

The keyhole lesion

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Abstract: Determining the entrance and exit wounds in gunshot injuries is important for forensics. Although the gunshot wounds have a round or oval image, there might also be atypical entrance wounds as well. When the firearm bullet hits the cranium with an acute angle or in a tangential manner, there might occur fractures in the bevelled-out hole on the outer table; and the defect called “keyhole lesion”, which is rare, might occur.

In this paper, the autopsy findings of a case with a gunshot wound that had atypical entrance wound in the shape of “keyhole lesion” have been presented. The bone flaps extracted with craniectomy are stored either in the body of the patients (by placing in the stomach or below the quadriceps) or in deep freezers. Especially in cases that have bone defects due to gunshot wounds, the bone flap must be stored after being photographed in detail in order to prevent the findings from being lost. In cases that have bone defects due to gunshot wounds, the distinction of the entrance and exit wounds may be performed after the examination of the bones.

Key Words: gunshot wounds, bone, entrance holes, exit holes, keyhole lesion, external lamina bevelling.

Prediction of the shooting distance in gunshot wounds and distinction of the entrance wounds and the exit wounds are important in determining the origin of the events. Generally, because of the characteristic morphological properties of the bullet, the distinction between the entrance wounds and the exit wounds is possible. Sometimes it is possible to observe atypical wounds that have both entrance and exit wound characteristics. These types of wounds are defined as “keyhole lesions”, and occur due to the acute angle of the bullet when hitting the cranium. With the broadest form, a bullet progressing in a tangential way has the vertical and horizontal force vectors. The bullet hitting the bone with an acute angle causes a defect in the shape of a triangle on the lamina externa of the defect occurring in the hitting point, and also causes a circular (or oval) defect in the lamina interna. The circular part of the defect in the bone is the first hitting point or the entrance point. The bullet breaks into pieces with the influence of the hitting with acute angle; however, the

main mass of the bullet generally enters into the cranial void [1-5]. The autopsy results of an atypical gunshot wound with “keyhole lesion” have been presented in this case study.

CASE

It is clear that 26-year-old male case was operated because of a gunshot fire in the right temporal area, and the patient died on the 5th day of the treatment. It was reported in medical documents that there were entrance and exit wounds in the head of the case. In the autopsy, an entrance wound 1x1 cm in size with a burn 2x1 cm in size, with partly scabs and suture on the right temporal area were observed. A second wound was determined in the area 4 cm up from the entrance wound in the right fronto-parietal area, whose direction was the same with the entrance wound, and in the shape of a tear/swab 3.5x1 cm in size (Fig. 1).

It was determined that there was no connection

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between the entrance wound and the tear wound under the scalp (Fig. 1). A 3.5x2 cm “keyhole lesion” defect was detected in the right temporal bone. The shape of the defect was oval in the bottom, and in the shape of a triangle whose top was facing downwards. There were soot and an internal bevelling in the bottom part of the defect; and an external bevelling in the upper part (Figs 2-5). The left temporal bone, which was excised because of the craniectomy process, was found as solid in the down-left quadrant below the skin.

Widespread subarachnoid bleeding was detected. 1 cm deformed bullet part in the left temporal lobe and 1x0.7 cm. Bullet jacket fracture was excised under the duramater in the right frontal area. It was determined that a 9 mm semi-automatic gun was used in the incident, and that the bullet was full jacketed.

In toxicological examination; no toxic substances were detected other than the ones used for treatment purposes. According to the skin, subcutaneous and bone findings, it was concluded that the shot was made “from a close distance, from the right to the left, from the bottom upwards, and slightly from the front to the back”. The cause of death for the person was declared as “cerebral hemorrhage and brain tissue damage together with cranial fractures due to gunshot wound”.

DISCUSSION

Generally, there might be findings that enable us to determine the gunshot distance in gunshot wounds [6]. The adult cranium consists of “diploe” called as lamina externa and lamina interna, which are parallel to each other. The external lamina is 2-fold thicker than the internal lamina [7].

While there occurs a circular or ovoid shape resembling the hole of a perforator in the external lamina of the cranium with entrance defect, there occurs internal bevelling in the internal lamina. In the external defect, on the other hand, there occurs external bevelling in the external lamina. A similar formation may also be observed in tabula like sternum, scapula, costas and coxae, and in processus transversus parts of the vertebrae.[1, 4, 5, 8-10].

The “keyhole lesion”, which is a rarely observed entrance lesion, may sometimes be misinterpreted as exit lesion [1, 4]. When the bullet hits the cranium with an acute angle or in a tangential manner, there might occur external bevelling in the external lamina of the entrance defect. However, almost always internal bevelling occurs in the internal lamina of the entrance defect. In such cases, it is definitely recommended to perform radiological examinations [5, 11]. In our case, the bottom part of the “keyhole lesion” in the right temporal area was determined to be in oval shape, and external bevelling was determined in the external lamina in the upper part. When the cranium was examined inside,

internal bevelling was detected in the internal lamina of the oval part of the defect. The fractured jacket parts of the bullet and the bullet were excised from the left temporal lobe and from the right frontal lobe subdural space.

