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CASE REPORT

Gunshot Injury in Hong Kong: Report of 2 Cases

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ABSTRACT

Gunshot injury is a serious but uncommon type of trauma in Hong Kong. This report describes 2 cases of gunshot injury, 1 by a handgun and 1 by a shotgun. The literature is reviewed, with emphasis on important imaging features and associated forensic implications.

Key Words: *Foreign bodies, Wounds and injuries, Wounds, gunshot*

INTRODUCTION

Gunshot injury is a serious but uncommon type of trauma in Hong Kong. According to the crime statistics of the Hong Kong Police, there has been a decreasing trend for robbery involving firearms (including stun guns) and pistol-like objects from 1995 to 2005. In 2005, there were 8 incidents of robbery involving firearms and 28 incidents of robbery involving pistol-like objects.[1]

There are 2 main types of projectiles used in firearms: bullets and pellets. Handguns and rifles fire bullets while shotguns fire pellets. This case report illustrates the different imaging features of gunshot injury caused by these 2 types of projectiles.

CASE REPORT

Patient 1

A 28-year-old man presented to the Accident and Emergency Department at Queen Elizabeth Hospital, Hong Kong, in 2006 after being shot in the right side of the face by a handgun.

Lateral cervical spine radiography showed metallic densities at the level of the mastoid (Figure 1). Urgent computed tomography (CT) scan of the face showed fractures of the anterior and lateral walls of the right maxilla (Figure 2). Fracture was also noted at the right mastoid, where there were associated metallic fragments in adjacent soft tissues compatible with bullet fragments. The fractures at the right maxilla and right mastoid could be aligned into a line corresponding to the path traversed by the bullet. The inward bevelling of the fractured anterior wall of the right maxilla indicated that the anterior wall of the right maxilla was the entry point of the bullet. Overall, the imaging findings were compatible with the patient's history of being shot in the face. CT of the brain and CT angiogram of the neck were unremarkable.

Figure 1. Lateral cervical spine radiograph showing multiple metallic densities of various sizes and shapes at the level of the mastoid.

The patient was also shot in the right shin, but the radiograph did not show any fracture. Wound debridement of the right face and right shin was subsequently

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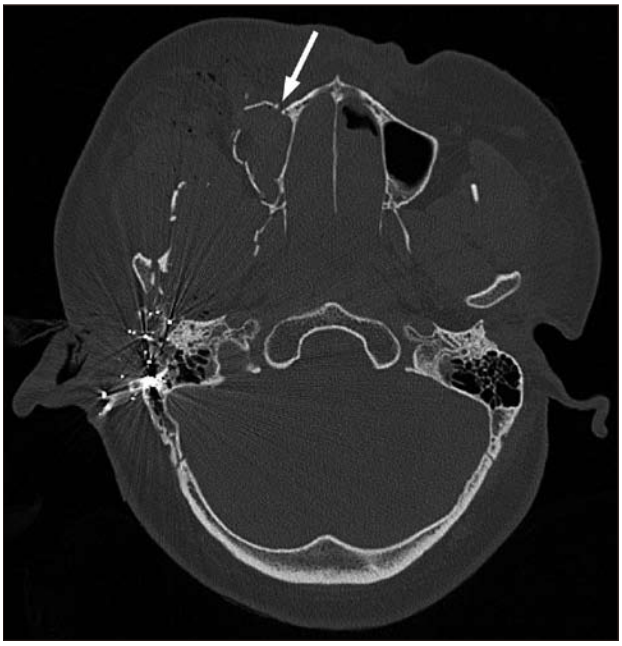

Figure 2. Non-contrast computed tomography scan of the face in the bone window setting showing fractures of the right maxilla and right mastoid. The linear alignment of the fracture sites corresponded with the path of bullet. There was inward bevelling of the anterior wall of the right maxilla at the fracture site (white arrow) indicating the location of the entry site.

performed. The patient had postoperative physiotherapy and had an uneventful recovery prior to discharge.

Patient 2

A 28-year-old man presented in 2006 with shotgun wounds to the left side of his body from a distance of 40 ft. CT scans of the thorax, abdomen, and pelvis were performed. Scout view showed multiple round, smooth, uniform-sized metallic foreign bodies over the left side of the body, compatible with pellets fired from a shotgun (Figure 3). Non-contrast CT images of the thorax, abdomen, pelvis, and thigh showed multiple round metallic densities in subcutaneous and intramuscular compartments over the left side of his body (Figures 4 and 5).

Diagnostic laparoscopy was performed, showing intact peritoneum. Wound debridement of the thigh by an orthopaedic surgeon was performed. Removal of the superficial pellets was done, but most of the pellets were deep-seated and were not removed. The patient requested discharge against medical advice on postoperative day 2 and was lost to follow-up.

DISCUSSION

Bullets are usually measured by their calibre, which is the diameter in inches or in millimetres. Shotgun cartridges are measured by gauge — the smaller the gauge, the larger the diameter. Rifles and handguns usually fire a single bullet, while shotguns fire multiple metal pellets at each discharge.

