

The Use of MartriDerm in Nail Bed Reconstruction of Thumb Injured by a Pellet

Salim Al Lahham, MD*†
 Ghanem Aljasseem, MD*
 Alreem Al-Khayarin, MD*
 Ruba Sada, MD‡
 Heba Mogahed, MD*
 Abeer ALSherawi, MD*

Summary: Gunshot injuries to the hand and upper extremity can be divided into low and high-energy injuries. Nonballistic firearms such as pellet guns are generally considered low-energy guns but can be associated with serious morbidity and even mortality. Management is tailored according to the severity and type of injured structures. Here, we present the case of a 21-year-old soldier who accidentally shot his thumb with an air gun while on a bird hunting trip, whose case was managed with extraction placement of bone graft and collagen matrix to prevent nail deformity. This case was written to increase the awareness about the need for safe use of such guns and to display the authors preferred way of management. (*Plast Reconstr Surg Glob Open* 2023; 11:e5197; doi: 10.1097/GOX.0000000000005197; Published online 25 September 2023.)

Fingertip injuries are the most frequently encountered injuries in the upper limb.¹ Thumb tip injuries are those presenting distal to the interphalangeal joint. The injury can be classified in terms of severity, as clean cut or crush injury, or by the tissues involved; that is, the injury can include a pulp tissue defect, a complete amputation, fracture of the distal phalanx, and/or nail and nail bed damage.²

The goals of thumb tip repair are to maintain the length and appearance, and restore the sensation.² Gunshot injuries to the hand and upper extremity have been studied during military conflicts and in urban settings. They are divided into low and high-energy injuries depending on the involved weapon. Management includes identification of injured structures, aggressive surgical wound care, and reconstruction of important functional structures.^{3,4} Nonballistic firearms such as BB and pellet guns are generally considered low-energy guns but can be associated with serious morbidity and even mortality.⁵

We present the case of a 21-year-old male soldier who was accidentally shot with an air gun during a bird hunting trip, along with a brief discussion of the management strategy.

From *Plastic Surgery Department, Hamad General Hospital, Hamad Medical Corporation, Doha, Qatar; †Fellowship in Hand Reconstruction and Microsurgery, Ganga Hospital, India and DAFPRS fellowship, Netherlands; and ‡CPESE, Hamad Medical Corporation.

Received for publication April 2, 2023; accepted June 20, 2023.

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DOI: 10.1097/GOX.0000000000005197

CASE PRESENTATION

A 21-year-old male patient with no known comorbidities who is working as a soldier in the Qatar military forces presented to the emergency department with pain and swelling of his left distal thumb. The patient reported history of accidental gunshot injury by an air gun on a bird hunting trip 20 days prior, with a retained pellet. However, he did not immediately seek medical advice, and as a result, his symptoms progressed to increased swelling and pain with discharge. His hand examination revealed left distal thumb swelling, redness, and pus discharge with an entry point to the volar aspect of the distal phalanx pulp.

A foreign body was palpated over the medial aspect of the distal thumb, and the range of motion of the interphalangeal joint was limited due to pain. His laboratory investigations showed normal results, including complete blood count and comprehensive metabolic panel. Left hand X-ray showed fracture of distal phalanx of the thumb with a radiopaque foreign body. (See figure, **Supplemental Digital Content 1**, which shows the preoperative X-ray showing the pellet. <http://links.lww.com/PRSGO/C780>.) (See figure, **Supplemental Digital Content 2**, which shows the 4-month postoperative X-ray, which shows full healing of the defect. <http://links.lww.com/PRSGO/C781>.) Based on his physical examination and X-ray findings, the patient was taken to the operating theatre for removal of the foreign body and further exploration. The thumb nail plate was removed, and the dorsal fold was retracted through bilateral incisions exposing the nail bed. The pellet tip was seen abutting the nail bed, a longitudinal incision through

Disclosure statements are at the end of this article, following the correspondence information.

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the nail bed was done to facilitate removal of the pellet, and proper curettage and irrigation of the bone defect was done. Then the defect was filled with synthetic β -tricalcium phosphate granules (Fig. 1).

