from the fused segments above the injury site. Conclusion: This case underscores the need for customized treatment strategies for patients with prior spinal fusion surgery. Initial circumferential stabilization might be crucial to distribute mechanical loads effectively and prevent instrument failure. Further research is necessary to develop definitive management protocols for these challenging cases.

Inadequacy of anterior-only fixation for reducible three-column injury of the subaxial cervical spine: case report

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Abstract

Introduction: Managing three-column injuries in the subaxial cervical spine in patients with prior spinal fusion surgery is complex. Current treatment algorithms generally advocate that an anterior-only approach is adequate for reducible subaxial cervical spine injuries. However, comprehensive studies on cervical trauma in patients with previously fused spines are lacking.

Case presentation: We report a case of a 62-year-old male with a history of C4 to C6 anterior cervical spine fusion. The patient sustained a C6–C7 translational injury from a fall. Despite successful intraoperative reduction and anterior instrumentation, instrument failure occurred within a month without further trauma. This complication may be due to increased mechanical load from the fused segments above the injury site.

Conclusion: This case underscores the need for customized treatment strategies for patients with prior spinal fusion surgery. Initial circumferential stabilization might be crucial to distribute mechanical loads effectively and prevent instrument failure. Further research is necessary to develop definitive management protocols for these challenging cases.

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Introduction

The management of three-column injuries of the cervical spine requires meticulous evaluation of several critical factors, including the attainment of adequate reduction, reconstruction of both anterior and posterior tension bands, decompression of neurological structures, and facilitation of early fusion for optimal rehabilitation outcomes.[1,2] Recent advancements in instrumentation techniques and appropriate patient selection have facilitated the development of alternative strategies, such as anterior-only stabilization with instrumented fusion. Furthermore, the current recommendation states that "anterior-only stabilization is a viable option for reducible subaxial cervical spine fractures."[3]

In cases of reducible subaxial cervical spine trauma, the anterior-only approach has gained considerable attention due to its potential benefits compared to the posterior-only or circumferential approaches.[4] Numerous studies have provided evidence indicating the superiority of the anterior-only approach concerning clinical outcomes and complication rates.[5] A retrospective study conducted by Srivastava et al. assessed the long-term outcome associated with anterior stabilization in three-column injuries of the subaxial cervical spine, yielding promising results.[6]

Our report presents a case of reducible subaxial cervical trauma in which the patient underwent anterior-only cervical spine fusion but ultimately experienced instrumental failure. There is a paucity of literature studies in cervical trauma patients with previous fusion. We hypothesized that the complication may have risen from the increased load borne by the previously fused cervical segments located superior to the site of trauma.[7] This case report was exempt from Institutional Review Board review.

Case report

This case report details a 62-year-old male with a prior surgical history of anterior cervical spine fusion from C4 to C6, performed four years prior to address previous radiculopathy arising from C45 and C56 cervical disc herniation. The patient was transported to the emergency department via ambulance following an accidental fall from a height of three meters, specifically from a second-floor ledge. The impact was mainly on posterior occipital head, causing hyperflexion of his neck. Upon arrival, he was fully conscious and exhibited stable vital signs. A physical examination revealed significant tenderness in the neck and shoulder regions. Immediate stabilization of the neck was conducted using a cervical collar by emergency medical personnel at the scene. Neurological assessment indicated preserved muscle strength (5/5) in all extremities, with intact sensory function. There were no indications of urogenital dysfunction or fecal incontinence, categorizing the patient as ASIA E.

Radiographic evaluation revealed a translational injury at the C6–C7 level (Figure 1), classified as type C according to the AO classification system. Cervical computed tomography (CT) demonstrated a unilateral facet fracture without evidence of locking. Additionally, magnetic resonance imaging (MRI) indicated disc herniation accompanied by spinal cord compression at the C6–C7 level (Figure 2). Following a thorough discussion with the patient, a decision was made to proceed with intra-operative head traction for cervical spine reduction, along with C6–C7 anterior discectomy and fusion.

Intra-operative reduction of the cervical spine was successfully achieved utilizing an 8 kg sandbag. The insertion of an anterior cage (Cervios, 8mm, filled with artificial bone minerals) and plating (VECTRA system) was performed without complications (Figure 3). During surgery, there were no immediate concerns regarding subsidence or poor bone quality. The endplates were intact.

