

Case Report

Full Endoscopic Surgery of Bullet Removal of The Spine: A Case Report

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ABSTRACT

Background: In the past decade, the endoscopic technique has been applied as a feasible and less invasive approach to orthopedic surgeries. Minimally invasive, full-endoscopic surgery has gained considerable attention in managing air gun injuries to the spine. Sacrum injuries among air gun wounds are rare and few have been published in case reports. Here, we present the management of air gun-bullet injury to the pediatric spinal spine in a 5-year-old child using endoscopic surgical intervention.

Case Report: A 5-year-old girl was accidentally shot in the lower back with an air gun. The CT scan imaging shown a retained projectile in the pedicle of S1 vertebrae without vascular injury or unstable vertebral fracture. A minimally invasive, full-endoscopic surgical technique was applied to remove the bullet in this patient. On post-surgical follow-up, the patient was in a good recovery state.

Discussion: Surgical intervention is needed for decompression, stabilization, and diminished risks of lead toxicity. The percutaneous endoscopic approach is the least invasive intervention performed to ensure a targeted approach through the anatomical openings of the spine and through intervertebral discs and bone structures, thereby further reducing spinal instability, blood loss, and infection risk.

Conclusion: The endoscopic operation of minimally invasive surgical techniques is an effective operative approach not only limited in spinal stenosis cases, but also in air gun injuries.

Keywords: Air gunshot wound; Spinal injury; Endoscopic surgery of the spine; Human and medicine

INTRODUCTION

Approximately 10 to 21 percent of spinal injuries are caused by gunshot wounds to the spine, with the majority occurring in the thoracic part, whereas bullet wound injuries to the sacrum are relatively rare. Surgical treatment should be individualized for each patient, considering factors such as nerve damage, projectile placement, stability of the spine, resulting traumas, and hemodynamic indicators.^{1,2} Percutaneous video endoscopy is the least invasive surgical technique currently employed in spinal surgery.³ With advancements in technology required for endoscopic approaches including high-definition cameras, optical elements, high-velocity burrs, and irrigation pumping systems, various endoscopic techniques can be used to perform minimally invasive spine surgeries. However, for most cases, percutaneous endoscopic interventions

were performed limited to the degenerative-dystrophic spine diseases.^{1,4}

This report presents the case of a child who was injured by an air gunshot, with the bullet implanted in the right pedicle of S1 without causing neurological injury. This report describes the capabilities of percutaneous video endoscopic intervention for bullet removal from the sacrum.

CASE REPORT

A 5-year-old girl with a bullet wound in her lower back from an air gun was referred to the orthopedic clinic. Upon admission, the patient had minimal complaint of pain in the lumbar-sacrum region of the spine without the presence of limb weakness. Initial patient history and physical examination revealed an entry wound in the lower back-near buttocks without exit wounds.



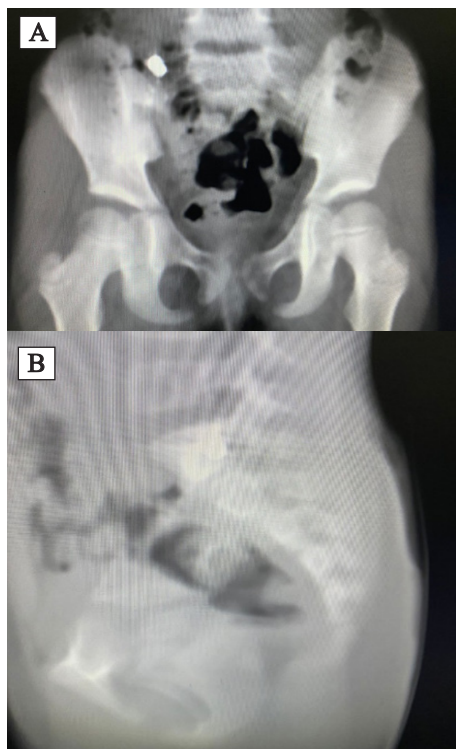


Figure 1. Anteroposterior (AP) (A) and Lateral view (B) of lumbar-sacrum radiographic examination revealed a foreign body in the S1.

