The Use of a Magnetic Port Finder in the Retrieval of Air Rifle BBs to the Upper Extremity

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Air-powered rifles shoot ball bearings with enough kinetic energy to penetrate skin and fracture underlying bones. In addition, there are reports of these ball bearings embolizing within the vascular network, causing serious injuries such as ischemic stroke with resultant blindness. The severity of these complications warrants occasional removal of these foreign bodies; however, they can be difficult to localize. In this case report, we describe the use of a magnetic port finder, a sterilizable tool used in breast reconstruction, to localize the foreign body in situ. We believe that this tool is effective at locating ferrous foreign bodies precisely, allowing for surgical retrieval while minimizing damage to surrounding tissue. (J Hand Surg Am. 2018;43(11):1043.e1-e3. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Key words BB gun, foreign body, innovations, magnetic port finder.

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IR RIFLES OR BALL BEARING (BB) GUNS are non-power guns that use compressed air to launch a projectile, typically a steel BB or lead pellet.1 According to data from the Centers for Disease Control and Prevention, the nonfatal age-adjusted rate of injury from BB guns in 2014 was 4.48/100,000 population, 63% of which were to the extremities. Standard air rifles fire BBs with a diameter of less than 0.18 in (4.57 mm); they can reach exit velocities ranging from 120 to over 400 m/s.1,2 These BBs have been shown to be able to penetrate skin, soft tissue, and bone, which often makes them challenging to retrieve.3 In addition, the diameter of the cephalic and basilic veins can reach upward of 6 and 8 mm, respectively, enabling proximal migration of these BBs if they become situated within the intravascular space of the forearm.4 In this article, we present a case of BB gun injury to the upper extremity and describe how the projectiles were retrieved with the aid of a magnetic port finder.

CASE REPORT

A 40-year-old woman presented to the emergency department 6 hours after sustaining multiple injuries to the left upper extremity after firing a BB gun. The patient noted an area of firmness and erythema on the volar surface of the left forearm, as well as pain and discomfort in the left palm hypothenar region. She denied numbness or tingling in the left upper extremity and was otherwise healthy with no medical or surgical history. Review of systems was negative for fevers, chills, or systemic findings. The physical examination was notable for an entry wound on the left volar forearm with surrounding reactive erythema and firmness. There was also a small wound on the ulnar aspect of the hand with a palpable foreign body deeply embedded in the hypothenar eminence. There was no clinical evidence of infection and the wounds appeared clean with no drainage. Radiographs of the left hand (Fig. 1) and forearm (Fig. 2) demonstrated 2
radiopaque foreign bodies within the soft tissue of the radial forearm and volar soft tissue of the hand overlying the base of the fourth metacarpal. The soft tissues were otherwise normal with no osseous injury. The patient was anxious about the retained foreign bodies and requested to have them removed.

One week after the initial injury, the patient was taken to the operating room and general anesthesia was induced. To facilitate the localization of the BBs, we used a magnetic port finder (Fig. 3). This device is most commonly used to localize the magnetic ports in tissue expanders. The magnetic port finder was placed flush against the radial forearm in the presumed region of the foreign body and carefully passed along the skin until the magnet started to move in response to the foreign body. The location of the foreign body was confirmed when the magnet finder was perpendicular to the skin. The site was marked, and localization was confirmed with fluoroscopy. An incision was made at the marked site and dissection proceeded through the skin and subcutaneous tissue. The radial sensory nerve and brachioradialis were identified and retracted and the foreign body was encountered immediately superficial to the radius and extracted. Attention was redirected to the left palm and the magnetic port finder was swept across the hypothenar eminence until the magnet finder was perpendicular to the skin, localizing the object. An incision was made over the area and dissection was continued through the soft tissue.
between Guyon canal and the carpal tunnel. The magnetic port finder was used to guide the dissection until the foreign body was encountered deep to the flexor digitorum tendon adjacent to the fourth metacarpal (Fig. 4).

DISCUSSION

Injuries caused by BB guns have increased in frequency; most of cases involve the extremities. Air-powered guns can generate enough kinetic energy to penetrate skin and fracture bones. Ballistic studies have found that skin penetration occurs at velocities of 45 m/s, and BBs can become lodged deep in the soft tissue. There is controversy regarding whether the retained BB or pellet needs to be removed in an asymptomatic patient. The risks for potential infections, bleeding, and injury to surrounding structures should be balanced against pain associated with the object as well as the potential for the BB to migrate or embolize. These events have been described in case reports, causing devastating complications such as intravascular bullet migration and embolization to the arterial and pulmonary systems.

In addition to plain radiographs, ultrasound has been used to locate superficial foreign bodies such as BBs. However, BBs imbedded deep in the tissue can be difficult to localize. We used a magnetic port finder to identify BB pellets in situ. This device is used in breast surgery to identify the center of the magnetic infusion port of tissue expanders. The ports are backed with a magnetic or ferrous metal to provide a backstop for the filling needle. The magnet is typically made of a neodymium alloy that is suspended by a pivot that moves from a tilted position when on one side of magnetic or ferrous material, to an upright position when directly over the material. These devices have a strong magnet, on the order of 1.25 T, which makes them amenable to finding metallic foreign bodies such as BBs or pellets embedded in the soft tissue. Ultimately, the benefits of retrieving a foreign body need to be weighed against the risks. In this case, the patient had pain and had been worried that the BB might embolize, because she had read of such reports. In cases where the foreign body is made of ferrous metal, a magnetic port finder can be a useful tool to locate the object in situ while limiting damage to surrounding tissue.

REFERENCES