The anterior cage was well positioned in good quality bones. There was no sign of pseudoarthrosis from previous fusion. Post-operatively, the patient exhibited significant improvement, with complete alleviation of neck and shoulder pain, and was discharged three days following the procedure.

However, during a follow-up visit at the outpatient clinic 24 days post-discharge, the patient reported a recurrence of neck and shoulder pain, with no recent trauma noted. X-ray imaging revealed instrument failure, including screw pull-out and cage dislodgement (Figure 4). A cervical CT scan was conducted to facilitate pre-surgical planning (Figure 5). An immediate re-operation was recommended, which involved circumferential stabilization of the C6–C7 segment, repositioning of the anterior cage and plates, and additional stabilization through posterior transpedicular screws. The patient demonstrated a favorable recovery post-revision surgery, with resolution of pain, and was discharged seven days after the operation. Follow-up X-ray imaging confirmed the proper positioning of the cage, plating, and screws (Figure 6). At an outpatient clinic follow-up conducted eight months after the revision surgery, adequate stabilization of the C6–C7 segment was observed, with complete fusion achieved (Figure 7).

Discussion

There exists a considerable body of evidence advocating for the implementation of anterior-only stabilization in instances of reducible subaxial cervical spine trauma. Numerous studies have indicated that anterior stabilization can achieve effective bony fusion and optimal alignment in patients presenting with reducible cervical subaxial dislocations.[2] Furthermore, anterior surgical interventions are associated with shorter operative times and less blood loss compared to posterior surgery.[8] Thus, anterior instrumentation accompanied by interbody grafting may serve as the

preferred initial treatment modality for stabilization in this particular patient demographic according to current consensus.[3]

However, when it comes to management of patients who already have fused spinal segments, such as the patient in this case report, current literature falls short. Furthermore, in the event of a unilateral facet fracture, even without a facet lock, can lead to significant instability due to the disruption of the posterior tension band.[10] This instability necessitates surgical more radical intervention to restore alignment and prevent further neurological compromise.

In the case under discussion, despite the successful intraoperative reduction of the C6–C7 segment and the smooth application of the anterior cage and plating (Figure 3), the instruments became dislodged within one month without any associated traumatic event, prior to the establishment of any bony fusion (Figure 4). Moreover, the anterior and posterior elements in this case exhibited disruption, characterized by multiple spinous process and bilateral facets fractures (Figure 5). Considerations arise for patients with fused spinal segments located superior to the site of a three-column injury. The anterior-only approach may fail in patients with pre-existing fusions due to the altered force distribution and increased mechanical load on the stabilization construct. Increased mechanical load from fused segments above the injury site can lead to excessive stress on the anterior-only stabilization construct, resulting in failure. Biomechanical studies have shown that circumferential stabilization significantly reduces range of motion and stress on the construct compared to anterior-only approaches, thereby enhancing stability and preventing failure.[10,11] In such scenarios, the implementation of initial circumferential stabilization may be necessary to effectively distribute the mechanical load and mitigate the risk of instrumental failure.[12] While anterior-only stabilization has demonstrated favorable outcomes in cases of reducible subaxial

cervical trauma, its application may be limited in scenarios involving altered biomechanical forces from fused superior segments to the injury site.

Biomechanical studies have shown that circumferential stabilization significantly enhances construct stability, reduces range of motion, and effectively distributes mechanical loads, thereby mitigating stress on anterior constructs and preventing instrument failure.[9-11] In contrast, anterior-only stabilization may fail under increased mechanical stress, associated with higher risks of instrument dislodgment and surgical revisions, as presented in this case report. Additionally, circumferential stabilization offers more robust stabilization by combining anterior and posterior approaches, ensuring optimal alignment and reducing the risk of reoperation.[11] The importance of individualized treatment plans is underscored, with long-segment anterior plating as an alternative strategy for selected patients. As existing literature on cervical trauma in individuals with fused spines is limited, further clinical investigations are essential to establish definitive evidence guiding surgical management in this unique patient demographic. This case highlights the necessity for tailored surgical strategies to address the challenges posed by pre-existing spinal fusions in cervical trauma management.

