ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXVI | No. 4 December 2022

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DOI: 10.33962/roneuro-2022-082

Romanian Neurosurgery (2022) XXXVI (4): pp. 456-459
DOI: 10.33962/roneuro-2022-082
www.journals.lapub.co.uk/index.php/roneurosurgery

Penetrating head injury caused by a screwdriver. A case report

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Abstract

Background: Penetrating head injuries (PHI) caused by sharp objects are associated with a high risk of potentially life-threatening complications and are estimated to account for approximately 0.4% of all head injuries. Since not many cases of PHI with a screwdriver have been described in the literature, the treatment of these patients is quite controversial and non-standardized. Therefore, the aim of this paper was to present our experience with treating a patient with a PHI caused by a screwdriver.

Case description: The authors present a three-year-old female patient who accidentally sustained a PHI with a screwdriver through the right orbit. A computed tomography scan of the head was performed, which demonstrated the presence of the metal end of a screwdriver in the anterior cranial fossa. The patient underwent emergency surgery and the foreign body was evacuated with the repair of dura and brain injury. The intervention was followed by a complete postoperative recovery without any gross neurological deficits. Follow-up examinations were performed up to three years after the injury, while the patient's condition remained unchanged. Our patient's case supports immediate neurosurgical intervention and removal of a foreign object from the endocranium.

Keywords
craniocerebral trauma, craniotomy, paediatric brain injury, penetrating head injury

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Introduction

Penetrating head injuries (PHI) of non-missile origin caused by sharp objects are associated with a high risk of potentially life-threatening complications and are estimated to account for 0.4% of all head injuries (3). Areas with cranial openings and with a thinner bone, such as the orbit and the squamous portion of the temporal bone, are more susceptible to penetrating injuries caused by sharp objects (2). However, these injuries constitute only a small number in the pediatric population and the transorbital localization of PHI has been reported in about 45% of pediatric cases, while it occurs in 25% of adult PHI cases (1,6).

Although penetrating head injuries caused by a screwdriver are rare, these injuries should not be neglected due to the length of the screwdriver and the spiral force, as well as the fact that the metal end of the tool can rotate in the skull and cause serious trauma. Moreover,

ISSN online 2344-4959
© Romanian Society of Neurosurgery

First published
December 2022 by
London Academic Publishing
www.lapub.co.uk

the superficial skin wound does not correspond to the severity of intracranial trauma, so the extent of trauma can be easily overlooked (10). These injuries may be accompanied by rare contrecoup lesions and radiating skull fractures, depending on the dimensions of the screwdriver (8).

Since not many cases of PHI with a screwdriver have been described in the literature, the treatment of these patients is quite controversial and non-standardized.

Case report

The authors present a three-year-old female patient who accidentally sustained a PHI with a screwdriver through the right orbit (Figure 1). The patient did not lose consciousness or vomit after the injury. She was previously examined by an ophthalmologist and a pediatric surgeon at the local hospital. During the neurosurgical examination, on admission, the patient was conscious, oriented to time, space and person (Glasgow Coma Scale score of 15), cardiopulmonary stable, without any recorded gross neurological deficits.

Figure 1. The metal part of the screwdriver passes through the medial part of the orbit.

A computed tomography (CT) scan of the head was performed, which demonstrated the presence of a metal end of a screwdriver in the anterior cranial fossa (Figure 2, Figure 3). The CT scan did not detect any vascular or brain parenchyma injuries.

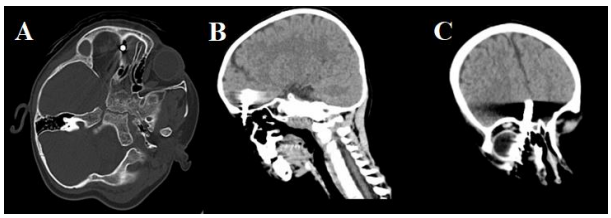

Figure 2. The axial (**A**), sagittal (**B**) and coronal (**C**) CT tomograms demonstrate a metallic foreign body, penetrating the medial wall of the right orbit and partially through the roof of the ipsilateral orbit, with the metal tip extending along the cerebral falx. The brain parenchyma was without evident and detectable injury.

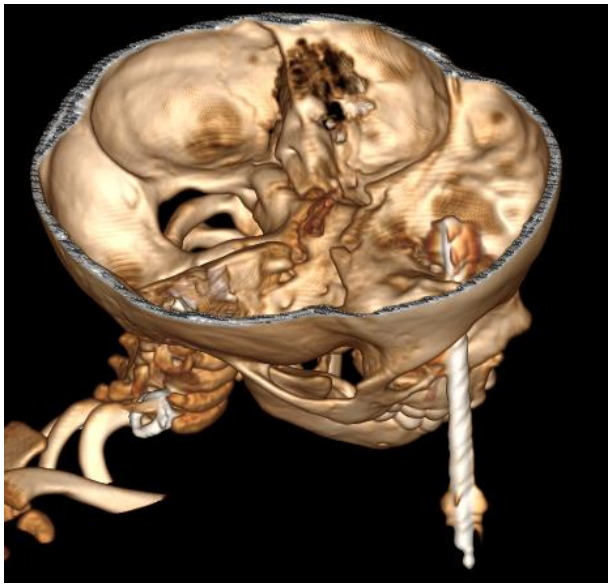

Figure 3. A 3-D CT scan revealed the penetrating injury in the anterior cranial fossa.