Figure 3. Scout view of non-contrast computed tomography of the thorax, abdomen, and pelvis showing multiple round uniform-sized metallic densities at the side of the body wall and both thighs.

Pellets spread outwards with a rapid decrease in velocity after leaving the barrel of the shotgun.[2] The area of distribution increases and the energy in each pellet decreases with range. Therefore, range differences affect the wounding potential of shotgun pellets far more than they affect the wounding potential of bullets.

Bullet injuries differ in severity in different kinds of tissues. Injury is most severe in friable solid organs

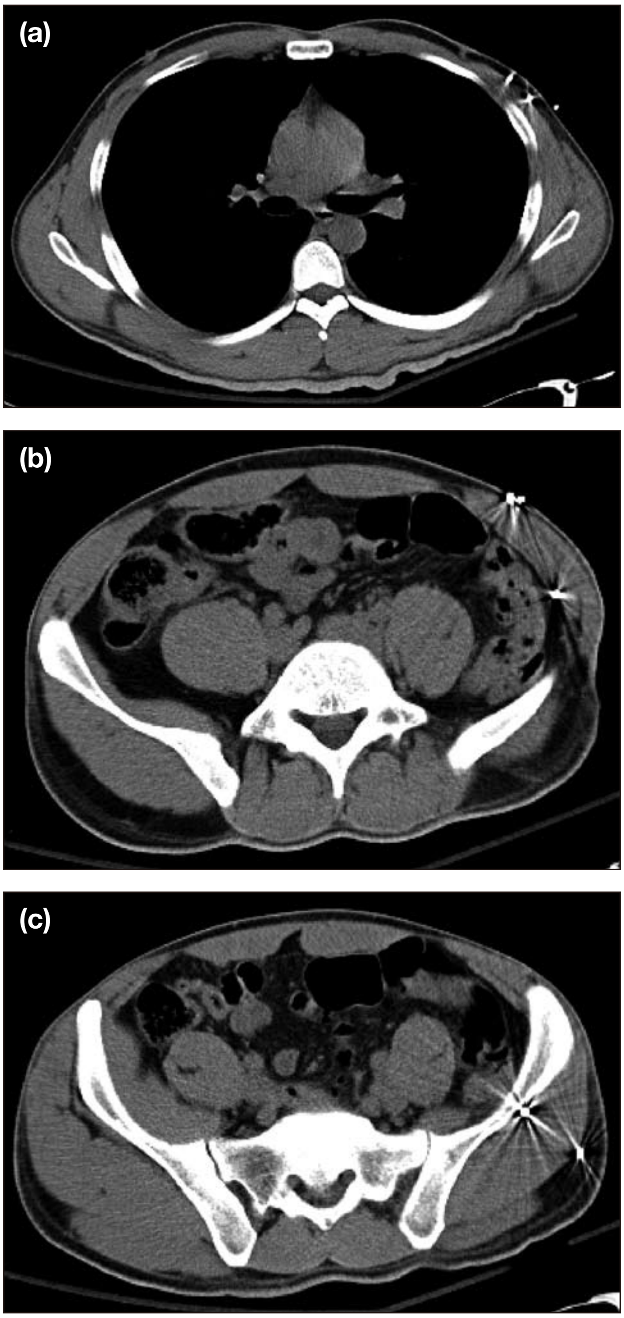

Figure 4. Non-contrast computed tomography of the (a) thorax, (b) lower abdomen, and (c) pelvis, showing multiple shotgun pellets in subcutaneous and intramuscular compartments.

