

Ball bearing (BB) gun injuries

滾珠（BB）鎗傷

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War game has become quite a popular recreational game in Hong Kong nowadays. Ball bearing (BB) and pellet gun-related injuries should not be overlooked. This article presented a case of BB gun-related soft tissue injury on the face with retained pellet. We also reviewed the types, power levels, and the injuries of non-power guns. The management of BB and pellet gun-related injuries and the preventive measures concerning legislation, education program, product safety awareness and protective gears usage would be emphasized. (*Hong Kong j.emerg.med.* 2010;17:488-491)

戰爭遊戲已成為香港時下相當受歡迎的消遣遊戲。有關滾珠（BB）及丸彈的鎗傷不應被忽略。本文描述一個有關滾珠鎗傷面部軟組織及遺留下彈丸的個案。我們亦檢視非動力鎗的類型、動力級別及創傷；並強調有關滾珠及丸彈鎗傷的處理及有關立法、教育方案、產品安全意識及防護裝備應用的預防方法。

Keywords: Firearms, weapons, wounds and injuries

關鍵詞：火鎗、武器、傷口與創傷

Introduction

Ball bearing (BB) and pellet guns are non-power guns but their related injuries have been reported worldwide. They represent a significant cause of injury especially among children and teenagers.¹ Most people, including emergency physicians, tend to underestimate the severity of injury caused by non-power guns. In fact, missiles from BB and pellet guns can penetrate skin, eye, thorax, and abdomen and even cause bone fracture.² In this article, we present a case of BB gun soft tissue injury with retained pellet on the face and discuss on BB gun injuries and their prevention.

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Case

A 15-year-old boy presented to a local emergency department (ED) in February 2010 for a painful swelling on the nose for one week. He participated in a war game before the onset of symptom. He recalled that he had received shootings over his face for several times during the game and he suspected that the painful swelling was related to the game. The patient did not complain of any nasal block, bleeding or discharge. On physical examination, he could walk, talk and breathe well without any difficulty. On the nose, there was an erythematous nodule overlying the supra-alar crease of the left nose. The nodule was firm in consistency, about 8 mm in diameter and looked similar to acne. There was no discharge from the nodule and the surrounding skin was normal with no sign of inflammation (Figure 1).

Based on the history and physical finding, we suspected that a foreign body had been implanted under the skin to cause the swelling. An ultrasound examination was

performed in the ED. We scanned by using a gel pad on the surface of the nose and with a linear probe of 10.0 MHz. A foreign body of size 6 mm in diameter was revealed just underneath the skin. The foreign body was spherical in shape and composing of a hyper-echoic surface with a hypo-echoic centre. Reverberation artifacts were also observed (Figure 2). These features were compatible with a BB gun pellet.³

The patient received local wound exploration and the BB gun pellet was removed (Figure 3). The wound was treated with daily dressing and healed one week later uneventfully.

Discussion

BB guns have been used for over a century. They were developed initially for target shooting or hurting small

animals like birds, squirrels and small rodents. They were not used for recreational purpose until the 1940's when a western comic Red Ryder promoted BB guns as an advertising gimmick. Airsoft guns are a relatively new type of BB gun developed just 30 years ago in Japan. Airsoft guns shoot relatively less harmful plastic pellets and have lower power than the traditional BB guns. With the popularity of war game, injuries by these non-power guns increase rapidly. Many countries have passed corresponding laws to restrict possession or the use of BB and pellet guns. In Hong Kong, airsoft guns are legal to use but only in private area and they must not be fired with muzzle energy above two joules. Also, people are not allowed revealing airsoft guns in public areas.

