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ORIGINAL ARTICLE

A 1810 skull of Napoleon army's soldier: a clinical–anatomical correlation of steam gun trauma

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Abstract

Introduction In the following article, we are presenting a clinical observation of Baron Larrey. In 1804, Larrey was the inspector general of health, as well as the chief surgeon of the imperial Napoleonic Guard. He participated in all of Napoleon's campaigns. A paleopathological study was performed on a skull from Dupuytren's Museum (Paris) with a long metal stick in the head. We report here a clinical case as well as the autopsy description of this soldier's skull following his death. We propose a different anatomical analysis of the skull, which allowed us to rectify what we believe to be an anatomical error and to propose varying hypotheses regarding the death of soldier Cros.

Materials and methods The skull was examined, observed and described by standard paleopathology methods. Measurements of the lesion were performed with metric tools and expressed in centimeters. Historical research was made possible through the collaboration with the Museum of Medicine History-Paris Descartes University.

Results Following the above detailed anatomical analysis of the path of the metal rod, we propose various possible lesions in soldier Cros due to the accident. At the inlet, the frontal sinuses could have been damaged. At the level of the second portion of the intracranial path, all of the anatomical elements present in the cavernous sinus could have been injured (cranial nerves III, IV, V1 and V2, VI, internal carotid artery and cavernous sinus). The exit orifice of the foreign body passes through the left condylar fossa of the occipital bone, points to a highly probable lesion of the left hypoglossal nerve (12th cranial nerve).

Conclusion The paleopathological study of human remains, when combined with anatomical and clinical knowledge of the pathologies of the head and neck, can rectify diagnoses of the past.

Keywords Larrey · Paleopathology · Skull base

Introduction

In the following article, we are presenting a clinical observation of Baron Larrey. In 1804, Larrey was the inspector general of health, as well as the chief surgeon of the imperial Napoleonic Guard. He participated in all of Napoleon's campaigns leading to Waterloo. Baron Larrey made the following observation with the help of Major Caizergues, a second-rank surgeon of the Grand Army ambulances, who used pliers and a trephine as surgical tools to extract a rifle wand from Private Cros' skull. Private Cros was part of the 61st Line Regiment, which participated in all campaigns of the 1st Empire. At the time of this particular event, March 23, 1810, he was most probably stationed in Hess, Germany. A fellow soldier of the 61st Infantry Regiment wounded this soldier on March 23, 1810 while playing a game. Convinced that his rifle was not loaded, the soldier pulled the trigger in the direction of comrade Cros. Cros was then hit in the head

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by a long metal stick, which was inadvertently left in the rifle. We report here the clinical case as well as the autopsy description of this soldier's skull following his death. Initially, he was practically unharmed by the blow, and was transferred to the nearest hospital where Caizergues, the surgeon on duty, tried to extract the foreign body externally and perform trephination. Private Cros passed away on March 25, 1810, 2 days following the accident. The clinical data reported by Baron Larrey did not mention any symptoms and the autopsy analysis performed at the time implied a lesion of the glossopharyngeal nerve. We propose a different anatomical analysis of the skull, which allowed us to rectify what we believe to be an anatomical error and to propose varying hypotheses regarding the death of soldier Cros.

Materials and methods

The skull was examined, observed and described by standard paleopathology methods [2, 3, 6]. Measurements of the lesion were performed with metric tools and expressed in centimeters. Historical research was made possible through the collaboration with the Museum of Medicine History-Paris Descartes University.

Results

Baron Larrey first describes the clinical signs exhibited by Private Cros. He reports that there was no epistaxis or external bleeding, and that Private Cros was fully conscious and had no neurological deficit immediately following the accident. He then proceeded to describe the metal stick, which spanned the full length of his skull:

> *The surgeon present at the scene, Mr. Caizergues, called all of his colleagues in close proximity for help because he was unable to extract the foreign body. The group decided that it was necessary to extract the wand by its front portion. After a few attempts, a portion of the rod yielded to the pliers. This fragment of the wand, which was subsequently lost, was reported by Mr. Caizergues to measure about fifteen centimeters in length, and was not stained with blood or brain matter. They tried to extract the remaining portion by the extremity which protruded at the nape of the neck but in vain. It seems that even with the strongest of pliers and the greatest of efforts, the remaining fragment did not budge due to its curved structure. The group had the idea of using a trephine as close as possible to the extrusion point of the foreign body. Going against all of the principles of the art and in spite of the danger of such an operation, trephination was practiced on the edge of the occipital extrusion point, in close proximity to the posterior condylar fossa. It was therefore necessary to cut through the thick layers of the trapezius muscle, the splenius muscle, and the vessel and nerve bundles to get to the bone. M. Caizergues did not mention the difficulties which he necessarily encountered, nor did he reveal the specific circumstances of the operation and the post-operative period. All that was stated was that the trephine was useless, and that they were forced to abandon the idea of completely extracting the metal rod, thus allowing nature to run its course. He pointed out that this soldier had endured the operation with the greatest courage, and that he had not even lost consciousness. However, he died on the 25th of the same month. There was no mention of the symptoms that preceded the death, nor of the result of the operation. Larrey then relates the description of the autopsy practiced: "The frontal bone was pierced, between the sinus', a circular-shaped opening, without evidence of fracture, and measuring about the diameter of the rod, which was first directed horizontally between the two hemispheres of the brain without injuring them, tearing only the tip of the falx cerebri. The iron rod was then introduced into the body of the sphenoid bone, under the left optic canal; it continued its course in this thick bone, then through the tip of the temporal bone and the basilar part of the occipital bone, directed towards the left condylar process. The exit hole was not far from this site, passing through the overlying soft tissues. Throughout this path, the metal rod had not injured any vital organ. Having passed first between the two hemispheres of the brain without breaching them, it had then slipped under the cavernous sinus and the carotid artery without piercing them; it was even separated from the cavernous sinus by a bony fragment which had been barely detached from the body of the sphenoid. Finally, it was far enough from the third cranial nerves and the internal jugular vein. The resistance of the bony parts, their elasticity, combined with the annihilation of the projectile force stopped the movement of this foreign body which had remained locked in the bone path that where it had traveled (…)"* [5].

Our paleopathological study revealed a dry skull including mandibular bone, whose cranial vault was sawed open to perform an anatomical study. This is a young man (between 25 and 45 years old). There is a fracture of tooth number 12 and a good overall oral state (Fig. 1). The metal rod follows a ventro-dorsal orientation, slightly oblique from right to left and in a cranio-caudal direction (Fig. 2). The inlet is measured at 8 mm and the outlet at 10 mm. After having penetrated the skull at the level of the frontal bone,

Fig. 1 Frontal view of the soldier's skull

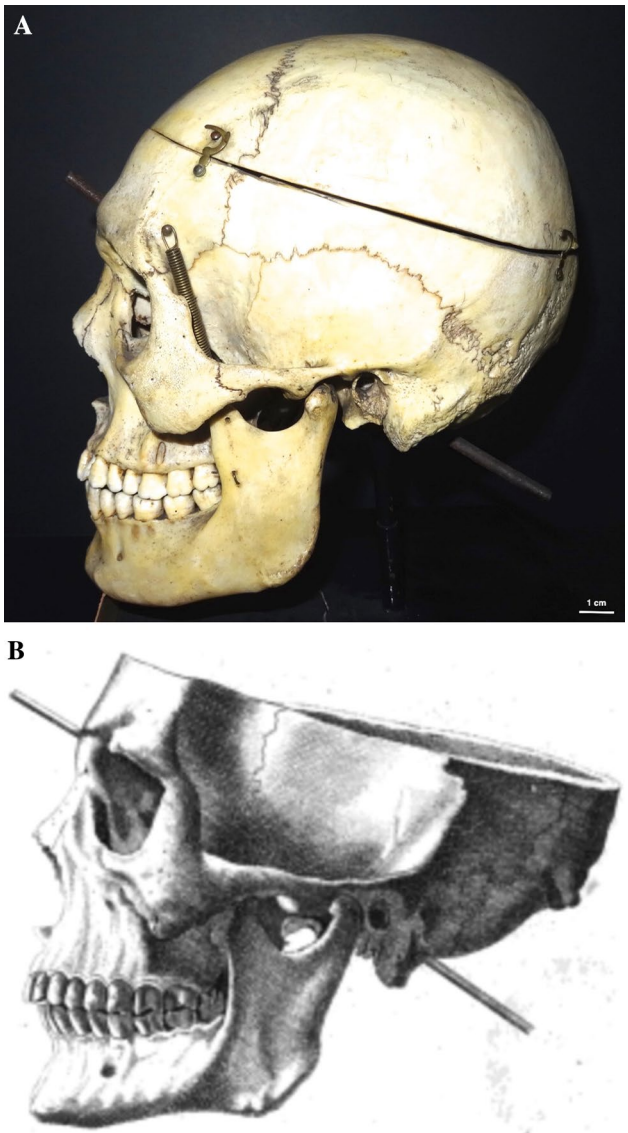

Fig. 2 Side view of the skull with the metal rod running through it from front to back

almost medially, 1 cm above the glabella, one can describe three portions in its intracranial course. The first portion of its intracranial course is at the level of the anterior base of the skull. This path begins at the inner and medial portion of the frontal bone, just below the insertion of the falx cerebri, so the rod most likely passed through the foramen cecum, located at the base of the frontal crest and marking the beginning of the superior sagittal sinus. At this point, the rod continued its course, taking an oblique direction laterally to the left and exiting the anterior skull base by perforating the jugum sphenoidale, in a paramedian position, of equal distance to two sagittal planes: the median line and the line parallel to it passing through the left anterior clinoid process (Fig. 3). At this level, we can note the absence of the dorsum sellae of the sphenoid, probably broken or injured during the initial autopsy. The second portion of the intracranial path takes place at the level of the middle skull base. At this location, the rod appears to lift the cortex of the body of the sphenoid bone at its left lateral surface, opposite the carotid groove.