A collagen-elastin template was used to separate the granules from the nail bed, to prevent adhesions and create a straight, smooth layer below the nail bed to avoid nail bed deformity, and we folded the MatriDerm to get a layer of 2-mm thickness (Fig. 1). The nail was reapplied, and a splint was placed for stabilization. Tissue culture showed profuse growth of *Staphylococcus aureus*. The patient was discharged home on amoxicillin-clavulanate 1000 mg BID for 1 week and prescribed pain medications. Sutures were removed after 3 weeks in the clinic. At the time of submitting this case, he had completed 1 year posttreatment, showing full

finger recovery and full range of motion, and had resumed his work in the military without any limitations (Fig. 1).

DISCUSSION

Gunshot injuries to the hand can be classified according to the energy of the missile and the location of injury.^{3,6} High-energy gunshot injuries are caused by high-caliber handguns, the greater the velocity the greater the damage. The goal is to prevent early infections by doing the sufficient required debridement and coverage with antibiotics and to regain as much hand function as possible.⁷

Low-energy (<1000 fps) injuries usually take place in urban settings and are usually caused by airguns

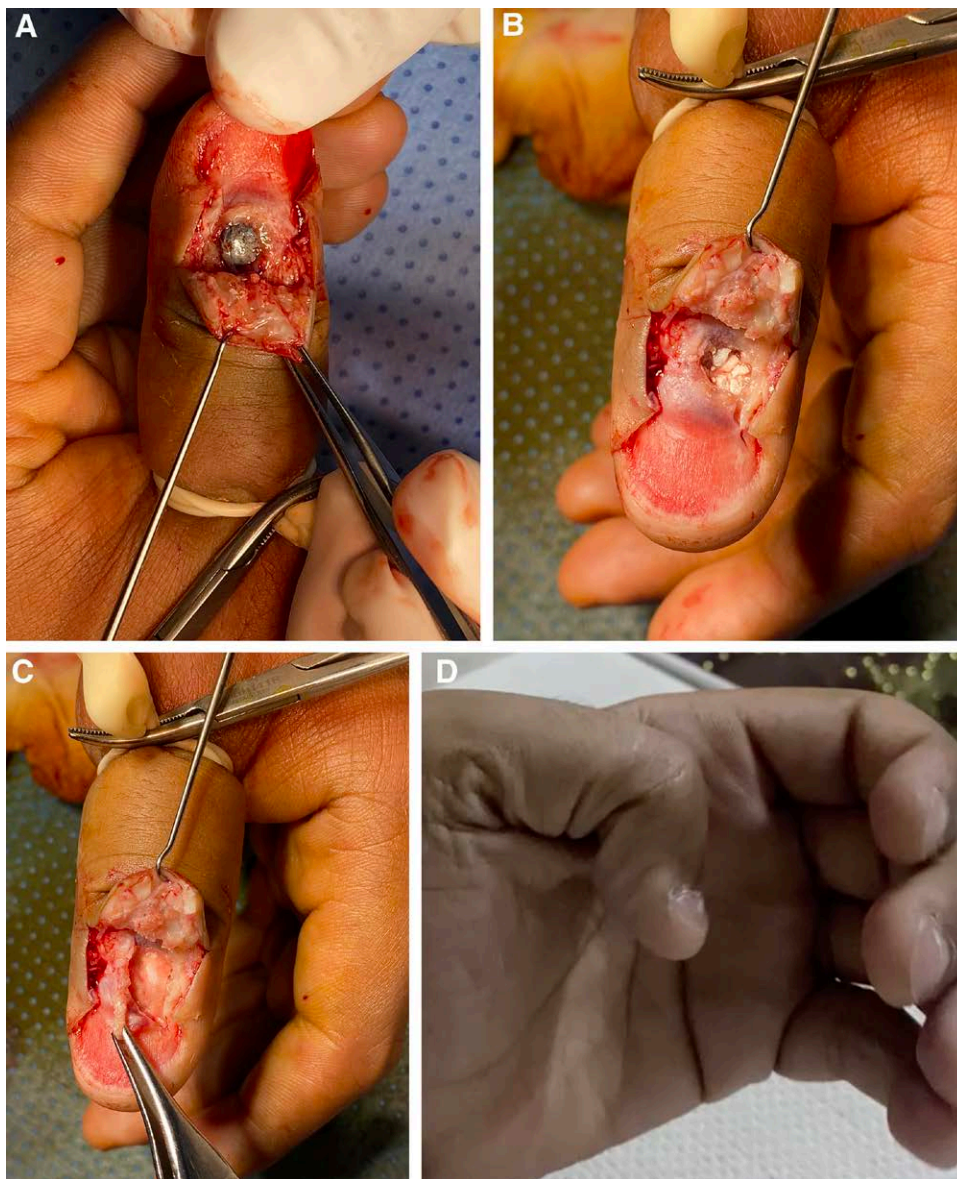


Fig. 1. Intraoperative and postoperative patient photographs. A, Retained bullet in the distal phalanx. B, Placement of the artificial bone graft. C, Placement of MatriDerm. D, Full healing 4 months postoperative.

(nonballistic guns). Although some of these guns can have high velocity that can cause serious damage and mortality, evidenced by 39 nonballistic firearm-associated deaths between 1990 and 2000,⁸ they are often not destructive and require simple treatment and early rehabilitation. Infection rates are usually low when aggressive wound care is used.⁹

The majority of the air gun injuries seen in the emergency department are caused accidentally. Birdshots, the smallest type of air gun pellet, are the most commonly used.¹⁰ They are small metal spheres. Air gun pellet injury can result in serious soft tissue and bone damage. A retained pellet can cause lead intoxication.¹¹

Our case is a typical case of unintentional low velocity air gun injury with retained pellet in a distal thumb, sustained while bird hunting. In 80%–90% of cases, these injuries occur in young people, and 60%–75% of these injuries are caused by self-harm or playing with a friend.¹²

