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CASE REPORT

Surgical tool entrapment in a young patient with recurrent lumbar spinal stenosis: a case report

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Key Clinical Message
Lumbar spinal stenosis (LSS) is a prevalent cause of leg and back pain. In the youth, LSS is not common and mainly results from hereditary musculoskeletal disorders. Moreover, spinal fusion is a surgical approach to the treatment of LSS. Entrapment of surgical tools due to breakage is a rare yet important phenomenon in such operations. Therefore, neurological sequelae of these events need to be explored. The case was a 24-year-old male complaining of local back pain. Initially, he was diagnosed with LSS at L4 and L5. After the fusion of the vertebrae by the posterior spinal fusion (PSF) method, the patient's pain was resolved. However, the subject complained of worsening local back pain limiting his ability to do routine tasks. A few years later, radiographical evaluations indicated the possible presence of a surgical tool that could not be removed via surgery. During a third operation, the object was removed, and the patient's symptoms recovered. Immediate removal of entrapped surgical objects is necessary due to risks associated with migration and central nervous system damage. Comparing our results to other similar reports, we conclude that in cases of foreign object entrapment, neurological sequelae may be nonexistent or progressively worsen. Also, sequelae emerge either soon after the operation or emerge later. This complicates the diagnosis of such events and the decision of whether to subject the patient to additional neurosurgical operations to remove the tool. These variations may be observed due to the moving of the entrapped tool. Follow-up of neurological sequelae in spinal surgery patients is recommended.

KEYWORDS
lumbar spinal stenosis, neurosurgery, spinal cord injury, surgical tool entrapment

1 | INTRODUCTION

Lumbar spinal stenosis (LSS) is a prevalent cause of lower extremities and back pain. LSS makes up for a considerable portion of disability in the senescent population, and it is the most important cause of spinal surgery in patients over 65 years of age.[1] In the youth, LSS is often a result of a hereditary condition that influences

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the musculoskeletal maturation process, such as scoliosis.[2,3] The condition denotes a restriction in the vertebra, in the regions of the lateral recess, central canal, and the neural foramen. Moreover, the stenosis of the lateral recess and neural foramen could prompt the clinical presentation of lumbar radiculopathy in the lumbar area. Even though lumbar spinal stenosis is a common condition, the term still needs to be defined more clearly, and universal radiological diagnostic criteria that are agreed upon should be developed. The latter problem is due to the large percentage of the senescent population, making the decision to subject patients to multiple operations difficult due to the possibly high risk of operation.[4,5] One issue that complicates the clinical diagnosis of LSS is that data on the association among clinical symptoms and findings on neuroimaging has produced nonhomogeneous outcomes.[6–8] The precise process through which a constrained canal or nerve foramina emerges in the form of clinical symptoms is still not known.[9] The diagnosis of LSS relies on history, clinical presentations, physical examination, and imaging is used as a verification method.[10]

There are various conservative and invasive approaches to the treatment and management of LSS. The options for nonsurgical management comprise pharmacotherapy, physiotherapy, targeted interventional approaches, lifestyle changes, and rehabilitation. Nonetheless, a limited number of well-conducted randomized clinical trials have examined conservative options. A literature analysis of systematic reviews was performed using the keyword "lumbar spinal stenosis" on publications from 2000 to 2015. The analysis showed that the studies are not sufficient to advise any particular type of noninvasive choices. Various surgical procedures are utilized to treat cases that do not recover with nonsurgical treatments. Given that rapid deterioration is rare and symptoms often wax and wane or slowly enhance, surgical operation is almost fully elective and opted for solely if sufficiently irritating presentations persist, even after attempts of noninvasive methods. Results (lower extremity pain and disability) appear to be better for surgical operation than for nonoperational treatment, however, the evidence is nonhomogeneous and usually low quality.[9]

There are multiple reports of surgical objects left in various sites of surgery, such as the abdomen, retroperitoneum, pelvis, and spinal canal. The object can migrate or cause unfavorable reactions (e.g., induce an immune response), and therefore it is important to assess the criticalness of the possible damage by the instrument to the surrounding tissue, especially in neurosurgical cases.[11,12] Entrapment of foreign objects in the spinal canal usually results from penetrating spinal trauma or failed internal instruments. However, retention of an external object in the cervical spinal canal during surgery is rare, and whether such an object may cause neurological complications remains unknown in the literature.[11]

In the present article, we report a rare case of a young male with LSS who underwent posterior spinal fusion (PSF), an operation that helps to stabilize the spine and help cases affected by lower back and lower extremities pain, impaired coordination, numbness, or weakness to pressure on the nerves.[13] After the operation, the local pain symptom and further evaluations that verified retention of a curette edge in the spinal canal and subsequent interventions to remove the object.