One can note here a known anatomical variation, which is the absence of the foramen spinosum on the right (passage of the middle meningeal artery) (white arrow in Fig. 3). The metal rod then appears to cross the tip of the petrous part of the left temporal bone, always in a slightly oblique axis caudally, dorsally and laterally to the left. It thus begins the third portion of its intracranial path, which appears to be exclusively intraosseous, in the posterior base of skull, that is to say, in the petrous portion of the left temporal bone and then at the level of the left clivus. It travels in this intraosseous course just opposite the furrow of the lower petrosal sinus, before exiting the skull through an orifice coinciding exactly to the left condylar foramen of the occipital bone. During this third portion of the intracranial course, the rod appears to avoid the left jugular foramen and the left internal auditory meatus, which seem to be intact cranially.

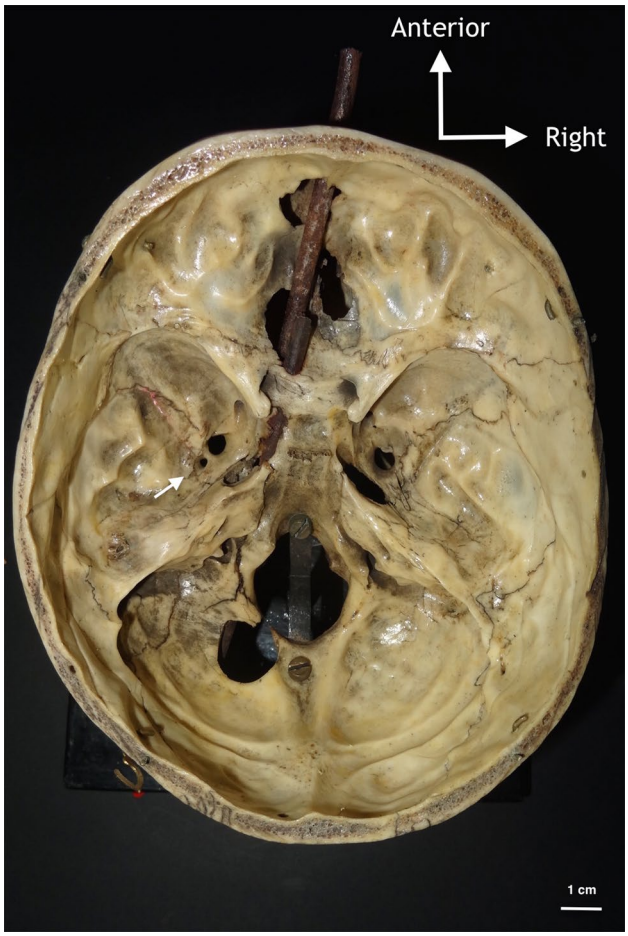

Fig. 3 View of the base of the skull seen from above. The white arrow shows the presence of the foramen spinosum on the left; on the right it is absent

The trephine hole is 2 cm in diameter and is located to the left and a little more caudally to the foramen magnum. The traces of fine cuts confirm that they were made on fresh bone. We note numerous traces of cuts at the level of the upper part of the hole allowing us to infer the force and intensity with which the surgeon must have executed his gestures to divide the various musculo-cutaneous layers to reach the bone and carry out the trephination as quickly as possible (Fig. 4).

Discussion

Given that anesthesia was not introduced until 1846, timely gestures, even at the expense of being imprecise, were essential to limit patient suffering. The absence of loss of consciousness of this patient allows us to infer that this was in fact the case here [1]. Following the above detailed anatomical analysis of the path of the metal rod, we propose various possible lesions in soldier Cros due to the accident. At the

