



Minimally invasive treatment of transorbital penetrating injury of skull base and cavernous sinus – A case report

Minimalno invazivno lečenje penetrantne transorbitalne povrede baze lobanje i kavernoznog sinusa

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Abstract

Introduction. A transorbital intracranial injury with a foreign body can be a very complex and controversial therapeutic problem. The orbit's content is susceptible to penetrating trauma, and neurovascular skull base structures are at high risk from injury. There are some traditional cranial surgical approaches and more recently reported different endoscopic approaches for treating this kind of injury. **Case report.** We presented a case of a 30-year-old male who had an accident at work when a piece of wood hit him in his head and entered through the medial aspect of his left orbit with skull base and cavernous sinus injury. Rapid and complete radiological and clinical assessments were performed, and the patient was treated in a minimally invasive manner. The foreign body was manually extracted with an endoscopic and endovascular team ready to treat adverse events. No postoperative complications were reported, and visual acuity increased at the one-month follow-up. **Conclusion.** Penetrating wounds of the orbit represent a challenge that requires a multidisciplinary assessment and well-organized management. Combined endoscopic minimally invasive approaches should be considered during the treatment of this kind of injury.

Key words:

decompression, surgical; head injuries, penetrating; minimally invasive surgical procedures; neurosurgical procedures.

Apstrakt

Uvod. Transorbitalna intrakranijalna povreda stranim telom predstavlja veoma složen i kontroverzan terapijski problem. Sadržaj očne duplje je podložan penetrantnim povredama, a postoji i veliki rizik od povreda neurovaskularnih struktura baze lobanje. Postoje tradicionalni transkranijalni hirurški pristupi, ali se u skorije vreme sve više koriste različiti endoskopski pristupi pri tretiranju tih povreda. **Prikaz bolesnika.** Prikazan je tridesetogodišnji muškarac koji je, na radnom mestu, zadobio penetrantnu povredu leve očne duplje komadom drveta što je dovelo do povrede baze lobanje i kavernoznog sinusa. Posle kliničkog pregleda, brze i kompletne radiološke dijagnostike i sprovedene procene, pacijent je zbrinut minimalno invazivnom metodom. Strano telo je ručno izvađeno uz pripravan endoskopski i endovaskularni tim za lečenje mogućeg pogoršanja stanja i komplikacija. Do komplikacija nije došlo, a na kontrolnom pregledu mesec dana po otpustu ustanovljeno je poboljšanje oštrine vida pacijenta. **Zaključak.** Penetrantne povrede očne duplje predstavljaju izazov koji zahteva multidisciplinarni i dobro organizovan pristup lečenju. Trebalo bi uvek razmotriti kombinovni, minimalno invazivni endoskopski tretman ovakvih povreda.

Ključne reči:

dekompresija, hirurška; glava, penetrantne povrede; hirurgija, minimalno invazivne procedure; neurohirurške procedure.

Introduction

Transorbital penetrating injuries present a significant threat not only to orbital but also major skull base vascu-

lar structures and cranial nerves. This type of injury represents a small portion of all head injuries; however, they make up 24% of penetrating head injuries in adults and 45% in children ^{1, 2}. The penetrating injury and foreign

body of the orbit can be followed by traumatic optic neuropathy presented by partial or complete loss of visual function. The extent of cerebral and skull base injuries is related mainly to the size, shape, trajectory, and velocity of the penetrating object and orbital bone anatomy. Some injuries may be occult with a smaller foreign object and entry wound, and the foreign body itself may be composed of different materials.

Computed tomography (CT) is most frequently used to assess head injuries, mainly because of the need for rapid diagnosis and potential metal foreign material in this kind of trauma^{3,4}. The local physical, neurological, and ophthalmic examination must be performed before and after any treatment.

The aims of the treatment are to remove the foreign body while preserving the orbital content. Reconstruction of the skull base relationships, if required, is mandatory with as little secondary injury as possible⁵. Recovery and the functional outcome depend on many factors, the time elapsed after the injury being one of the most important⁶. The range of potential delayed intracranial complications from penetrating orbital injuries is rather broad and includes meningitis, encephalitis, pyogenic abscess, cerebrospinal fluid leakage, traumatic pseudoaneurysm, or carotid-cavernous fistula⁷.