2 | PRESENTATION OF THE CASE

The case was a 24-year-old male complaining of local backpain. Initially, he was referred to a medical center in Hamedan with the diagnosis of LSS at the level of L4 and L5. After fusion of the vertebrae by the PSF method, the patient's pain was resolved. However, the subject reported a worsening local back pain limiting his ability to carry out normal daily activities, but was only reassured by the physician. The patient had urinary problems which correlated with the level of the entrapment. A few years later, radiographical evaluations were performed (Figure 1), giving rise to the possibility of an external object entrapment, that seemed to be a bistoury. Magnetic resonance imaging (MRI) could not be performed as a result of this possible diagnosis.

The patient underwent spine surgery a second time; However, the surgical instrument could not be found or removed. A subsequent computed tomography (CT) scan showed that the patient developed LSS at the level of the other three lumbar vertebrae. Further, electromyography (EMG) assessments corroborated the involvement of lower extremities as a result of significant nerve constraint. Bilateral mild findings were reported in the EMG analysis. Changes were related to L4/L5 roots.

A third surgical operation was performed with the aid of neuromonitoring and navigation techniques to resolve this new issue as well as remove the bistoury from the spinal canal. Ultimately, the external object was removed (Figure 2) and found to be a curette edge. The lumbar vertebrae were fixed by six screws. In the week following the last operation, the patient's pain subsided, and the complications of the patients mentioned above were resolved.

3 | DISCUSSION

The failure of surgical tools during neurosurgical and orthopedic operations occurs in less than 1 percent of the cases.[11] During spine surgery, the best practice involves