After an adequate preoperative examination, the patient underwent an emergency surgery. During the operation, the head was positioned for a pterional craniotomy with little deflection and greater rotation of the head by using the skull fixation device and an arcuate incision was made starting from the projection of the zygomatic arch anterior to the tragus in the length of about 15 cm and behind the hairline area. The dissection of the temporal muscle was done in the interfacial fashion.

Afterwards, the fronto-temporo-sphenoidal craniotomy was performed with the three points of trepanation.

Following an adequate hemostasis and the incision of the dura mater, the prophylactic dural tenting sutures (DTS) were placed through the perforations made along the edges of the pterional craniotomy.

Upon accessing the anterior cranial fossa and the olfactory cistern, a metal end of the screwdriver was encountered, which superficially injured the right olfactory bulb and right gyrus rectus, as well as the right medial frontobasal artery, while the metal tip was extending along the cerebral falx. Moreover, the screwdriver was then removed by pulling the handle outwards, with taking special consideration about the potential twisting of the screwdriver, which must not occur.

Furthermore, the authors managed the superficial injuries of the previously mentioned areas of the brain tissue and blood vessels with the use of regenerated oxidised cellulose (Surgicel®).

A penetrating bone defect was irrigated with hydrogen peroxide and normal saline profusely.
The dura mater was repaired with simple interrupted absorbable vicryl sutures and collagen-based dural graft (DuraGen®), an epidural drain was placed, while the bony lid was returned with titanium plates.

The patient was treated with dual antibiotic therapy (Ceftriaxone in the dose of 750 mg once a day and Metronidazole in the dose of 100mg three times a day) as well as with prophylactic anticonvulsant therapy (Levetiracetam-oral solution in the dose of 150mg twice a day). Both tetanus toxoid and tetanus immunoglobulin were administered due to the unknown immunization status of the patient.

The intervention was followed by a complete postoperative recovery without any gross neurological deficits. Follow-up examinations were performed up to three years after the injury, while the patient's condition remained unchanged.

Discussion

Due to the lack of adequate recommendations in the scientific literature, insufficient retrospective data collection, as well as described complications arising from such a rare mechanism of injury, there is no consensus on the adequate treatment of patients with PHI with a screwdriver. Although head CT indicated that there was no injury to brain and vascular structures, non-operative screwdriver extraction was initially rejected due to the possibility of injuring numerous structures of the brain base as well as the formation of a cerebrospinal fluid fistula.

Depending on the characteristics and dimensions of the screwdriver, whether the screwdriver has a larger or smaller cross-sectional area of the tip, taking into account the sharpness of the tip and the applied stabbing force, these objects make a disproportionately small skin stab wound in comparison to the injuries of the intracranial structures they cause (8).

Our patient reportedly tripped and fell head first on the tip of a screwdriver, sustaining a penetrating injury through the right orbit. Although the gold standard in the diagnostic assessment of these patients is brain CT with CT angiography if blood vessels injury is suspected (7), no brain injuries were reported on the brain CT, while superficial brain lesions were determined during the operation.

The most common complications of these injuries are vascular injuries, which occur in 19% of patients, and often in the form of pseudoaneurysms (46%) and cutting of blood vessels (32%), and therefore require treatment (5).

After a penetrating brain injury occurs, thromboplastin is released, which promotes blood coagulation, while on the other hand, intracerebral bleeding can occur as well. Disseminated intravascular coagulation, acute respiratory distress syndrome and neurogenic pulmonary edema may develop. If the screwdriver is not surgically removed 48 hours after injury, the chance of acquiring meningitis and brain abscess increases from 4.6% to 36.5% (8,9). For those reasons, the authors decided on an urgent operation and removal of the screwdriver from the anterior cranial fossa with preventive irrigation of the operative field and administration of dual antibiotic therapy.

Moreover, about 50% of these patients develop a late post-traumatic epilepsy (8,9). Consequently, we decided on convulsion prophylaxis for a year, and the patient has not experienced any form of convulsions to this day.

Although when deciding on a surgical approach, one could opt for the right frontal approach, the right subfrontal approach and other approaches (3), we decided on the pterional approach because it allowed us to see all the structures affected by the injury and enabled the repair of the dura mater lesion. Aesthetic reasons also played a role as most

of the scar would be covered by hair after the wound had healed.

The use of DTS in hemostasis is an important technique, which can lead to unnecessary complications if they are placed before opening of the dura. In elderly patients, subdural hygromas may occur after placement of DTS (4). We decided therefore to place DTS after opening the dura and visualizing the brain tissue through a microscope.

Conclusion

In conclusion, this is a very peculiar case of a PHI with a screwdriver, while the authors of this paper have not found a similar case described in the literature. It is necessary to make an adequate diagnosis as soon as possible and urgently surgically evacuate the screwdriver from the endocranium with adequate medical therapy in order to prevent possible complications.

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