We reported successful extraction of wooden foreign body from the orbit with skull base and cavernous sinus injury.

Case report

A 30-year-old male was admitted to the Emergency Department after an accidental work injury when a piece of wood hit him in his head, in the region of the superior eyelid. It entered into the medial aspect of his left orbit and became wedged with a massive part visible outside (Figure 1). He was admitted within one hour after the injury, completely conscious, with a Glasgow Coma Scale score of 15/15. Vision, light reflex, as well as all bulbomotor functions in the left eye were lost. No cornea, lens, or posterior segment damage of the eyeball was present. The numbness into the ipsilateral V1 region was present, and the rest of the cranial nerves were normal. Other than the entry wound, there were no signs of injury or bleeding. A non-contrast-enhanced CT scan revealed a hypodense foreign body localized along the axis of the orbit, between the superior rectus, medial rectus muscles, and the optic nerve. The tip of this piece of wood penetrated the skull base and entered into the anterior part of the cavernous sinus (Figure 2). A CT angiogram showed no carotid injury, but there were some air bubbles into the cavernous sinus itself.

The multidisciplinary team proposed manual extraction of the foreign body in general anesthesia, with the tip of it gently detached from the cavernous sinus and pointed away – towards the lateral and caudal side during the extraction process. The immediate postoperative course was uneventful, and the patient was placed on high-dose steroids for optic



Fig. 1 – Computed tomography reconstruction of patient initial appearance with wooden foreign body penetrated into the left orbit (anatomical view).



Fig. 2 – Preoperative axial computed tomography scan reveals tip of the foreign body (asterisk) in the anterior part of cavernous sinus with some air bubbles consequently in it (arrow).

nerve protection as well as prophylactic antibiotics for three weeks. A control CT scan revealed no significant bleeding and secondary injury (Figure 3). The patient was discharged home three weeks after the surgery. The left pupil remained



Fig. 3 – Postoperative axial computed tomography scan demonstrates complete decompression of the orbit and no additional intracranial hemorrhage in the region of cavernous sinus (arrows).

nonreactive to light, and facial numbness resolved completely. Visual acuity improved, and all bulbomotors regained their function at the one-month follow-up with a good local cosmetic result.

Discussion

Penetrating transorbital injury always represents a complex and controversial therapeutic problem that requires a thorough patient condition assessment. These injuries often lead to severe consequences, and complications can occur if appropriate surgical intervention is not performed. Traumatic optic neuropathy is one of the most important ophthalmic

emergencies, and recovery success depends on the rapid treatment of optic nerve injury and decompression within 8 hours^{8,9}. Standard skull and facial radiographs are not sufficient, and CT studies should include dedicated axial, coronal, and sagittal images. Fractures can be absent when the natural skull base foramina are transversed. The role of angiography is not to be underestimated before the treatment because it is essential to assess the extent of the injury and rule out carotid dissection, traumatic pseudoaneurysm, cavernous sinus thrombosis, or carotid-cavernous fistula¹⁰.

Some traditional and rather extensive cranial approaches to posterior orbit have been described in the literature, and in the last decade, the role of endoscopy in treating the anterior cranial fossa and skull base pathology is continuously evolving^{11,12}. Our multidisciplinary team from neurosurgery, interventional neuroradiology, anesthesiology, maxillofacial surgery, and ophthalmology planned the best and the least invasive way to extract the foreign body¹³. There were two main solutions to this problem. The first is pterional craniotomy and direct microsurgical control of the cavernous sinus and potential carotid injury during extraction. The second is manual extraction itself and, if needed, subsequent endoscopic examination with local tamponade of the wound. Angio suite was prepared for fast access and endovascular carotid control in case of uncontrolled bleeding during an actual treatment^{14,15}. The endoscope inserted through the wound or additional surgical incision offers good exposure of the orbit and all anterior skull base region, with the possibility of angled vision to important neurovascular structures¹⁶.

Conclusion

Surgical removal of penetrating orbital foreign bodies is a classic example of an interdisciplinary therapeutic approach, where the best outcome is usually the result of rapid intervention and assessing the best approach. Combined endoscopic minimally invasive approaches should be considered during the treatment of this kind of injury.

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