

Abstract

Objectives: This case report will illustrate successful endovascular and surgical management of a penetrating metal rebar injury involving the neck, skull base, and temporal lobe. Proximal and distal hemostatic control of the jugular bulb are also discussed.

Methods: A 22 year old male suffered a penetrating neck injury after falling on a piece of steel rebar. Physical exam and CT imaging revealed the rebar entered zone II of the neck, extended through the left jugular foramen into the cranial vault.

Results: Angiography revealed possible damage to the jugular bulb, directing further evaluation of the jugular vein and sigmoid sinus via mastoidectomy/infratemporal fossa approach. A temporoparietal frontal craniectomy allowed for direct control of the superior limit of the rebar, which was then successfully removed. At one year followup cranial nerve function was intact but the patient does suffer periodic seizures.

Conclusions: Penetrating zone II neck trauma extending through the jugular foramen can be successfully managed with a combined endovascular and mastoidectomy/infratemporal fossa approach.

Case Report

A 22 year old male construction worker fell approximately 12 feet off a ladder and onto a piece of vertically oriented metal rebar. The patient was found by his coworkers on his feet, bent over with the rebar, and conversational, with the metal rod entering his neck just beneath his left mandible. No exit wound was visible.

Paramedics and were called the scene, and together with the patient's coworkers cut the piece of rebar from its concrete foundation, taking over an hour. During the course of freeing the rebar and waiting for AirCare transport, the patient became more combative and eventually stopped following commands. Once in the air, AirCare paramedics intubated the patient due to a GCS of 6 and combativeness. En route to the hospital the patient developed a Cushing response with elevated systolic blood pressures to the 180s and bradycardia to the 40s, and subsequently was given mannitol.

On arrival at the ER, CT scans of the head and neck showed the rod pierced the skull base through the left jugular foramen, causing hemorrhage and occluding blood flow through the left jugular vein. The patient was emergently rushed to the OR, where a ventriculostomy was placed revealing elevated ICPs. Angiography was then performed via injection through the left jugular vein, confirming extravasation of contrast. At that time a SynchroSoft and SL10 microcatheter were used to embolize the left sigmoid sinus, jugular bulb, and distal segment of the left jugular vein using coils and Onyx.

Next a temporoparietal frontal craniectomy was performed for elevated ICP, as well as to evacuate the intraparenchymal hematoma and directly control the distal end of the rebar. A mastoidectomy/infratemporal fossa approach to the neck and skull base allowed for ligation of the sigmoid sinus and jugular vein, exposure of the lower cranial nerves, and exposure of the rebar traversing the jugular foramen.

Once the entire area was exposed, the rebar was removed from the skull base via gentle traction from below. A small amount of bleeding was noted from the defect created by the rebar, easily controlled with FloSeal and OxyCel. The mastoid antrum was packed with muscle and fat taken from the Wound to prevent CSF leak, and the wound was closed in multiple layers with a drain left in place. The patient was then transferred to the SICU intubated but in stable condition.

The patient's post surgical course was defined by IV antibiotics and epileptic prophylaxis via levetiracetam. The patient was febrile for the first week up to 39.2, however intra-cerebral cultures failed to show growth. By POD#7 the patient was responding appropriately to commands, and he was discharged on POD#17. His follow up course was complicated by extra-axial CSF collection around the hemicraniectomy site due to communicating hydrocephalus ex-vacuo, requiring placement of a ventriculoperitoneal shunt. At one year follow up, the patient suffers from periodic seizures, as well as right homonymous hemianopia and self reported cognitive slowing. The patient's lower cranial nerve, facial nerve, and vestibular and auditory function remained intact bilaterally.

