

WOUND BALLISTICS BEHIND THE ASSESSMENT AND LOCATION OF LOW VELOCITY GUNSHOT INJURIES IN THE MAXILLOFACIAL REGION

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ABSTRACT

Purpose: The damage caused by low velocity gunshot injuries depends upon the ballistic principles or the path traversed by the missile or the bullet.

Objective: the objective of the paper is to impart knowledge of the ballistic laws of a projectile for assessment and location of the sphincter of gunshot injuries.

Case report: this paper presents a case report of shotgun injury to the face and also discusses the various imaging techniques to find out the exact location and the damage caused by the bullet in the vicinity of important structures of head and neck region.

Conclusion: It is very critical to locate the bullet after gunshot injury to ensure the health of the important anatomic structures of the head and neck region.

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INTRODUCTION

The incidence of homicide rate with gunshot injuries in India is about 0.93% according to United Nations Office on Drug & Crime 2000¹. 14% of gunshot related assaults will result in head and neck Injuries. Although there are many incidence of craniofacial gunshot injuries they are still not common as those to other region of the body².

Low velocity (<2000FtS⁻¹) results in non-fatal injuries. These injuries are different from missile or high velocity Injuries as they have sphincters that can cause multiple damage³. The damage caused by gunshot injuries depends upon range of the shot, type of the shot (Size & Weight), impact velocity and body tissue resistance⁴.

Knowledge of ballistic science is very important to assess and locate the bullet projectile. The aim of the article is to hypothetically trace the path followed by the bullet in the maxillofacial region.

Case report

An 11 year old girl reported to oral and maxillofacial surgery department with a gunshot injury to the right side of the face immediately below the right orbital rim.

Patient was conscious and cooperative. Clinically 5mm wide entry wound was seen approximately half an inch below the right orbital rim of the right eye (Figure 1).



Figure 1 Clinical presentation of the case of Gun Shot injury

There was no evidence of the exit wound. All vital signs were within normal limits. There were no signs of accumulation of blood and pus discharge from the entry wound. Extra orally there was generalized swelling of the right side of the face with shortening of right eye as a result of swelling. On palpation small. Entry wound was debrided and cleaned. The size of the sphincter was not the actual size of the bullet as told by the witness. So more diagnostic imaging modalities were adopted.

Panoramic radiograph revealed well circumscribed pointed radiopaque mass on the right side near the vertebral area. In

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the OPG the shadow of the bullet also was observed on the contralateral side but not at same mirror image site (Figure2).



Figure 2 OPG with the bullet on right side and ghost image of the bullet

Occipitontal view also was assessed but with the same results (Figure 3) The exact location could not be judged by these radiographs. All bony landmarks were examined in the OPG, there were no other signs of bony damage caused by the bullet in that radiograph.



Figure 3 Occipitontal view with the bullet and its ghost image anteriorly

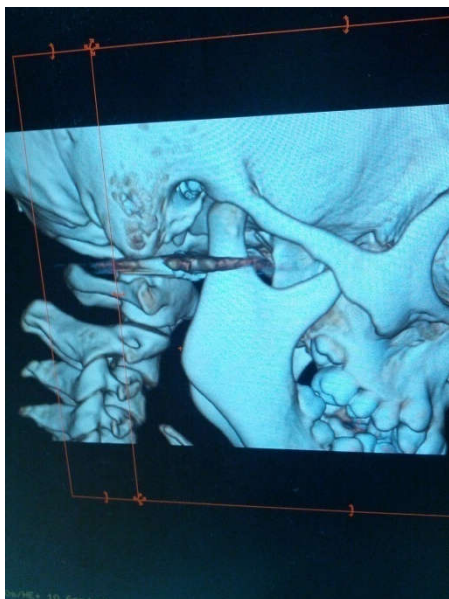


Figure 4 3D reconstruction with the location of the bullet

CT scan showed metallic artifacts on the sections and a 3D reconstruction, 3D reconstruction was attempted to project the course and trajectory of the bullet (Figure 4). 3D

reconstruction revealed that the bullet was directed near mastoid area of the right side pointing posteriorly (Figure 5). Bullet has not fractured any part of orbital rim and maxilla but was lying in the soft tissues around the mastoid process. The impact most probably was on hard compact orbital rim that lead to change the path of the bullet towards the posterior part of the face and ultimately the path of the bullet was terminated in the soft tissues around mastoid area.