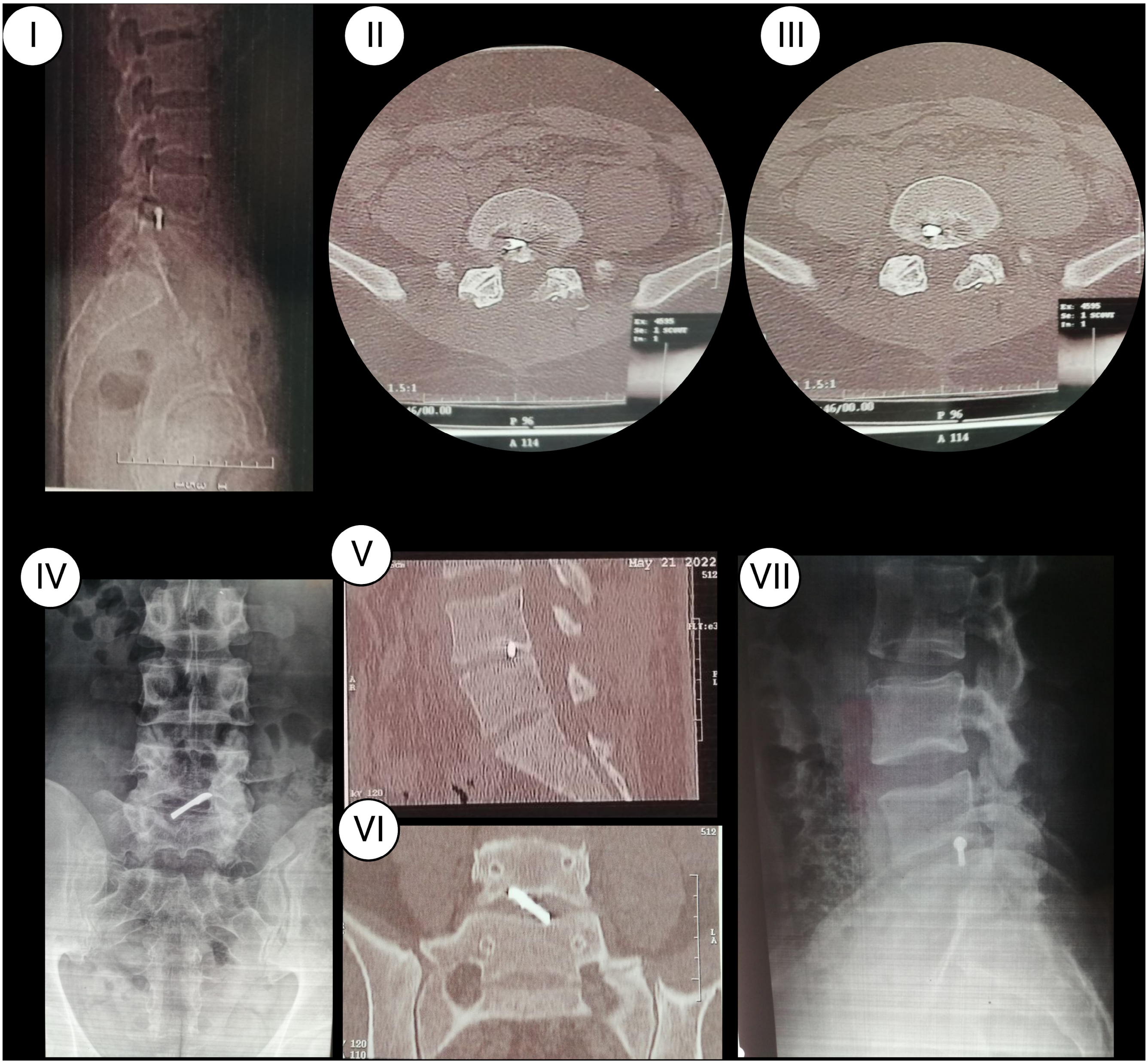

FIGURE 1 Spinal radiographic presentation of the patient.

the immediate removal of the fragmented metal piece. This is because, in the spinal canal, the object resides in close proximity to key central nervous system (CNS) constructs and could emigrate into the intradural area and lead to crucial neurological sequalae.[14,15] In our case, the possibility of the surgical instrument migrating was unknown. However, research shows surgical instruments can show unexpected migratory behaviors.[16] For instance, researchers have reported that during a liver surgery, a surgical instrument may have transported into the colon. Also, the fact that surgical operation may fail to locate and remove the entrapped objects, as was the case with similar reports of spinal surgery, highlights the importance of clinical decision-making and appropriate imaging techniques to decide whether to perform exploratory surgery.

In the spine canal, the dural sac pulses coupled with heart contractions, and the dural pressure alters by shifting position during routine activities.[17] Interestingly, a "spring phenomenon" exists that can force the external object to emigrate or puncture its way into the intradural area, leading to encroachment upon the spinal cord or the roots of the nerve.[11,18]

We utilized neuroimaging to detect the cause of local back pain at the surgical site. Neuroimaging via simple radiography, CT, MRI, and nuclear techniques is essential for the exploration of lumbar spinal post-surgery cases. Neuroimaging could be carried out routinely to assess the position and appearance of spinal instrumentation or to evaluate the advancement of spinal fusion as well as to explore post-surgery events.[19] The MRI provides benefits in

