

Removal Technique of Penetrating Nail in Head: A Case Report

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Abstract

Objective: To present a unique case involving a 44-year-old man who sustained a penetrating head injury after nailing his head with a hammer. Despite the severity of his injury, the patient underwent successful surgical treatment and experienced a good recovery.

Methods: Clinical and imagery review was performed on a cranial puncture trauma caused by a metal nail, which penetrated the cranium, dura mater, right parietal cerebral parenchyma, and right ventricle. The nail was lodging next to midline without damaging the superior sagittal sinus. The patient underwent craniotomy nail removal and debridement with normal saline and metronidazole antibiotics.

Results: Craniotomy, careful nail extraction, wound debridement, and duraplasty remain the treatment standard for penetrating nail injury in the head. Patient in this case study did not exhibit any signs of neurologic deficit or infection.

Conclusion: Proper diagnosis and treatment are required in patients with penetrating brain trauma, with head x-rays and CT scans help in evaluating vascular depth and damage. Craniotomy and debridement are the main treatments for this type of trauma.

Keywords: Nails, head injury, surgery

Introduction

Since the 1980s, the use of nail guns has become widespread due to their efficiency in increasing productivity. However, their usage has also been associated with a rise in injury incidents. According to reports, there were approximately 5,000 cases of injuries caused by pneumatic nail guns per year in the United States between 1991 and 1993. This number significantly increased to as much as 15,000 cases per year from 2001 to 2003. Penetrated brain injury is a challenge in the case of brain surgery because this trauma can cause damage to the blood vessels of the brain. Complications arising from this condition may involve bleeding and thrombosis, both of which can cause additional neurological deficits, such as paresis or seizures. Furthermore, in cases where the bleeding or infarct is extensive, there may be an increase in intracranial pressure leading to further complications. Cases of nail

injuries have a better prognosis than cases of penetrated brain injury by a knife or bullet. The surgical procedure to remove the nail not only addresses the physical trauma but also serves as a means to prevent potential infections, such as meningitis or encephalitis, which can have severe consequences. Ideally, surgery for penetrating brain injuries should be conducted within 12 hours, especially in cases where there are no signs of mass effect or active bleeding. Therefore comprehensive treatment and follow-up care are essential for ensuring the best possible outcome.^{1,2}

In general, surgical treatment for penetrating brain injury primarily focuses on treating mass effect and decreasing the risk of infectious complications. Small entrance wounds to the scalp and skull can be managed with local wound care, but larger or more complex injuries may require extensive debridement with subsequent primary closure or grafting to achieve a watertight closure.

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Routine removal of small bone and missile fragments is not recommended due to the associated high morbidity. Delayed removal of contaminated foreign bodies like wood has been linked to higher rates of complications compared to immediate surgical intervention. People with psychiatric disorders such as schizophrenia and major depressive disorder have been associated with previous cases of intracranial nail gun injuries. It is therefore recommended that psychiatric services be involved in the diagnosis and management of any suicide attempt survivors during and after their injury treatment. This underscores the importance of ongoing mental health maintenance and follow-up.³³

Case

A 44-year-old man came with his family to the ER with nailing his head with a hammer. The patient is conscious but complains of headaches and hallucinations. A head CT-

scan was performed, resulting in an elongated metallic foreign body with a defect in the right parietal bone penetrating through the right parietal lobe and right ventricle (Fig. 1). On blood examination, there was leukocytosis (19.18 thousand/uL), with dominant neutrophils (76.9%).

The patient had a history of trauma from falling two years ago during a flood that caused the patient to suffer brain contusion. At that time the patient complained of headache, without neurological deficit. The patient was treated at the stroke center for 3 days and then moved to the inpatient room for one week. After returning from the hospital the patient is still working. But in the next 1 month, the patient's family complains of changes in the patient's attitude, mood, and memories that often repeat themselves. The patient also had attempt to kill himself by slashing his hand because he heard whispers. The patient routinely controls to psychiatric with diagnosis organic mental disorder, he had