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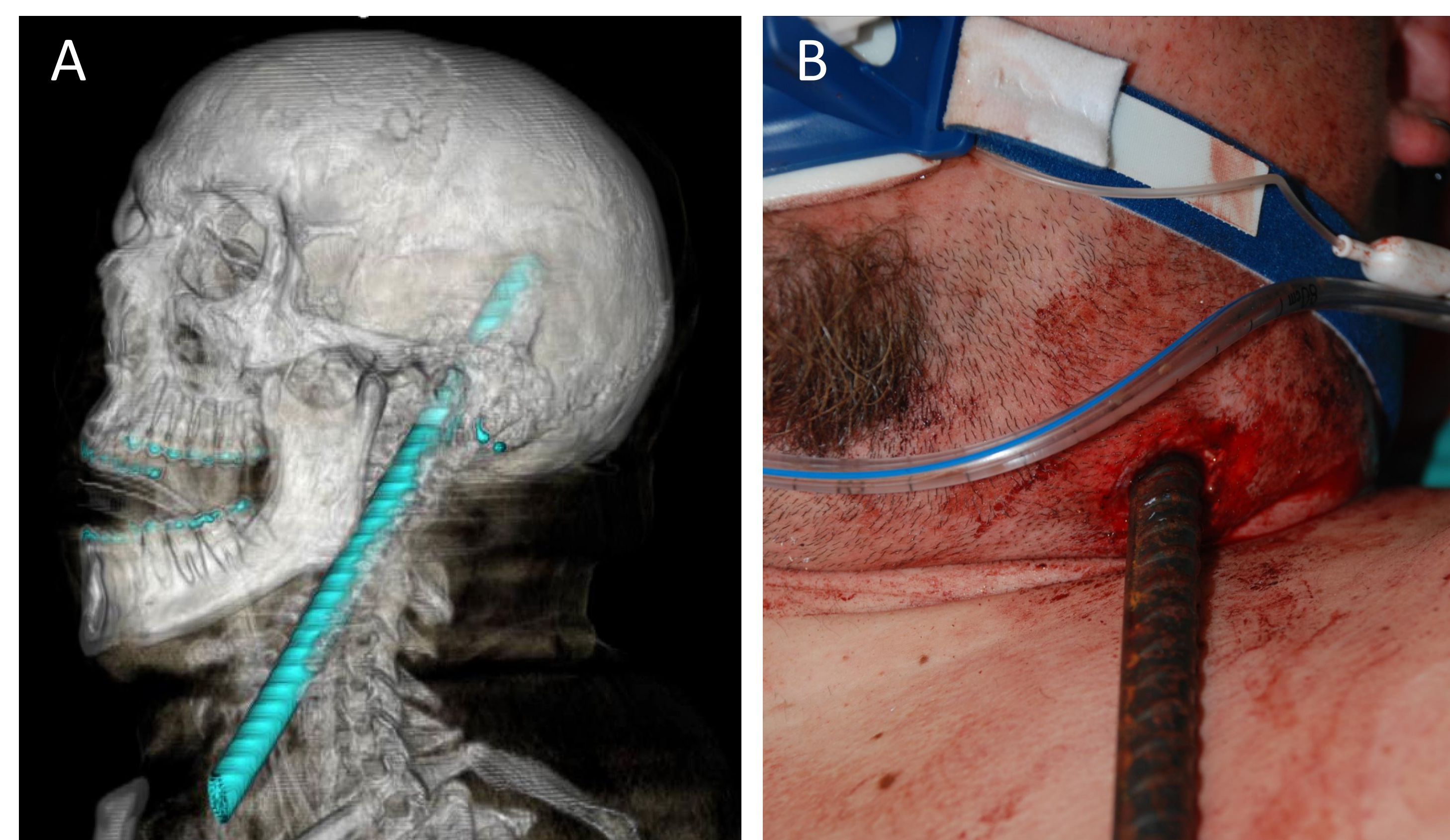


Figure 1. A) CT 3D reconstruction of metal rebar piercing left level II into the skull base; B) Pre-op photo illustrating entrance site of rebar