It has been reported that a bullet hitting the cranium with an acute angle may proceed under the scalp for a short time after fracturing until it stops or is excised from the body. More rarely, it has also been reported that the full jacketed bullet may enter the cranial cavity [1]. In our case, a second wound was detected in the 4 cm upper part of the entrance wound in the right temporal area (Fig. 1). It was concluded that there was no connection between the entrance wound and this wound, which was in the shape of a tear, under the scalp; and that this wound might have been resulted with some of the parts of the fractured bullet proceeding outside the body.

It has been reported that there might be bevelling in the internal and external laminas in both entrance and exit defects, and this might cause confusions [1, 3, 12]. In such cases, the skin and the subcutaneous findings must be examined with extreme care. In addition, it has also been reported that the entrance and exit wounds could not be differentiated from each other by depending on the bone findings in decayed corpses [13]. In such rare and difficult cases, it is reported and recommended that the computerized tomography examination must be performed before the autopsy, and the priority gunshot must be determined firstly by making use of the rule “the secondary fractures cannot exceed the firstly-formed fracture line” especially in the cranium [14].

In the medical documents of our case, it was reported that there were entrance and exit wounds in the cranium of the case. However, it was determined with the autopsy and radiological examination that there was only entrance wound, and there were no exit wounds. It was concluded that the second wound, which was in



Figure 1. The wound in the shape of a tear, and the entrance wound in the right temporal area (arrow: the direction of the shot).

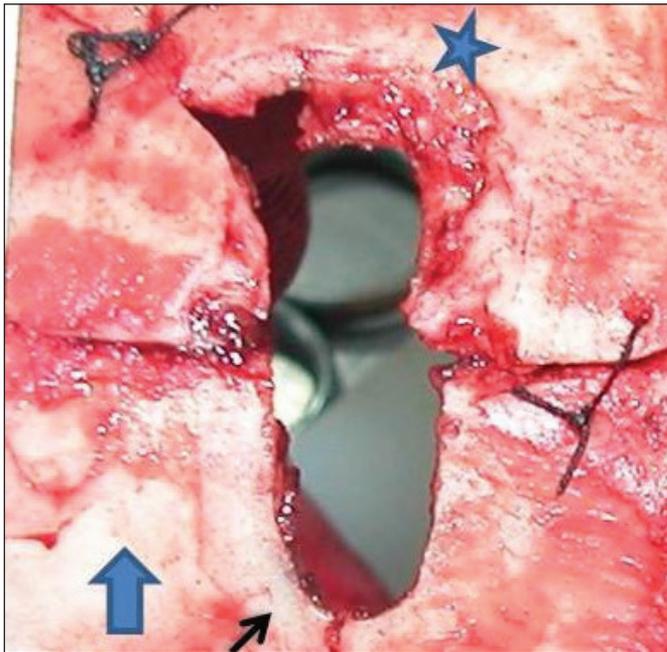


Figure 2. External view of the entrance wound (thick arrow: bullet direction; thin arrow: deposit of soot; star: external beveling of the outer table).

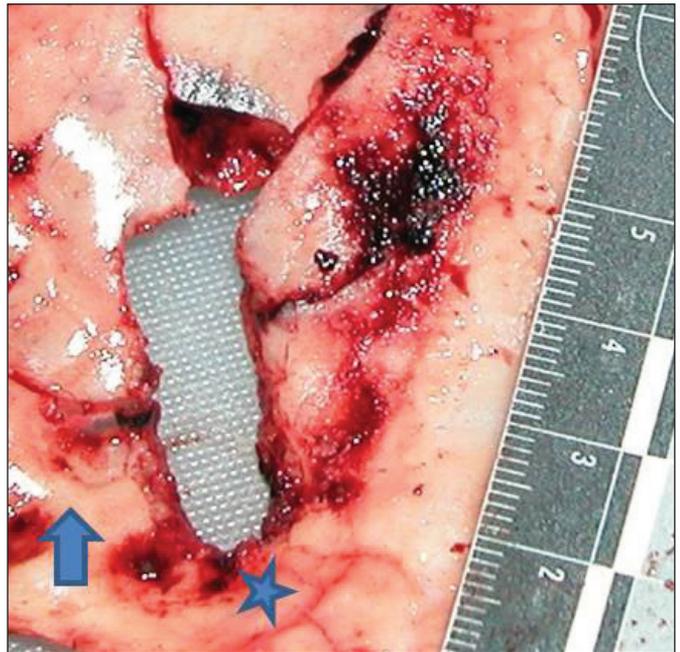


Figure 3. Internal view of the entrance wound (star: internal beveling of the inner table).