This case report elucidates the decision-making process associated with the provision of adequate stabilization for three-column injuries of the sub-axial cervical spine in patients with a prior history of spinal fusion surgery. There exists a paucity of studies addressing cervical trauma in individuals with previously fused spines. Consequently, additional research and clinical investigations are imperative to establish more definitive evidence regarding the optimal management strategies for patients with fused spinal segments located superior to the site of the three-column injury.[3]

Conclusion

In conclusion, although anterior-only stabilization has demonstrated favorable outcomes in cases of reducible subaxial cervical spine trauma, the decision-making process becomes increasingly intricate when addressing patients with previously fused spinal segments. Tailored treatment plans and further research are essential to inform the management of such cases.

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Ethics approval and informed consent

This research was conducted in accordance with the ethical guidelines outlined by the Institutional Review Board of E-Da Hospital. Written informed consent was obtained from the patient for publication of this report.

Authorship contribution statement

YYW: Conceptualization, Investigation, Writing - Original Draft. PYC: Validation, Supervision. KL: Validation, Supervision. IFL: Software, Writing - Review & Editing.

Author disclosure statement

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Figure Legends

Figure 1. Initial (A) lateral and (B) anterior-posterior views of the patient's neck, showing a C6C7 translational fracture with previous C4–C6 anterior cervical spine fusion. (C, cervical)

Figure 2. Initial mid-sagittal plane of the patient's neck is shown in (A) T2-weighed magnetic resonance imaging and (B) computed tomography. The computed tomography results indicate (C) a fractured left facet and (D) an intact right facet in C6C7. (C, cervical)

Figure 3. (A) Intraoperative fluoroscopy demonstrated adequate cervical reduction and instrumentations. Postoperative X-ray confirmed proper alignment in (B) lateral and (C) anterior-posterior views.

Figure 4. Follow-up X-ray on post-operative day 24 of the patient's neck in (A) lateral and (B) anterior-posterior views.

Figure 5. Computed tomography of the patient's neck reveals C6C7 collapse in (A) mid-sagittal plane, with (B) a progressed fracture of the left facet and (C) a new fracture of the right facet. (C, cervical)

Figure 6. Post-operative (A) lateral and (B) anterior-posterior views following the patient's cervical circumferential stabilization.

Figure 7. (A) Lateral and (B) anterior-posterior views at the 8-month follow-up after the patient's revision operation, showing correct cervical alignment and complete fusion at C6C7. (C, cervical)

Figure1

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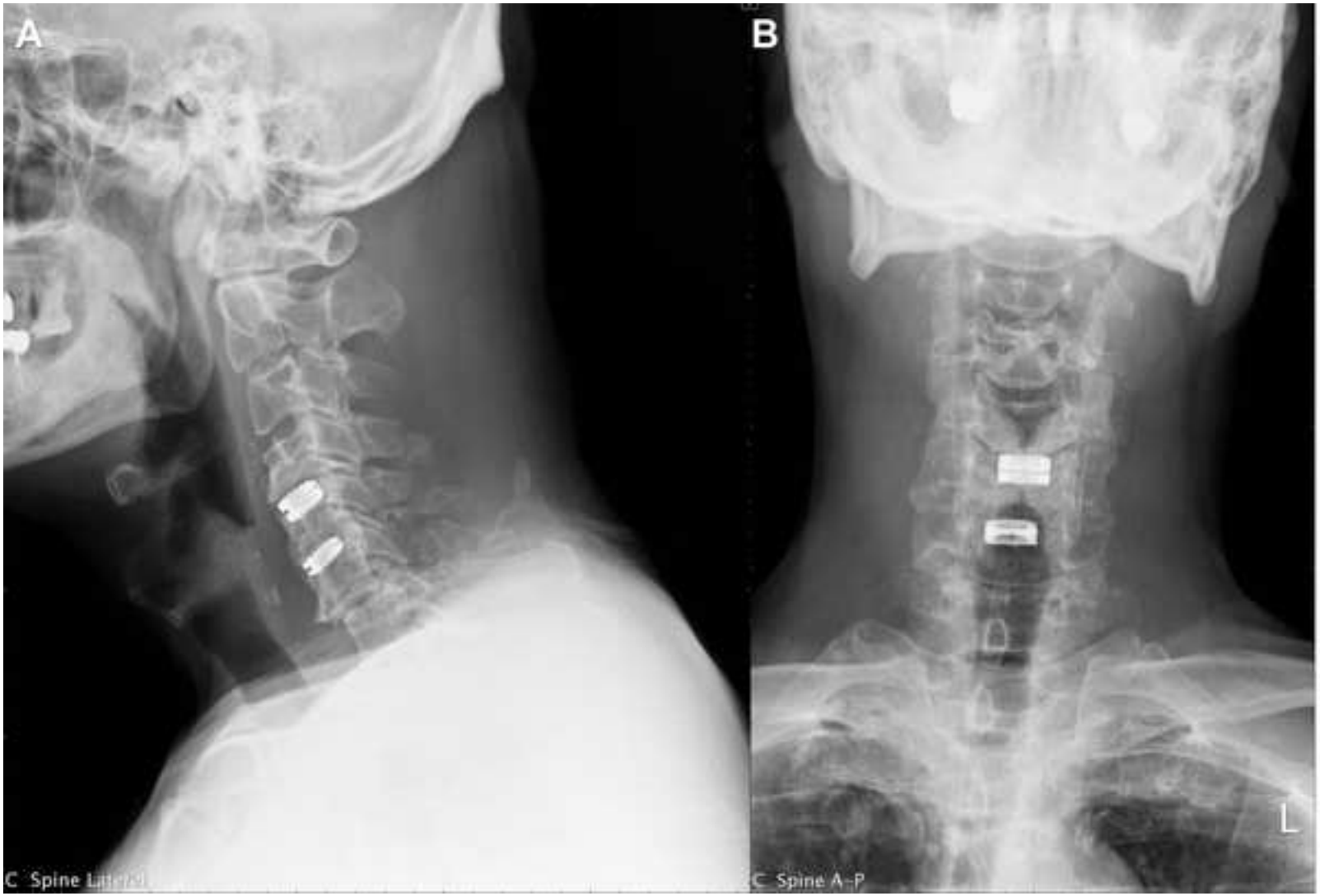