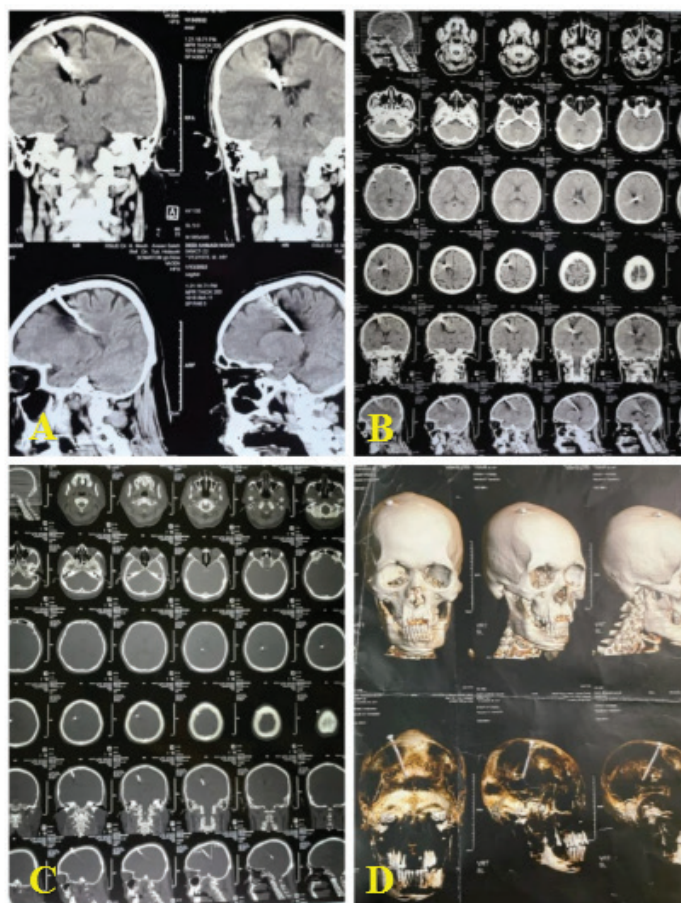


Fig. 1 Patient Head CT Scan Pre-Operation (A-D)



Fig. 2 Durante Operation Pictures (A-E). The nail and bone has been extracted (A). Design of the incision with lazy s incision and play close attention to superior sagittal sinus (B). Craniotomy around the nail perimeter (C). The nail track was debrided and control bleeding (D-E).

total mini mental status examination (MMSE) score was 23 with the impression of moderate cognitive-dementia impairment. The patient also did a clock drawing test (CDT) and could only draw a closed circle.

The operation was performed 12 hours after the patient was pierced by the nail. Prior the surgery, the patient received broad-spectrum antibiotics, Ceftriaxone IV 2x1 gr, anticonvulsants phenytoin IV 3x100 mg, tetanus immunoglobulin IM 250 IU and tetanus toxoid IM 0.5 ml.

The patient was placed in the supine position under general anesthesia with endotracheal intubation. The patient's hair was shaved and then treated with antiseptic with povidone-iodine, and the operating field was narrowed with a sterile dressing. Marking was done in the operating area followed by making a lazy S incision up to the cranium. After that,

a retractor was placed on the skin and a 2 cm en block craniotomy was performed around the nail perimeter by avoiding the superior sagittal sinus. Cranium is lifted along with the nail (Fig. 2).

The nail track was evaluated, debrided, washed with normal saline around the nail track, and flushed with metronidazole into the track. Evaluate bleeding, and control bleeding with a hemostatic sponge. Then proceed with duraplasty. The operation was completed and a head CT scan post operation was performed (Fig. 3).

After the operation, the patient immediately regained consciousness. The patient was treated for 2 days in the intensive care unit (ICU). Postoperative head CT scan results showed a post-puncture intracranial wound with intracerebral hemorrhage and perifocal vasogenic edema (Fig. 3). The patient went