Although less than 1000 fps is considered low velocity, these velocities still pose a risk of penetrating the eyes (130 fps), human skin (290 fps), and bone (350 fps).¹³ In air gun injuries, the risk of death increases as the velocity exceeds 350 fps.

The management of such injuries is guided by the physical exam of the injured structures. Simple X-rays are sufficient for locating metallic fragments. Computed tomography scans are required to assess soft tissue and bone damage. It is also useful for determining the trajectory of the projectile.¹²

Our patient presented with a birdshot pellet that penetrated his thumb tip from the volar aspect and was retained in the distal phalanx abutting the nail bed, causing him pain and localized infection. Because of his presentation, the patient was taken to theatre for extraction of the pellet.

A dorsal approach was used because pulp scars are not preferable. It might cause tenderness for quite some time after surgery; in addition to that, the pellet was closer to the dorsal site abutting the nail, which made the dorsal approach easier for extraction.

Thumb tip injuries are managed according to type of the injured structures, ranging from simple suturing in case of mild soft tissue injuries, to fracture fixation and nail bed repair, to more complex reconstruction in case of a soft tissue defect with exposed bone. The goals are to maintain the length, sensation, and appearance as much as possible.

Using a dorsal approach, the pellet was removed, which resulted in a bony defect. To avoid nail bed deformities, the gap was filled with artificial bone graft, and the graft was separated from the nail bed by an acellular collagen and elastin template (MatriDerm), to even the surface of the bone and to prevent nail bed adhesions to the graft and possible deformity.

The patient was referred to occupational therapy for range of motion exercises, because he had painful restricted motion of his thumb interphalangeal joint, almost 3 weeks before presentation for surgery. Our follow-up showed full range of motion with no residual deformity in the thumb.

Our main purpose for writing this case report is to increase the awareness about the possible injuries that can be caused by such guns, and to display the authors' preferred management of the case to get the best possible outcome.

Ghanem Aljassem, MD

Plastic Surgery Department

Hamad General Hospital, Hamad Medical Corporation

Doha, Qatar

E-mail: galjassem@hamad.qa

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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