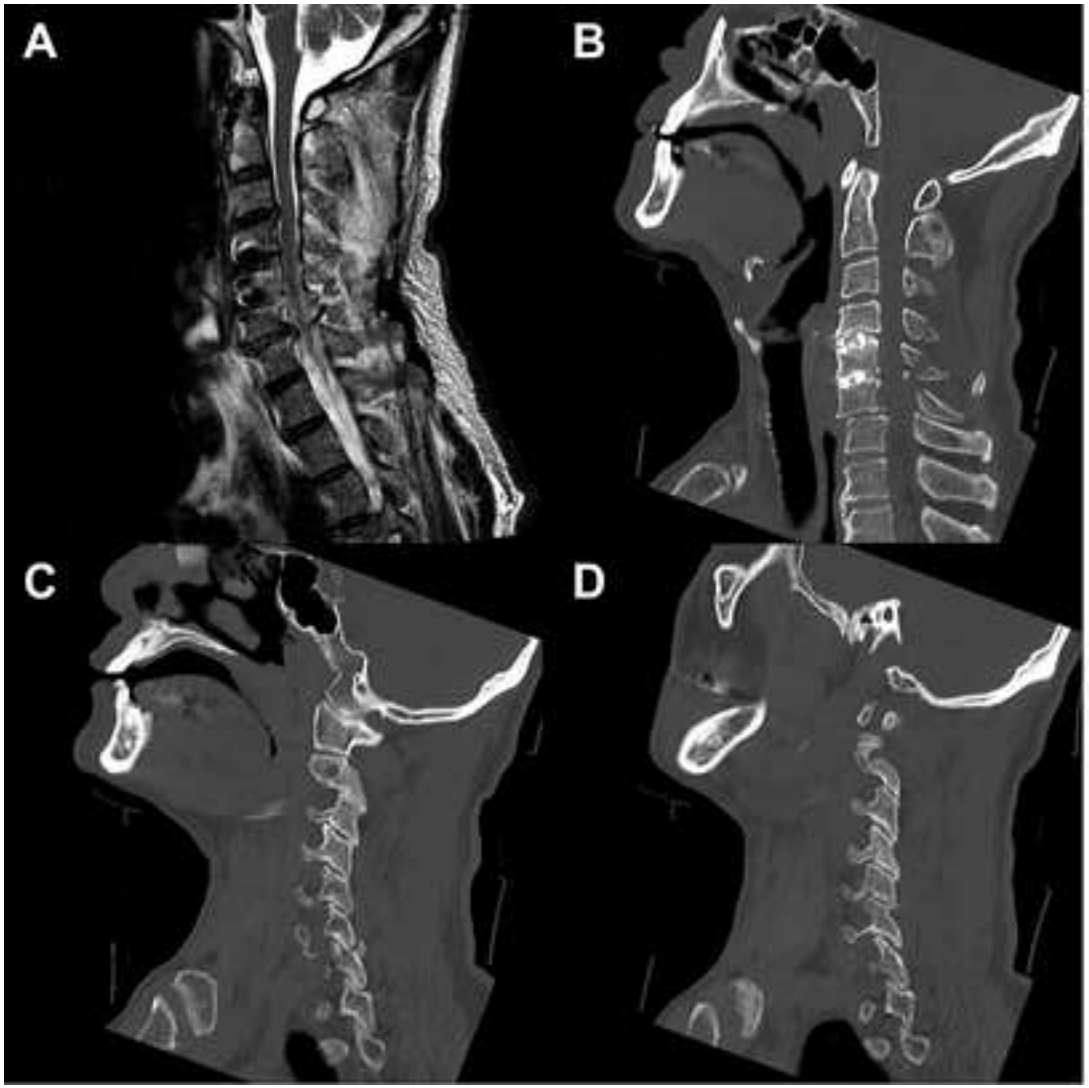

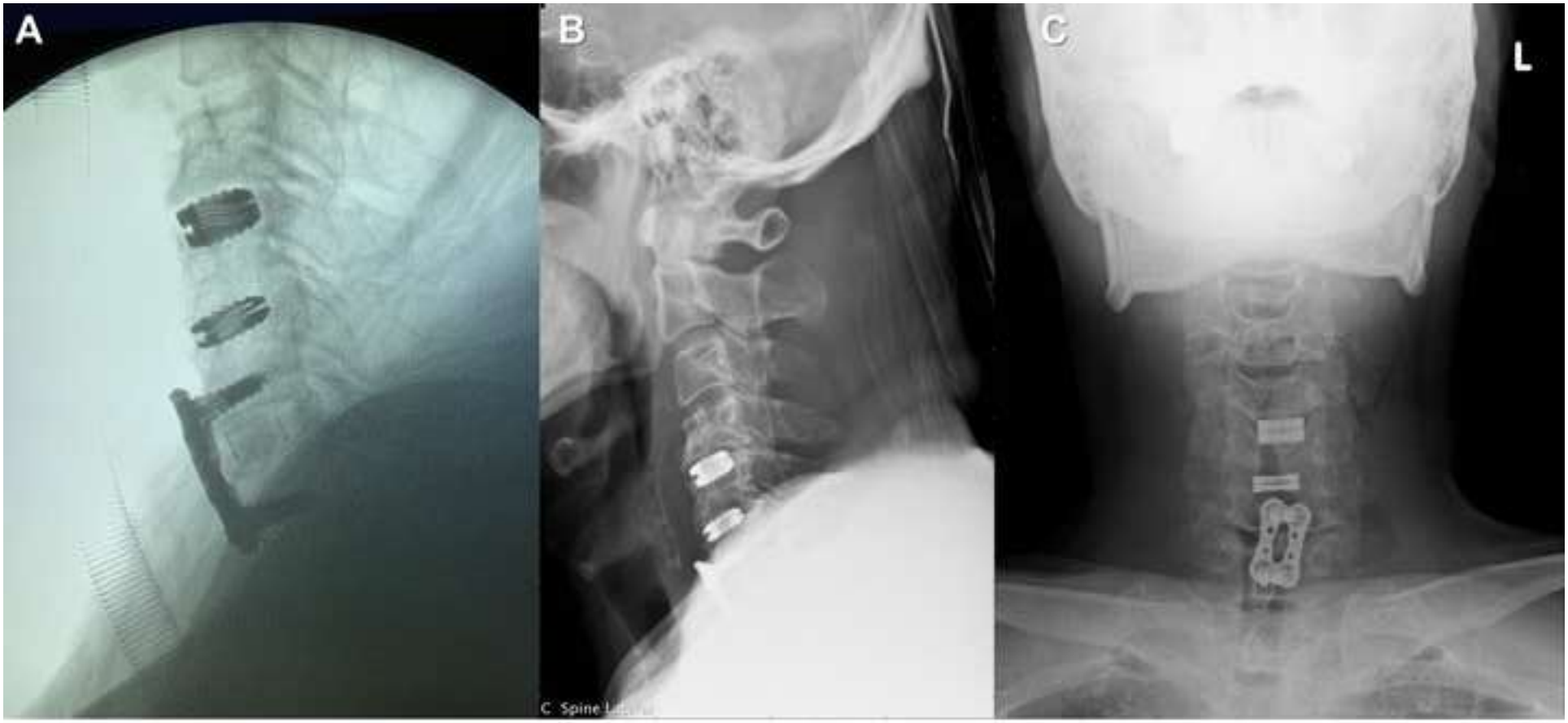