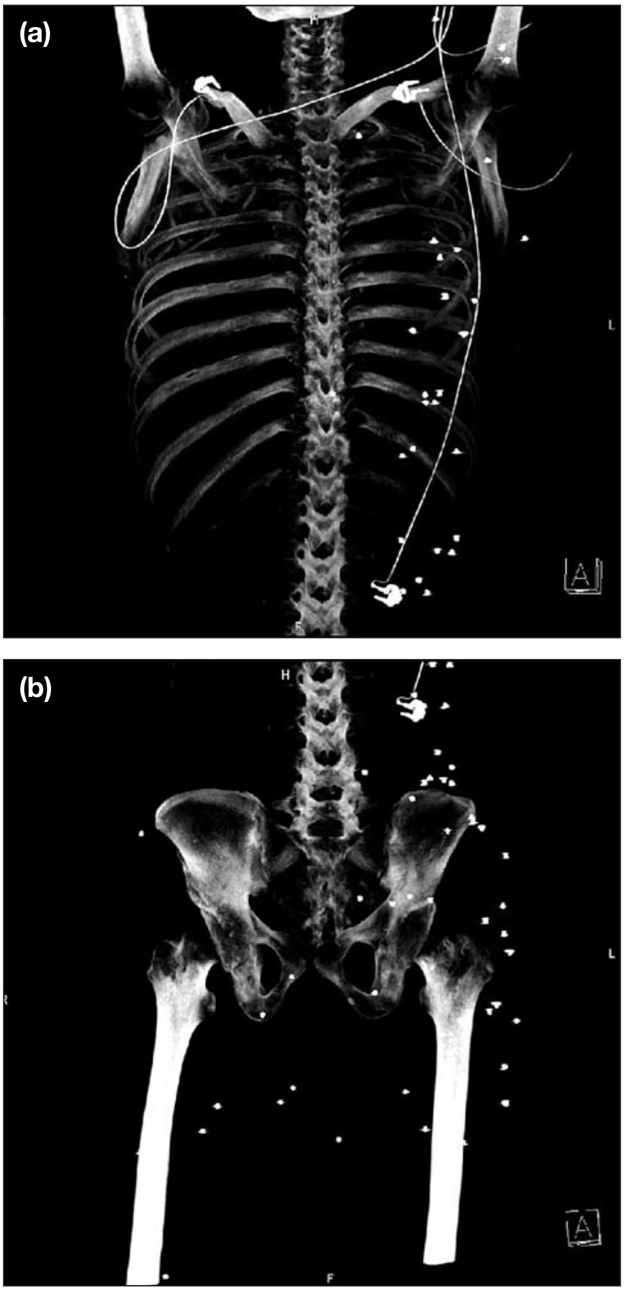

Figure 5. Non-contrast computed tomography, using the volume rendering technique, of the (a) thorax, and (b) pelvis and upper thighs, showing the locations of the pellets and their relationship with the adjacent skeleton.

(liver and brain). Dense tissues (bone) and loose tissues (subcutaneous fat) are more resistant to bullet injury.[2]

The combined mass of multiple pellets fired at a short distance can cause severe soft-tissue and bone damage, because a relatively large mass is decelerated, with its kinetic energy deposited in a small volume of tissue. The aims of imaging for patients with gunshot wounds are well defined: to determine the path of the projectiles, to assess which tissues have been injured, to estimate the severity of injury, and to determine what additional investigations are needed.[3,4]

Conventional radiography with 2 orthogonal views should be the initial investigation to assess the path of the projectile and extent of tissue damage.[5] Bone and bullet fragments are usually distributed within the soft tissues, beyond the defect in the bone, along the bullet path. Bevelling of the bone in the direction of travel is another indicator of the path of the projectile.[5] The 'lead snowstorm' appearance on radiographs is seen with injury from high-velocity bullets.[2] A conical distribution of lead fragments is seen on radiographs, as the area over which the lead snowstorm fragments widens as the distance from the entry site increases. Therefore, the apex of the cone indicates the entry site.

CT is useful for the preoperative planning of surgery in the head, neck, and trunk, especially when an exclusive body-wall or retroperitoneal path is suspected. In the head and neck region, CT is useful for analysis of the bullet path and to determine which specific brain structure is injured. CT is also useful to determine whether the peritoneum is traversed by the bullet. If peritoneal penetration is suspected, laparotomy is indicated. Preoperative CT assessment of the degree of solid organ injury, intestinal injury, and abdominal aortic injury helps to guide the operation. The urinary tract can also be assessed by CT, using excretory phase images.[4] CT is rarely necessary for injuries of the extremities. No significant intra-abdominal injury was detected by CT in patient 2, but the clinical suspicion of peritoneal penetration was high. The surgeons therefore selected diagnostic laparoscopy as the treatment of choice, enabling fast postoperative recovery.

Angiography is essential when vascular injury is suspected.[4] Vascular injury must be suspected whenever projectiles travel close to major vessels, as pellet embolisation is a significant complication of gunshot injury.[6] Potential organ or tissue infarction may occur.

Messmer and Fierro suggested specific questions to be answered in the radiological forensic investigation of fatal gunshot wounds.[7] These are summarised in Table 1.

The safety of magnetic resonance imaging (MRI) for assessment of patients with gunshot injury is a concern. As steel is ferromagnetic, bullets jacketed with steel or steel pellets may be subject to dangerous motion in a strong magnetic field. Therefore, MRI may be contraindicated for patients presenting with gunshot injuries. However, it is sometimes possible to distinguish steel and lead pellets on radiograph.[8] Lead pellets tend to become deformed and fragment on impact with soft tissues and bone while steel pellets usually retain their shape.

Table 1. Questions for the radiological forensic investigation of fatal gunshot wounds.

1. Is an intact projectile present?
2. What is the location and number of the projectiles?
3. Has the projectile struck bone?
4. Suicide or homicide?

Lead toxicity is another potential complication of gunshot injury, if the lead fragments remain in a joint space, bursal space, or disc space. Lead fragments left in a joint space can also lead to a severe, destructive synovitis.[9] As bullets and shotgun pellets are not sterile, bacteria can be deposited with the projectiles in the wounds, which can contaminate deep tissues in the body. Bacterial wound infection and tetanus are therefore potential complications.

This report illustrates the spectrum of imaging findings by bullets and shotgun pellets in gunshot injuries. Radiologists should be aware of the associated complications and forensic implications when they interpret images of gunshot wounds.

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