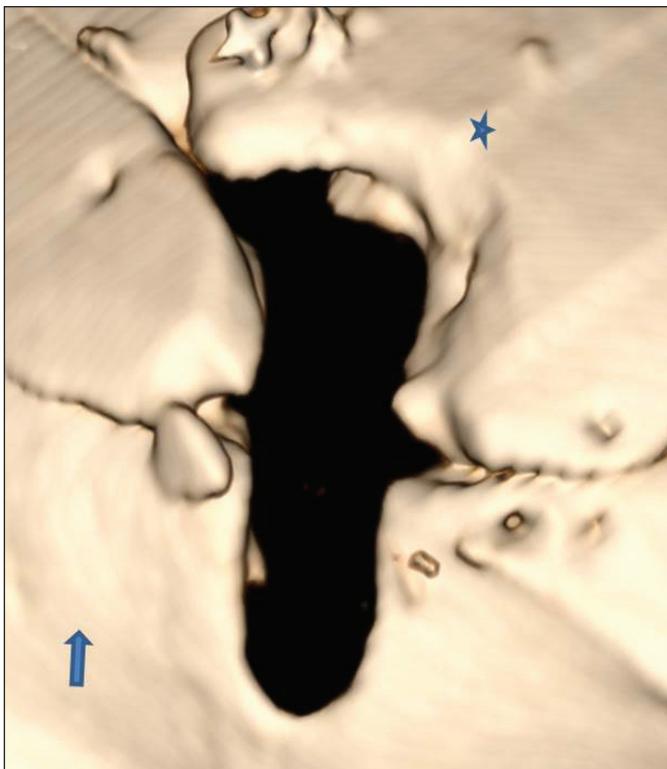


Figure 4. External view of the entrance wound with computerized tomography (arrow: bullet direction; star: external beveling).

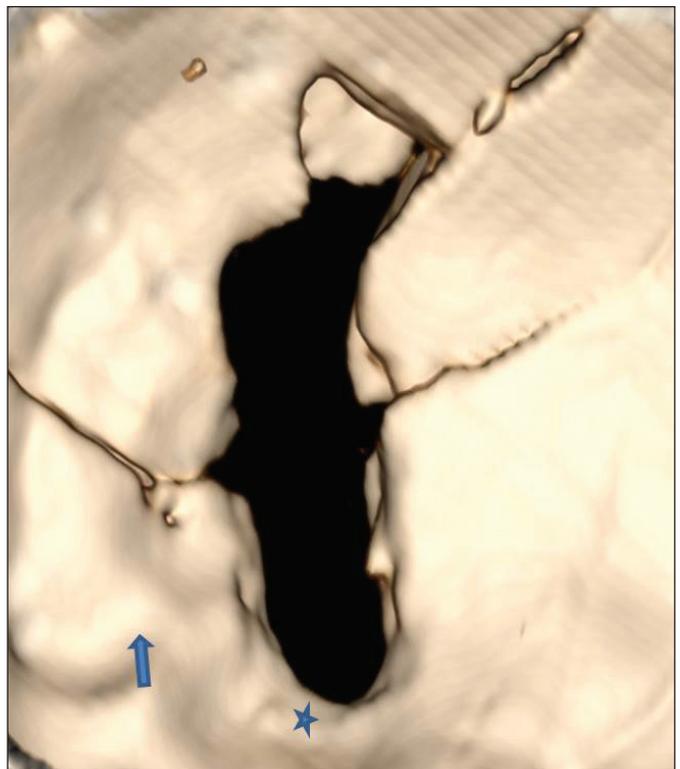


Figure 5. Internal view of the entrance wound (star: internal beveling).

the shape of a tear, in the right parietal area in the upper part of the entrance wound was due to the parts of the fractures of the bullet hitting the cranium with an acute angle (Fig. 1).

After a craniectomy performed for any reasons, the bone flaps are stored either in the body of the patients (by placing in the stomach or below the quadriceps) or in

deep freezers. If there are multiple fractures in the bone, if there is an infection in the area where the flap is kept in the body, or if there is a problem in the freezing process, the bone flap is thrown away. It must be kept in mind that this or similar types of body tissues or the foreign objects like bullet excised from the body may be forensic evidence. The possibility of the bone flaps being thrown

away has increased with the widespread use of artificial implants in many surgical branches (brain surgery, plastic and reconstructive surgery, orthopedics, traumatology, dental and maxilla surgery) for reconstruction purposes. Especially in gunshot wounds, the wound and the bone flap must be photographed in detail in order to prevent the findings from being lost. In cases with bone defects due to gunshot wounds, the distinction between the

entrance and exit wounds may be performed after the examination of the bones.

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

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