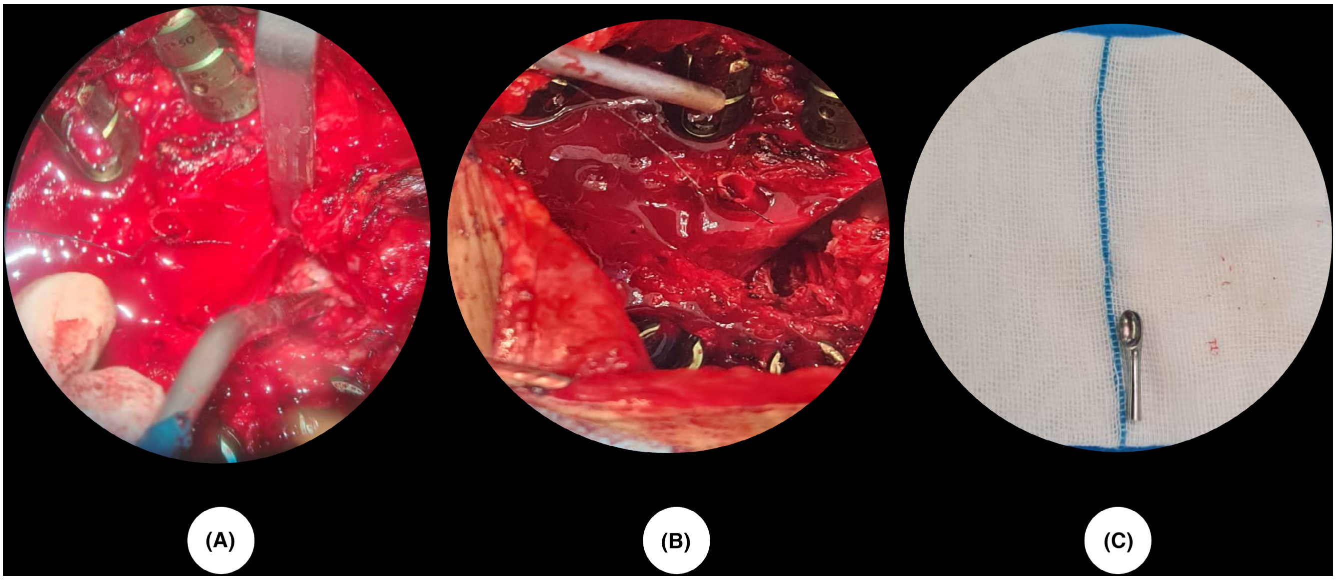

FIGURE 2 Entrapped curette tip in the stenotic lumbar spinal canal.

detecting the degree of spinal cord compression or accompanying cord edema compared to CT scan.[20] To decipher the exact cause of the neurological deficits of patients and to plan the neurosurgical procedure, obtaining both CT scan and MRI is recommended.[2] Unfortunately, we could not perform MRI due to the metal entrapment within the spinal canal. However, we confirmed the involvement of the nerves by EMG findings. Therefore, we stress that careful consideration of all differential diagnoses is mandatory before recommending an MRI for a patient. In addition, one novel approach to target immune reactions to the implants and accidentally left pieces of neurosurgical tools is to target immunological elements that mediate inflammatory processes, such as toll-like receptors (TLRs), inflammasomes, and adaptive immune system components. In silico methods may be useful for the rapid design and development of immunotherapeutics.[21–23] The alloy used in the foreign object may be important in the development of different immune reactions. Titanium alloy and stainless-steel alloy group implantation influence TLR-4 pathways and CD4 + CD25 + T^{reg}-cells in various ways. In summary, their findings support that NF-κB/p65 and NF-κB1/p50 could be valuable therapeutic targets in the prevention of harmful immune reactions to metal, particularly for alleviating inflammation following implantation. It is important in the case of metal objects, for instance, the curette tip may be made of stainless steel[24] while the implant could be made of titanium. Also, foreign objects could travel and penetrate the dura or even nerves, on the other hand, this is less likely in a properly fixed implant. Since there is a chance that both of these objects stay in the body of a patient for a long time, it is important to attempt to study the immune response and develop immunotherapies for future efforts.[25] Hypothetically, relief by targeting the immune system would be less prominent in the case of nerves being pressured by surgical tools, compared to inflammation-accentuated pain at the surgical site. These therapeutic approaches could be utilized to manage pain in such patients in addition to standard treatments. Immunoinformatics studies could help to rapidly personalize and develop immune-mediating treatments to shift the immunological profile.

The limitation of our case report is that we could not properly follow-up on whether the tip migrated, and our information on the situation of the patients during the first operation remains somewhat limited. Also, the generalizability of the findings in this case may be poor. However, we could demonstrate neurological sequelae may get progressively worse and impact day-to-day activities (e.g., urinary dysfunction), warranting surgical operation to remove the tool. This case report should be interpreted with other reports of foreign objects being trapped in the spinal canal to give a clear picture of possible clinical findings and neurological sequelae of neurosurgical tool entrapment in spinal canal stenosis.

4 | CONCLUSION

In conclusion, the present study suggests rare medical errors should be ruled out, in addition to the failure of fusion or usual surgical complications. Failure to remove the external objects may lead to different results, ranging from the fixation of the object in situ by granulomas without migration to migration or constant pain that cannot be relieved. When conducting surgical operations, the instruments should be checked for any signs of breakage or failure. Finally, the present study helps outline the neurological sequelae of entrapment of metal surgical objects in the spinal canal of patients with LSS.

AUTHOR CONTRIBUTIONS

Alireza Zali: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; supervision; validation; visualization; writing – original draft; writing – review and editing. **Bijan Herfedoust Biazar:** Methodology; project administration; supervision; validation; visualization; writing – original draft; writing – review and editing. **Kiarash Saleki:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; supervision; validation; visualization; writing – original draft; writing – review and editing. **Meisam Akhlaghdoust:** Conceptualization; data curation; formal analysis; methodology; project administration; resources; supervision; validation; visualization; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

Data is available from the corresponding author on reasonable request.

ETHICS STATEMENT

This study was approved by Functional Neurosurgery Research Center, Shohada Tajrish Neurosurgical Comprehensive Center of Excellence, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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