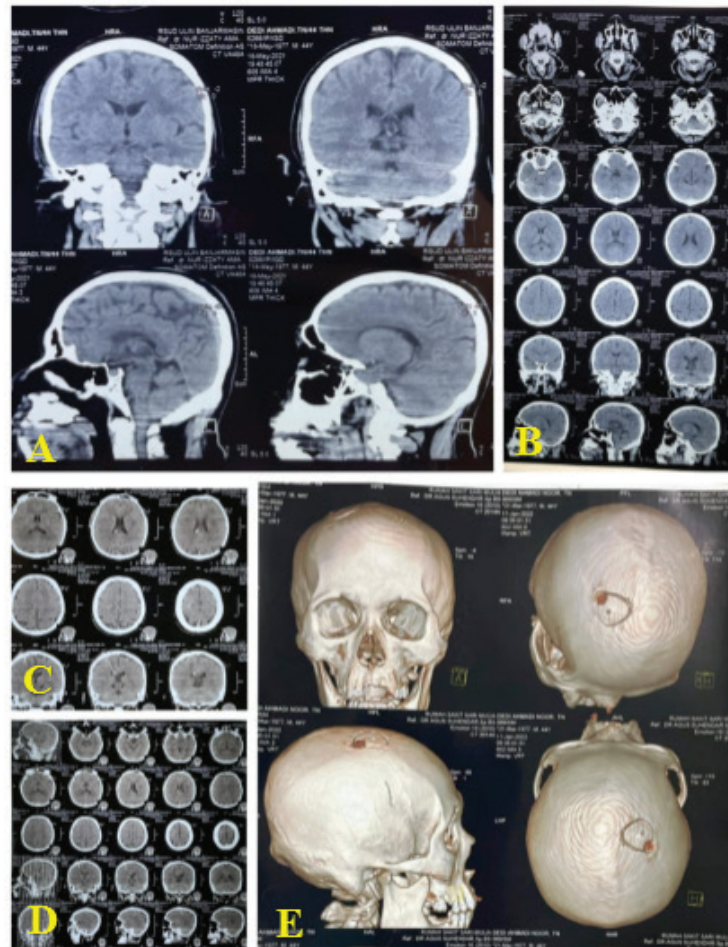


Fig. 3 Patient Head CT Scan Post Operation (A-E)

home after undergoing 11 days of treatment at the hospital. He had no complained of seizure neither tetanus nor meningitis. The patient was on leave from work for 3 months and continued treatment at the psychiatric department.

Discussion

Head trauma due to foreign body penetration is less common than closed head trauma but has a worse prognosis.¹ Penetrating head trauma can be classified as a missile or non-missile injury. The difference between a missile and a non-missile is, missile trauma has velocities of more than 100 m/s causing damage by heat and kinetic trauma. Missile trauma has worse morbidity and mortality. Non-missile trauma has a lower velocity and usually causes tissue laceration and maceration. Although non-missile trauma is less common this trauma has

a better prognosis and effect on treatment.³ Non-missile trauma is usually caused by accidents, crimes, and attempted suicides. In this case, the patient had non-missile trauma caused by attempted suicide. According to the literature in developing countries, it is reported that there are many nail penetration traumas with the intention of suicide.⁴

Diagnosing brain trauma requires a detailed history, physical examination, and investigations. X-ray photos are useful for diagnosing trauma caused by metal materials. Investigations with head CT scans are useful for evaluating foreign bodies and predicting the depth of foreign bodies, besides that, a head CT scans can be useful for monitoring postoperative complications. MRI examination is very limited for diagnosing metallic foreign bodies because of the ferrous content of the metallic material. CT angiography is usually performed in cases of penetrating trauma to

look for vascular complications.^{5,6} In this case, CT angiography was not performed due to limited facilities at our center.

Craniotomy remains the preferred method of neurosurgical treatment for penetrating foreign body injuries, as it is associated with fewer complications compared to blind removal. Reports indicate that blind removal of foreign bodies can result in subdural hematoma and intraparenchymal hemorrhages. To ensure safe removal, the craniotomy should be performed around the area where the foreign body entered. Bone fragments should also be removed with the aid of brain navigation if required, and the area should be thoroughly cleaned to prevent brain abscess formation.⁷

The operations performed are aimed at removing the foreign body as soon as possible, removing bone fragments, focal debridement of nail track, decompression of neovascular structures, hemostasis, and duramater repair.⁸ In this case, nails were taken and debridement was performed using normal saline and metronidazole antibiotics. After confirming that there was no bleeding, a duraplasty was performed to prevent cerebral fistula.