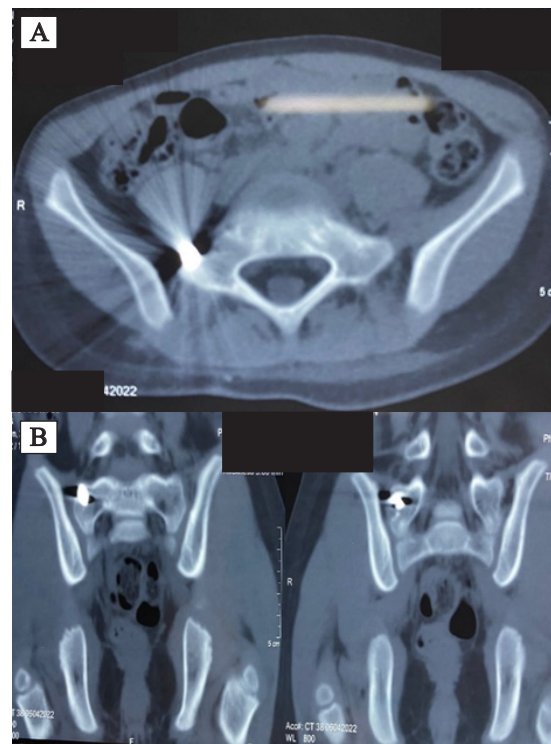


Figure 2. Axial (A) and coronal (B) view of computed tomography imaging identifying the location of the bullet at the right pedicle of the S1 vertebrae.

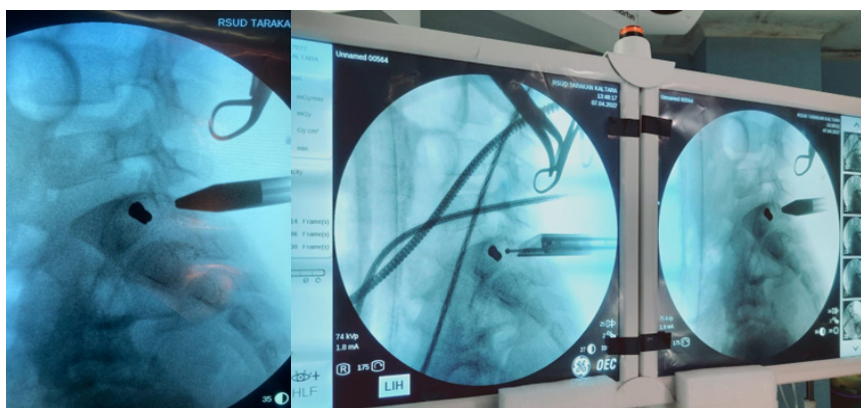


Figure 3. Intraoperative lateral fluoroscopic images before the bullet extraction

From neurological examination, there was full motor function in both lower extremities, normal sensory examination, and absence of other neurological abnormalities. Plain radiographic imaging of the lumbar-sacrum region showed a foreign body in the S1 (Figure 1A and B). Axial CT scan of the spine showed hyperdensity in the right pedicle of S1 (Streak artifact) (Figure 2).

It was decided to manage the injury with the minimally invasive, full-endoscopic approach to extract the bullet from the right pedicle of the S1 vertebrae. General anesthesia was induced and the patient was put in the prone po-

sition. Control of fluoroscopy was placed in AP and lateral views at the S1 vertebral level. An 18G needle and wire were placed above the bullet wound inlet (Figure 3). A working tube was inserted after the needle was removed, and an endoscope was inserted into the working tube. Following flavectomy, the bullet was extracted using forceps (Figure 4). The working tube and endoscope were removed after a final revision of the surgical wound. The wound on the skin was closed with an interrupted suture.

The bullet fragment, successfully extracted, was 9 mm in length and 5.5mm in width



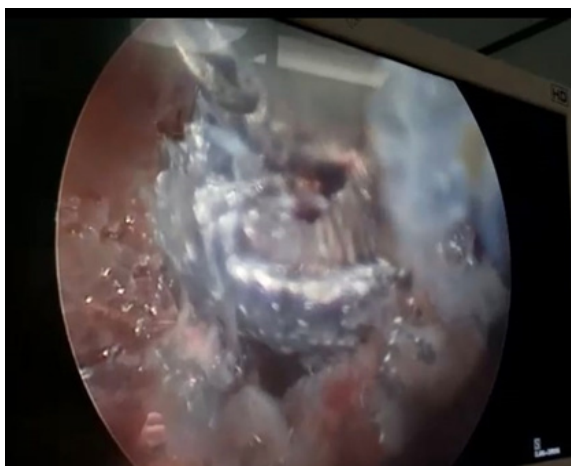


Figure 4. Bullet fragment extraction using forceps.



Figure 5. The bullet successfully extracted from the patient.

(Figure 5). The surgery lasted about 45 minutes. For postoperative observation, the patient spent one day in the hospital. At the time of discharge, the patient reported no complaints. During pre-operative and postoperative follow-up, her motor and neurological levels were on the same level.