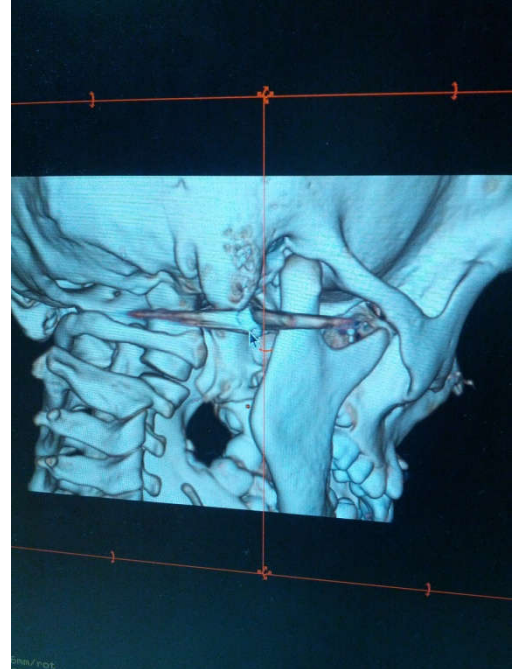


Figure 5 Direction of bullet after 3d Reconstruction

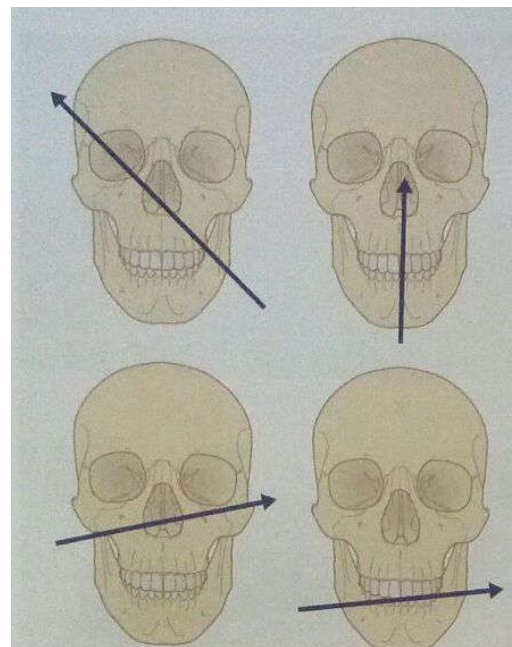


Figure 6 General Patterns of facial gunshot wounds (Clockwise)frontal cranium, the orbit and lower mid face and the mandible.

DISCUSSION

Bullet injuries can pose serious problems. If not assessed and located accurately away from the path of entry and exit can have detrimental effects⁵. The mechanism by which a projectile disrupts tissues is purely mechanical in nature. Initially the bullet crushes sufficient tissues to make a hole through which it penetrates underlying tissues. Depending

upon the speed at which it is travelling the destruction is caused to the tissues. Facial wounds are unique to any other body parts gunshot injuries. The facial bones make up so much volume of the face that any bullet always strike the a bone as soon as it enters the face. Resultant damage caused by the bullet depends upon the tissue density. Facial bones when hit suffer otherwise very serious damage because the specific gravity of facial bones is second highest, next to enamel of the teeth.

Another feature of the projectile is the characteristics in path traversed after entering and hitting the tissues of the face. Knowledge of ballistic science helps us in determining these paths. Ballistic laws are important to understand which will tell us the path traversed by the projectile. As the bullet enters the body different layers behave differently according to their specific gravity. A bullet can encounter muscle, nerves, vessels, and bone. The damage caused by the bullet depends upon the type of bone encountered. Yawing, Precession and Tumbling types of behavior can be noticed after a bullet enters the facial tissues⁵. Yawing type behavior is very common with low velocity gunshot injuries in the face area. Yawing means change in direction altering its original straight path. The path traversed depends upon the type of bone resistance it encounters. Cancellous bone will have drill hole type defect, whereas cortical bone will fracture⁶. In the above case the projectile would have hit the hard orbital rim but with slow intensity which did not cause any harm to the bone. And changed its path and was guided posteriorly. The angle with which it hits the bone also plays an important role. The reason why it did not fracture the rim would be the direction with which it had hit rim. Compact bone can withstand high impact forces at 90 degrees.

Yawing bullets are unpredictable in their path. Such behavior demands that thorough search for potential injuries be made before treating such cases. Surgical removal depends upon the accessibility of the site where they are lodged. Surgeon should consider leaving the sphincter close to the vital structures⁷. Bullet path in the soft tissues can cause hemorrhage and inflammation that can cause swelling and this can subside with time if not infected. So if the bullet is sterile and not infected that can be left like an implant in the soft tissues. Although this treatment modality cannot be a considered in each and every case. Only in those cases where surgeon feels that bullet is in the vicinity of important anatomic structure and bullet is dormant in the area, a decision for leaving the bullet can be taken by the surgeon. However thorough diagnosis to locate the position of the bullet should be made to ensure the decision of keeping the sphincter in the anatomic structure,.

Certain patterns of facial injuries due to penetrating bullets have been reported. Four general patterns of involvement of gunshot injuries have been noticed⁵ frontal cranium, the orbit and lower mid face and the mandible (Figure 6).

These paths can be assessed with the entry and exit wound. Although these paths become unpredictable with the yawing movement in case the bullet retains in the tissues.

In the above case 3D reconstruction diagnostic tool was used to locate the position of the bullet.

CONCLUSION

“The only rule regarding the ballistics is that the bullet follows no rule” as stated by Hough⁸.

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