There is no specific antibiotic for the treatment of penetrating trauma caused by nail. Our treatment was immediate and identical to the of several similar case reports. Broad spectrum antibiotic therapy, vaccination, craniotomy, careful nail extraction, wound debridement, and duraplasty was performed. Complications such as meningitis and cerebral abscess increase in patients with penetrating brain trauma due to contamination with foreign bodies, skin, and bone fragments carried by the brain parenchyma along the wound track.^{9,10} *Staphylococcus aureus* and gram-negative bacteria have been reported to be associated with secondary infections.³

Recent guidelines recommend using ceftriaxone, metronidazole, or vancomycin for 7-14 days in cases like our patient. However, some sources argue that antibiotics should not be used as a preventative measure unless there is a known bacterial source or a specific clinical need. At present, there is limited high-quality evidence from randomized controlled trials to guide treatment, indicating the need for further research in this area. In our case, we used ceftriaxone and metronidazole as therapeutic. Antibiotics were continued for up to 2 weeks postoperatively.¹¹

The prognosis for patients with penetrating brain trauma is usually good if the cerebral vessels and brainstem are not involved. In this case, a good outcome was obtained in the patient because it did not involve blood vessels and brainstem.² Whether antiepileptic drugs should be used to prevent seizures after penetrating traumatic brain injury remains a controversial issue. Early seizures (within 1 week of injury) occur in 6 to 10% of cases, and this percentage can increase to 53% in those with penetrating head injury. The surgical critical care guidelines committee issued a set of recommendations in 2017 that suggest ant seizure prophylaxis should only be given to patients with severe TBI, such as those with a brain contusion, intracranial hematoma, loss of consciousness, posttraumatic amnesia for more than 24 hours, or a GCS score of 3 to 8.¹² The patient did not complain of headaches or seizures when he was discharged. Late seizure cannot be evaluated because the patient died because of kidney and heart failure 9 months. There still no research study reported the rate of tetanus incidence in penetrating brain injury and the tetanus prophylaxis, in this patient we administer tetanus prophylaxis for prevention measures.

References

1. Wang SH, Chen MY, Yan JL, Huang TY, Chang CC, Chien CY. Survival after multiple nail gun injuries to the brain, lung, and heart: a case report and a review of the literature. *J Int Med Res.* 2021;49(10):3000605211049923. doi:10.1177/03000605211049923.
2. Arham A, Zaragita N. Penetrating injury of superior sagittal sinus. *Asian J Neurosurg.* 2021;16(01):132-5.
3. Zhu RC, Yoshida MC, Kopp M, Lin N. Treatment of a self-inflicted intracranial nail gun injury. *BMJ Case Rep.* 2021;14(1):e237122.
4. Fahde Y, Laghmari M, Skoumi M. Penetrating head trauma: 03 rare cases and literature review. *Pan Afr Med J.* 2017;28:305.
5. Wu R, Ye Y, Liu C, Yang C, Qin H. Management of penetrating brain injury caused by a nail gun: three case reports and literature review. *World Neurosurg.* 2018;112:143-7.
6. Zyck S, Toshkezi G, Krishnamurthy S, Carter

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- DA, Siddiqui A, Hazama A, et al. Treatment of penetrating nonmissile traumatic brain injury. case series and review of the literature. *World Neurosurg.* 2016;91:297–307.
7. Ferraz VR, Aguiar GB, Vitorino-Araujo JL, Badke GL, Veiga JCE. Management of a low-energy penetrating brain injury caused by a nail. *Case Rep Neurol Med.* 2016;2016:1–4.
 8. Pniel D, Withers TK. A case of multiple nail gun injuries to the head and one to the heart. *Surg Neurol Int.* 2018;9:221.
 9. Miki K, Natori Y, Kai Y, Mori M, Yamada T, Noguchi N. How to remove a penetrating intracranial large nail. *World Neurosurg.* 2019;127:442–5.
 10. Yuh SJ, Alaqeel A. Ten self-inflicted intracranial penetrating nail gun injuries. *Neurosciences.* 2015;20(3):267–70.
 11. Hoey A, Troy C, Bauerle W, Xia A, Hoey B. Delayed-onset seizures following self-inflicted nail gun injury to the head: a case report and literature review. *J Neurol Surg Rep.* 2022;83(02):e54–62.
 12. Rojas K, Birrer K. Seizure Prophylaxis In Patients With Traumatic Brain Injury (TBI). Department of Surgical Education, Orlando Regional Medical Center. Published 2017. Available from: <http://www.surgicalcriticalcare.net/Guidelines/Seizure%20prophylaxis%20in%20TBI%202017.pdf>.