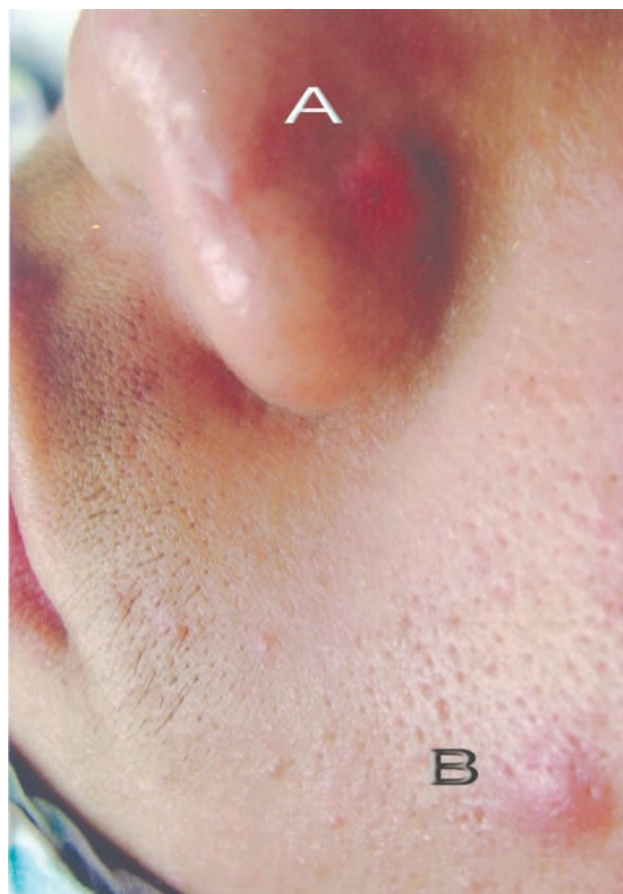


Figure 1. (A) The erythematous nodule where the BB pellet was embedded. (B) An acne that resembled the BB pellet wound, making the diagnosis easily overlooked.

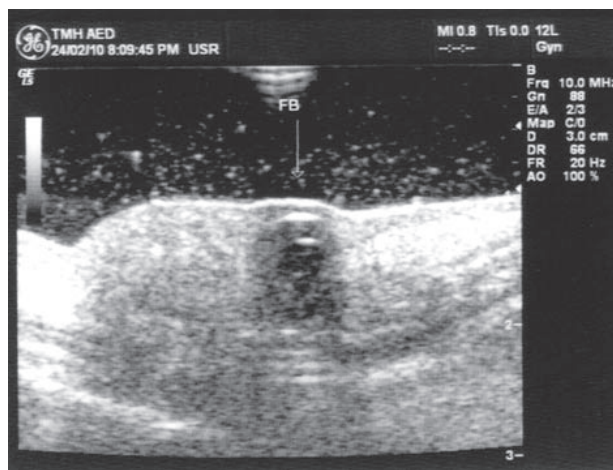


Figure 2. Ultrasound scan of the erythematous nodule showing a hyper-echoic surface with a hypo-echoic centre. Reverberation artifacts are also observed.

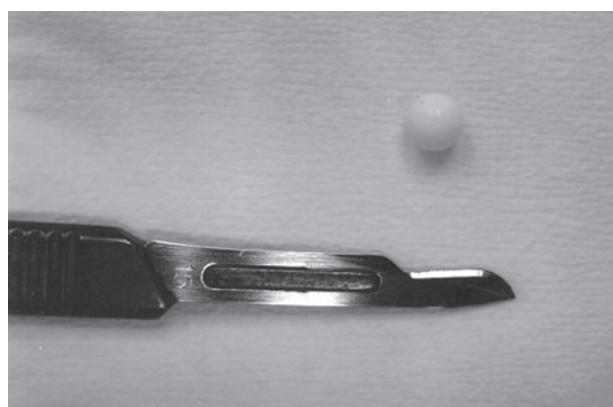


Figure 3. The BB pellet retrieved from the wound.

Different types of non-power guns generate different kinetic energy^{2,4} (Table 1). The kinetic energy (KE) of its missile or pellet⁵ can be calculated as follows:

$$KE = 1/2 MV^2; \text{ where } M = \text{mass of BB pellet and} \\ V = \text{velocity}$$

A BB gun-related injury could be defined as a gunshot wound from a pistol or rifle that fires a ball pellet. Air compression is operated by a spring or pump action mechanism; or by a carbon dioxide cartridge. Although most BB guns fire low-velocity missiles, some can still shoot to penetrate the abdomen, thorax, facial sinuses and even the cranium.⁶⁻⁸ A pellet with a velocity of 45 m/s can penetrate human skin and a velocity reaching 60 m/s can fracture bone.⁹ A low-velocity missile emitting from a BB gun causes damage to tissue in immediate contact only and will not cause damage from shock wave or temporary cavitation in contrast to high-velocity bullets emitting from a power weapon. However, in some cases, a low-velocity missile may ricochet after hitting bone and create secondary missiles from fragmented bone or teeth, thereby causing more injury than that would normally be expected.^{10,11} In addition to KE, the shape and material of the pellet itself will determine the rate of energy dissipation after hitting the target or tissue. It will give rise to different shapes of pathway and depths of penetration that may lead to different damaging effects on the tissue.