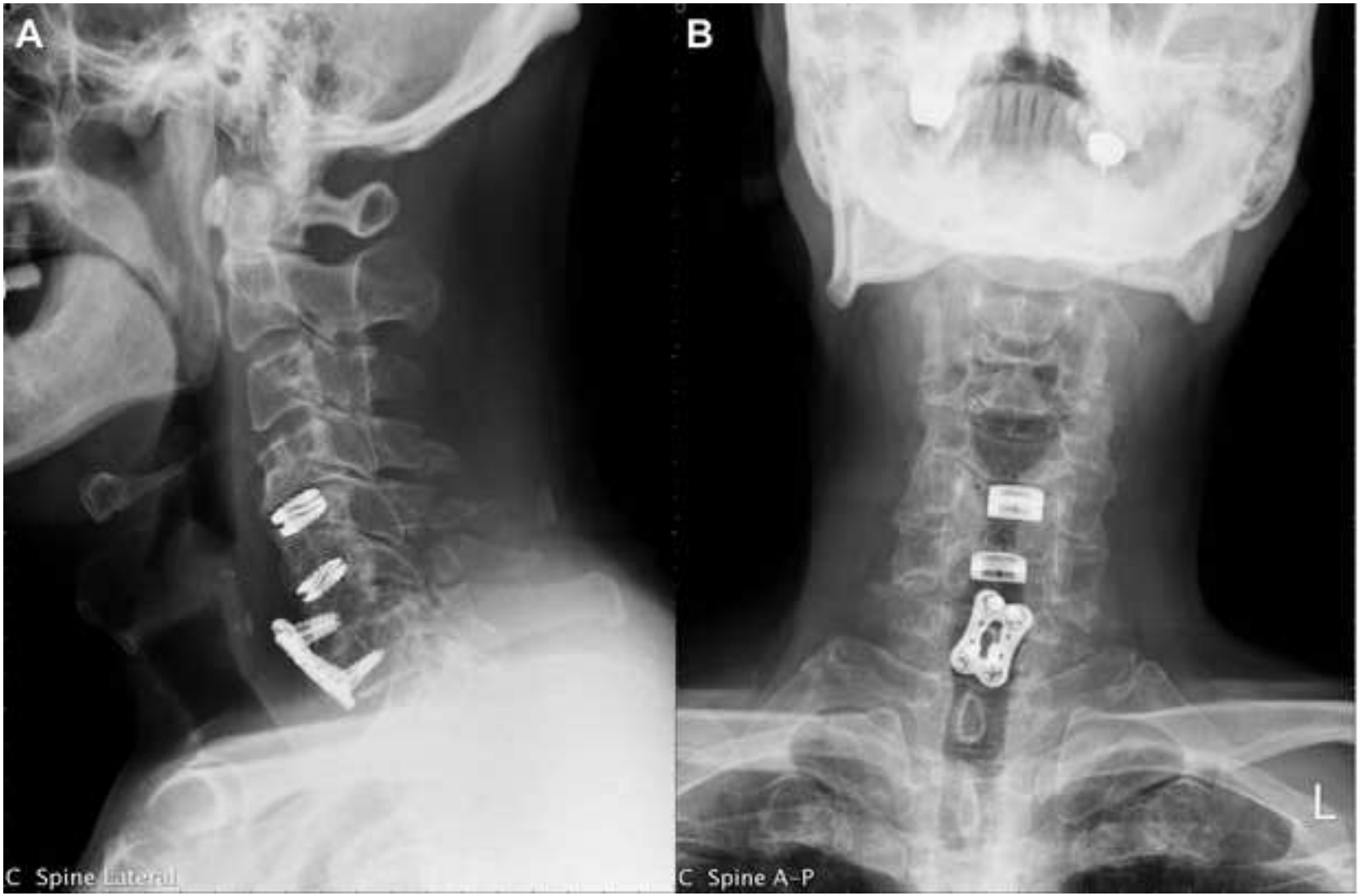

Figure5

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