Review of Phineas Gage’s Oral and Maxillofacial Injuries

Abstract

A large iron rod weighing 13.25 pounds passed through Gage’s head and surprisingly he lived 12 years with this injury. Though Gage survived this injury, his personality changed drastically. “Gage was no longer Gage”, he changed from an even tempered man to being “fitful, irreverent, indulging at times in the grossest profanity”. These events helped establish the relationship between personality and the frontal region of the brain.

However, his maxillofacial injuries are seldom noted. In this study, we reviewed previous texts and journal articles to enable a mapping of the trajectory of the iron rod through his maxillofacial region.

The iron rod first pierced through his left cheek, lateral to the mandible, anterior to the masseter muscle, and anterior to the parotid gland, therefore not penetrating the oral cavity. The zygomatic bone was then fractured and laterally displaced. The rod continued into the infratemporal fossa, apparently anterior to the pterygoid plexus and then entered the posterior orbit. It penetrated the cranial fossa through the frontal bone: its trajectory was anterior to the cavernous sinus. It then penetrated the orbital portion of the frontal lobe before exiting the skull.

Although Phineas Gage’s brain injuries are important, it is equally important to look at his maxillofacial injuries. The iron rod missed some major venous plexuses that could have possibly caused fatal bleeding.

Introduction

In 1848 Phineas Gage was a railroad foreman, an iron rod that he was using to pack explosive powder blew up [1,2]. The iron rod was 43 inches long, 1.25 inches in diameter and weighed 13.25 pounds shot upward and penetrated Phineas Gage’s skull. Luckily Phineas Gage survived this injury and he lived 12 years with this injury. However after this accident “Gage was no longer Gage.” Phineas Gage used to be an even tempered, and he changed to “uttering the grossest profanity”, and showed “little deference for his fellows.”

Phineas Gage became the most famous patient of neuroscience because he showed a link between brain injury and personality.

Methods

Multiple journal articles, and books were analyzed in order to determine what structures the iron rod could have possibly penetrated. Some of the information provided was indicated by journal articles, however most of the pathway was indicated by projecting the possible structures the iron rod penetrated.

Results and Discussion

Table 1: The iron rod first pierced his left cheek, lateral to the mandible, and anterior to the masseter muscle, and parotid gland, it may have lacerated the buccinator muscle, penetrating the oral cavity. We can’t confirm that it knocked out a maxillary molar.

<table>
<thead>
<tr>
<th>Source</th>
<th>Possible Structures Affected</th>
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<tr>
<td>The Boston Medical and Surgical Journal (1848) [1]</td>
<td>Taking a direction upward and backward toward the median line, it penetrated the integuments, masseter and temporal muscles, passed under the zygomatic arch, fracturing the temporal portion of the sphenoid bone, and the floor of the orbit of the left eye, entered the cranium, passing through the anterior left lobe of the cerebrum, and made its exit in the median line, at the junction of the coronal and sagittal sutures, lacerating the longitudinal sinus, fracturing the parietal and frontal bones extensively, breaking up considerable portions of the brain, and protruding the glove of the left eye from its socket by nearly one half its diameter.</td>
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<td>Dr. Harlow’s Case of Recovery from the passage of an Iron Bar through the head. (1993) [3]</td>
<td>I asked him where the bar entered, and he pointed to the wound on the left cheek, which I had not before discovered; this was a slit running from the angle of the jaw forward about one and a half inch it was very much stretched laterally. A linear cicatrix of an inch in length occupies the left ramus of the jaw near its angle. A little thickening of the soft tissues is discovered about the corresponding malar bone. The eyelid of this side is shut, and the patient is unable to open it. The eye considerable more prominent than the other, offers a singular confirmation of the pints illustrated by the prepared skull described below. It will be there seen that the parts of the orbit necessarily cut away are those occupied by the levator palpebrae superioris, the levator oculi and abducens muscles. In addition to a plosis of the lid, the eye is found to be incapable of executing with the outward or upward motion; while the other muscles animated by the motor communis are unimpaired.</td>
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Discussion

The projected trajectory is:

1) The iron rod first pierced his left cheek, lateral to the mandible, and anterior to the masseter muscle, and parotid gland, it may have lacerated the buccinator muscle, penetrating the oral cavity. We can't confirm that it knocked out a maxillary molar.
2) The zygomatic bone was then fractured and laterally displaced.

3) The rod continued into the infratemporal fossa, anterior to the pterygoid plexus and then entered the posterior orbit. The optic nerve remains intact however there is ptosis of Gage’s eye indicating a damaged cranial nerve III.

4) It penetrated the cranial fossa through the frontal bone: Its trajectory was anterior to the cavernous sinus.

5) It then penetrated the orbital portion of the frontal lobe before exiting the skull.

Conclusion

Phineas Gage is a major landmark case in neuroscience. It is surprising how Gage was able to survive this accident and live 12 years later. Phineas Gage’s oral and maxillofacial injuries were rarely noted. It is amazing how the iron rod penetrated the oral cavity, and caused limited intraoral damage. If the iron rod’s path was different and it penetrated the pterygoid plexuses or the cavernous sinus Phineas Gage could have bled to death.

References