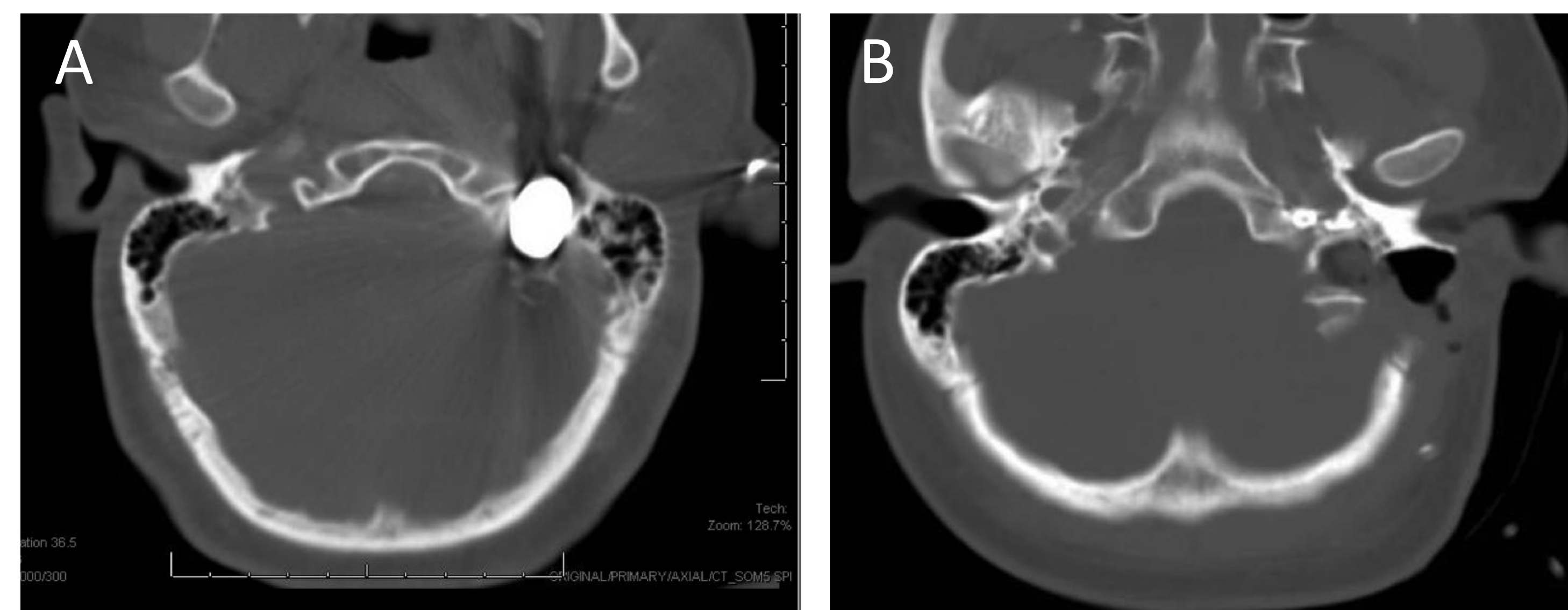


Figure 2. A) Pre- and B) post-operative CT imaging of the skull base, illustrating the lumen of the jugular foramen both with the rebar as well as after removal