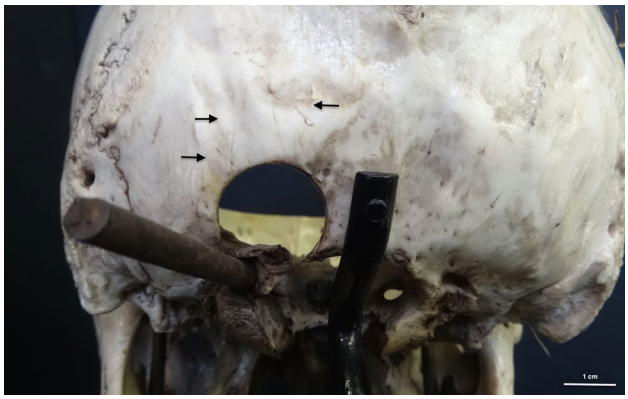

Fig. 4 Rear view of the skull with the trephination opening. Black arrows show traces of soft tissue cutting around the opening

inlet, the frontal sinuses could have been damaged. However, cranium cut made here for this study does not go through a section of the frontal sinuses. This means that the cut of the cranium may be too cephalic or that the soldier suffered from bilateral agenesis of his frontal sinuses, a frequent anatomic variation [4]. The foramen cecum of the frontal bone having been crossed by the rod, a venous bleeding could have emerged from the entrance point but the clinical description does not go in this direction. At the level of the first portion of its intracranial course, the rod is immediately above the upper face of the ethmoid bone, facing the cribriform plate and the crista galli. Olfactory bulb lesions can be suspected at this level with resulting hyposmia (Fig. 5).

At the level of the second portion of the intracranial path, all of the anatomical elements present in the cavernous sinus could have been injured (cranial nerves III, IV, V1 and V2, VI, internal carotid artery, and cavernous sinus). However, the clinical findings reported seem to exclude these possibilities. At the level of the third portion of the intracranial pathway, the brainstem and the cerebellum could have been damaged but the path of the rod appears exclusively intraosseous, which does not point to a direct lesion of these parts of the central nervous system. On the other hand, the fact that the exit orifice of the foreign body passes through the left condylar fossa of the occipital bone, points to a highly probable lesion of the left hypoglossal nerve (12th cranial nerve), contrary to the initial description which reported a lesion of the glossopharyngeal nerve (ninth cranial nerve) (Fig. 6). The lesion of the left hypoglossal nerve causes paralysis of the motor function of the left hemi tongue, usually manifested by a deviation of the tongue towards the affected side. Lingual atrophy should not be present if the paralysis is not prolonged. Concerning the etiological hypotheses of the death of soldier Cros, most vital structures having been surprisingly spared, we are in agreement with baron Larrey who proposed an infectious etiology. Even if

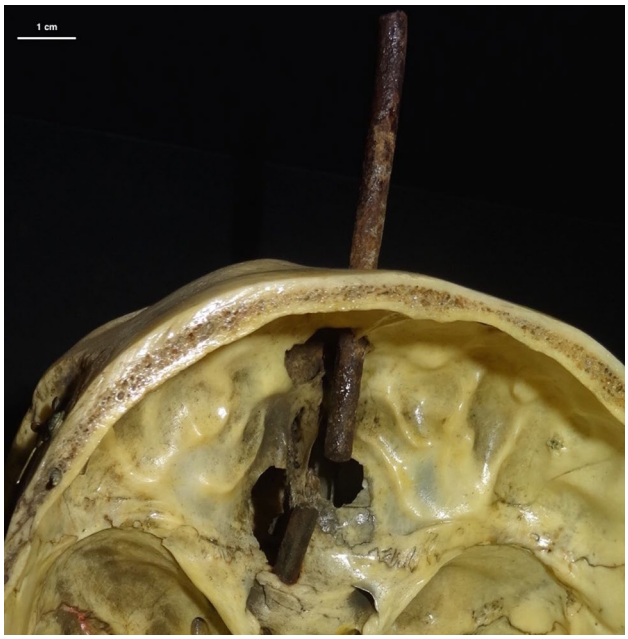

Fig. 5 View of the first portion of the metal rod at the level of the frontal sinuses

Fig. 6 View of the foramen magnum seen from above. The black arrow indicates the canal of the hypoglossal nerve

it is not clearly mentioned in the historic report, leakage of cerebrospinal liquid from the entry and exit orifices of the metal rod is highly probable, given that the foreign body must have breached the dura during its course (especially at the level of the anterior skull base), facilitating a septic event. Larrey also proposed a lesion of the cerebellum to explain the death of the soldier. We, however, refute this hypothesis because the path of the metal rod at the posterior fossa is strictly intraosseous, which seems confirmed by the findings of Major Caizergues during the trephination because he reported that it was useless for the purpose of extracting the foreign body. However, the occipital trephination performed was directly overlying the cerebellum and could have been the cause of an iatrogenic injury. Finally there is no sign of bone healing consistent with a short survival after the realization of this procedure. Anatomical screening is essential for forensic study.

Conclusion

The paleopathological study of human remains, when combined with anatomical and clinical knowledge of the pathologies of the head and neck, can rectify diagnoses of the past.

Author contribution NB: projet development, data collection, data analysis, manuscript writing. FC: data analysis, manuscript writing. AF: manuscript writing. PC projet development, manuscript writing.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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