DISCUSSION

Few sacral injuries caused by air gunshots have been documented in case reports.² In managing gunshot wounds, the surgeon must obtain the patient's history, physical examination, and imaging, with the focus on mechanical instability, neurologic abnormalities, associated injury of abdominopelvic structures, as well as final

bullet position.⁵ Sacral gunshot wounds are strongly associated with sphincter dysfunction loss and a high risk of neurologic injury.¹ The bullet removal of lumbosacral in the absence of a progressive spinal lesion is still supported by evidence. This may be due to the fact that after decompression, peripheral nerves below L1 are more responsive to recovery and have a greater capacity for regeneration.²

Surgical intervention is necessary for decompression and stabilization, regardless of spinal instability or progressive neurologic deficit. The necessity of bullet removal in uncomplicated, non-penetrating gun/air rifle wounds of the spine, particularly in the late period, remains debatable. In cervical spine injury, because of insignificant outcome of surgery, most of cases with the gunshot/air rifle wounds would be treated with conservative approaches.⁶ In the sacral spine, however, the majority of injuries are unilateral, and bowel and bladder function can be maintained if the S2 nerve root is preserved. Additionally, sexual function can also be preserved with at least one intact S3 nerve root.²

Retained bullet fragments are a concern for air rifle wounds. Lead poisoning is a late consequence of retained bullets. The majority of lead toxicity cases resulting from retained bullets are not diagnosed until the severity of the symptoms manifests.⁷ Long-term blood lead levels greater than 5 g/dl is associated with multiple adverse effects, ranging from mild symptoms such as hypertension to severe ones such as a decline in IQ and fertility problems.⁸ In this case, bullet fragment removal should be considered when calculating the benefit-to-risk ratio.⁹ Weighing the risk of lead toxicity effect, especially on child's development, is one of the main indications of performing bullet extraction in our patient.

Percutaneous video endoscopy is presently the least invasive surgical technique for spinal surgery. Endoscopes have been used for spine surgery for some time. Since the late



1980s, percutaneous endoscopic discectomy has been performed. In the early 1970s, Hijikata et al. performed the first percutaneous endoscopic disk surgery. A decade later, the nucleoscopy technique was developed by Forst et al. to visualize the intervertebral space. Following these developments, endoscopy emerged as an alternative to conventional open surgery.¹⁰

Percutaneous endoscopic discectomy is performed to decompress indirectly by removing the nucleus pulposus from the posterior one-third of the disc space.¹¹ In 1983, with a percutaneous technique developed by Kambin and Gellman, a 72 percent success rate was achieved in 136 patients. In a study conducted between 2013 and 2018 on 402 patients undergoing percutaneous endoscopic lumbar discectomy for herniated lumbar discs, the success rate was approximately 90 percent, with a substantial improvement in the VAS score and a hospital stay of approximately two days.¹²

Improved endoscopes and instruments, a benefit of minimally invasive procedure, have sparked an innovation explosion in endoscopic spine surgery. Endoscopic spine surgery has been used to treat far-lateral disc herniations, reherniations, extruded discs, spondylolisthesis, radiculopathy in the setting of instrumented fusion, discitis, discogenic back pain, and spinal tumors, among other conditions.¹¹ After the introduction and widespread use of percutaneous endoscopic techniques, successful bullet removal outcomes have been reported using this minimally invasive technique. This technique was utilized by Karaeminogullari et al. for shrapnel removal, and the patient was successfully treated without complications and sequelae.¹³

Spinal percutaneous endoscopic interventions enable a focused approach to a surgical goal through anatomical spaces of the vertebral segments (interlaminar space, intervertebral foramen) in addition to intervertebral discs and bone structures.¹⁴ These interventions substan-

tially reduce the risk of infection and subsequent complications.¹⁵ Wong et al. reported that surgical endoscopic approach leads to less blood loss and faster recovery compared to open surgery. These techniques reduce the risks associated with conventional surgery, such as In addition to avoiding destabilization, excessive blood loss, large incisions, and an increased risk of infection, these procedures result in a shorter hospital stay and an earlier return to daily activities.¹⁶ In our patient, the endoscopic spinal surgery approach provided a short duration of post-operative in-hospital admission and a satisfactory outcome.

CONCLUSION

To our best knowledge, this is the first reported case of sacrum bullet removal performed with the endoscopic surgery approach in Indonesia. Our case is unique because of the rare sacral location of the air gunshot wound and the use of minimally invasive surgical techniques performed. Our case report may prove the effectiveness of minimally invasive surgical techniques, not only limited to degenerative-dystrophic spinal diseases, but as an effective alternative to traditional approaches for air gunshot injuries.

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