Most BB pellets are made of plastic rendering them undetectable by X-ray examination, though some of them may have a metal coat on the surface accounting for certain degrees of radio-opacity.³ Ultrasonography is particularly useful for detecting those non-opaque pellets sited within soft tissue and for their localisation to facilitate surgical removal by placing a marking pin or alternatively, by providing real-time sonographic

visualisation.¹² For deeper injuries, CT scan can be the imaging modality of choice to evaluate the missile projectile course and to assess damages on both soft tissue and deeper structures. Rarely, angiography can be considered in patients with active bleeding, enlarging haematoma, absent pulse, presence of bruit, change in neurologic status or injury located close to important vascular structures.⁹

There is always a debate on whether the implanted BB or its fragments should be removed. Surgical removal can prevent potential complications of retained foreign body such as recurrent infection, fistula formation, persistent pain and recurrent haemorrhage. On the other hand, some deep seated foreign bodies may render surgical removal difficult and their removal may carry a high risk of damage to important structures like blood vessel or nerve.

Serious non-ophthalmic BB gun injuries are rare. However a superficial pellet retained in soft tissue as in our case may still cause serious late cosmetic effect and wound complication due to infection. Early recognition and prompt treatment are important to improve outcome. Emergency physicians should bear in mind that the entry wound may be small and easily missed on physical examination.

Prevention is always better than cure. The literature shows that most of the BB and pellet gun-related injuries occur in children and teenagers aged 19 years or younger.¹ Prevention efforts should focus on informing gun owners that these guns can be dangerous. They should be properly stored, locked and unloaded, so that children could not be tempted to play with them without adult supervision. Legislative statues on limiting the possession and the power of

Table 1. Different characteristics and types of guns^{2,4}

	Airsoft Gun (spring-type)	Airsoft Gun (pneumatic-type)	Airsoft Gun (paintball)	Ball bearing Gun	Firearm
Pellet diameter (mm)	6	6	17	4.5	Variable
Mass (g)	0.2	0.2	0.027	0.34	Variable
Velocity (m/s)	82.5-106	82.5-136	76-91	91-152	227-440
Kinetic energy (J)	0.681-1.124	0.681-1.850	0.078-0.118	1.408-3.928	>2

BB and pellet guns have been passed in many countries. Legislation significantly helps to reduce the number of BB and pellet gun-related injuries.¹ In Hong Kong, air gun is defined as any gun, rifle or pistol which uses compressed gas as propellant and from which any shot, bullet or missile must be discharged with muzzle energy not greater than 2 joules. Under the Firearms and Ammunition Ordinance (The Laws of Hong Kong, Chapter 238), for any air gun discharging muzzle energy greater than 2 joules, it will be regarded as firearm. Anyone with the possession of firearm without permission or license will commit an offence and is liable on conviction upon indictment to a fine of \$100,000 and to imprisonment of 14 years.¹³

Manufacturers should be encouraged to promote product safety and develop low-power guns. The American Society for Testing and Materials (ASTM) has set up voluntary safety standards for the BB gun industry. It contains performance requirements to ensure the proper functioning of products as well as provisions to address instructions, labelling and marketing. For low-power guns, for instance, the minimum labelled age is 10 years, and the risk of serious injury, particular to the eye, is indicated.¹⁴

Ocular injury associated with BB gun is well reported and the consequence could be disastrous. Eye-protective devices (EPD) or impact-rated goggles are highly recommended and effective. No serious ocular injury has been reported in any user while properly wearing an EPD up to ASTM standards.^{1,15} In our case, the patient was wearing an EPD but he sustained a facial soft tissue injury. It signifies the importance of shielding up all exposed body surface area. Wearing protective facial mask or even protective clothing should be promoted among war game players in addition to the EPD.

Conclusion

BB and pellet guns are more than toys. Emergency physicians should be aware of non-ocular injuries in treating victims hurt by BB guns especially retained foreign bodies. Ultrasound is useful in detecting BB gun pellets embedded in soft tissue. Education programs to promote the usage of protective gears

including eye-protective devices and protective garment should be promoted among all war game participants in Hong Kong.

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