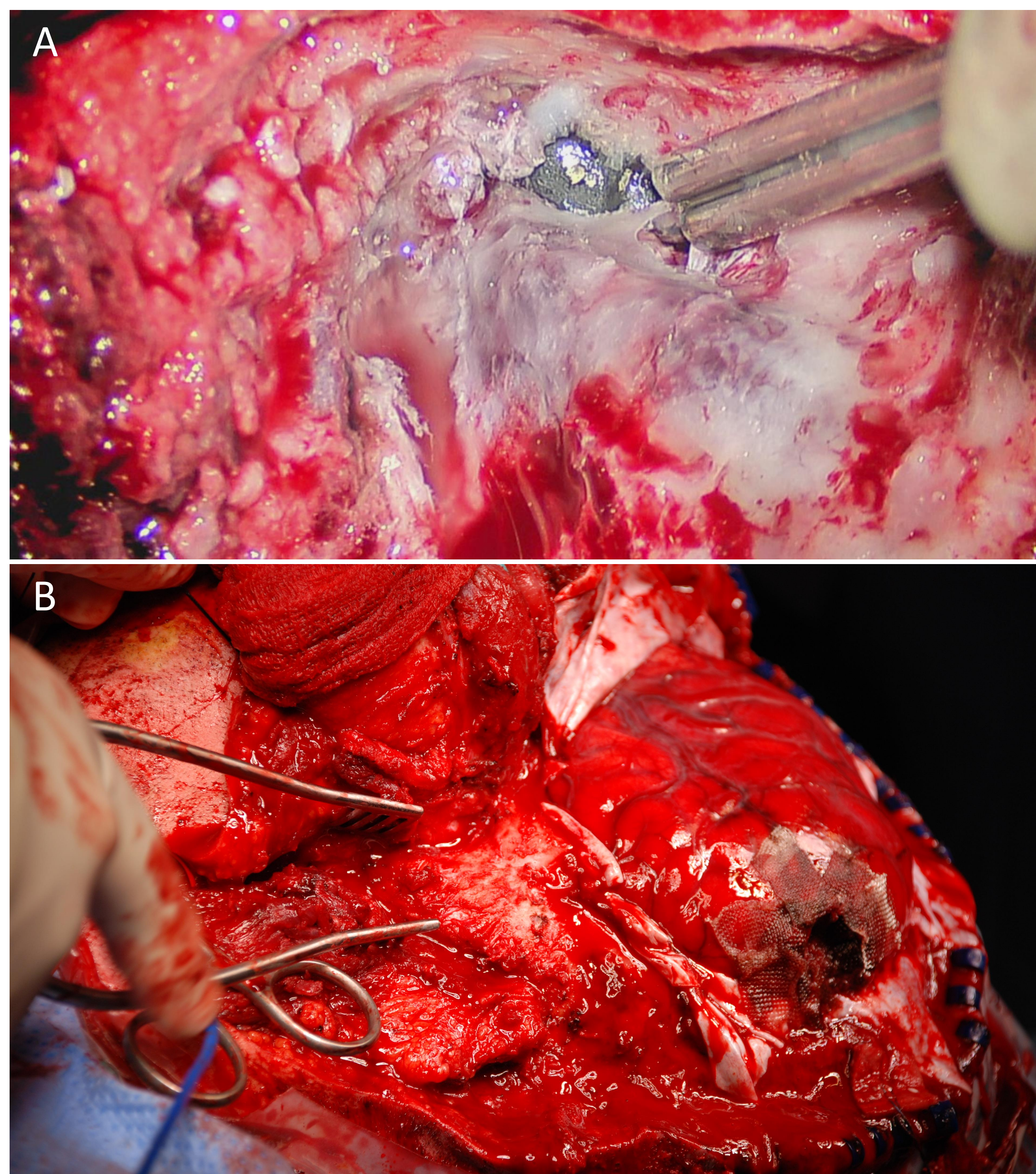


Figure 3. A) Exposure of the jugular foramen revealing the penetrating rebar at the level of the sigmoid and transverse sinuses; B) Hemicraniectomy, retrosigmoid approach, with corticectomy of the parietal lobe for hematoma evacuation and direct visualization of the rebar prior to removal.

Discussion

Clinical Findings Localizing Jugular Foramen Trauma

During primary evaluation, patients with skull base injuries may not have such obvious entrance wounds. Even in the presented case, the true extent of the injury was not immediately known. Specific constellations of cranial nerve deficits can be used to localize the damage prior to imaging evaluation. Vernet's syndrome (jugular foramen syndrome) is a constellation of deficits due to compromise of the cranial nerves IX, X, and XI as they pass through the jugular foramen. [1]

Patients classically present 1) difficulty swallowing; 2) paralysis of the soft palate with decreased pharyngeal sensation; 3) loss of taste on the posterior 1/3 of the tongue; 4) altered voice secondary to unilateral vocal cord paralysis; 5) paralysis of SCM and trapezius muscles.[2] Intracranial tumors are more often the cause of Vernet's syndrome, however penetrating skull base trauma such as this case can cause the same effects.

Imaging of Skull Base Trauma

Penetrating injuries to the skull base often pass through cranial foramina as such openings offer a path of least resistance. Because of the numerous vessels coursing the same foramina, vascular injury should be ruled out during operative planning. In agreement with previously published imaging protocols concerning penetrating head injuries, we utilized both CT with 3D reconstruction and angiography.[3] The CT scan was instrumental in evaluating the extent of the injury, giving timely, detailed information on the bony landmarks as well as intracranial extension of the rebar.

Once the entrance through the left jugular foramen was identified, angiography was essential in evaluating vascular integrity.[4] At our institution endovascular procedures are performed by the Neurosurgery team, which allowed diagnostic imaging of the patient's vascular compromise to immediately progress to timely therapeutic interventions via embolization, followed by the craniectomy and mastoidectomy.

Distal and Proximal Exposure and Control

Whether small and sharp or large and blunt, previous publications promote the benefits of exposing and controlling both the proximal and distal ends of the foreign body prior to extirpation. Direct visualization allows for careful, guided disimpaction to best spare the delicate nervous and vascular skull base structures from further trauma.[5, 6]

Another reason to obtain direct intra-cranial view of foreign bodies is for management of the bleeding that often follows foreign body removal. In our case, the defect to the jugular foramen left behind after removal of the rebar required additional hemostatic agents. We uniquely took additional steps to ensure hemostasis by both ligating the extra-cranial internal jugular vein, as well as embolizing the sigmoid and transverse sinuses before any other interventions were attempted.

Conclusion

- A unique case of penetrating trauma to the neck and skull base was successfully treated by a combined, team approach between neurosurgery and otolaryngology
- Imaging via CT of the head and neck with 3D reconstruction, combined with angiography provided essential information on the extent of the injury to the neck, skull base, and cerebrum
- Direct visualization and control of both the distal and proximal ends of the retained foreign body minimized collateral damage to surrounding tissues during removal

References

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