



Hand injury with a nail gun: a case report with literature review

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The nail gun was introduced in the late 1950s to increase the ease of driving nails, studs, bolts, or staples into various hard surfaces. The nail gun is a potentially dangerous device that is still commonly used in the construction industry. Since its introduction, an increasing number of studies have reported injuries associated with nail guns. Nail gun-related injuries—such as to the head, neck, and chest—can be devastating, and in some cases, even fatal. Extremity injuries, notably in the hand, can cause loss of function, missed work, and long-term health effects. This case report describes a nail-gun injury of the hand along with a discussion of the unique features of and treatment strategies for nail gun injuries.

Keywords: Hand; injury; nail gun.

The nail gun was introduced in the late 1950s to increase the ease of driving nails, studs, bolts, or staples into various hard surfaces. The nail gun is a potentially dangerous device that is still commonly used in the construction industry.^[1,2] Since its introduction, an increasing number of studies have reported injuries associated with nail guns.^[3] Injuries to different parts of the body have been described.^[1,3] Nail gun-related injuries—such as to the head, neck, and chest—can be devastating, and in some cases, even fatal.^[3] Extremity injuries, notably in the hand, can cause loss of function, missed work, and long-term health effects.^[3] Hand injuries frequently occur in the workplace.^[4] This case report describes a nail-gun injury of the hand along with a discussion of the unique features of and treatment strategies for nail gun injuries.

Case report

A 43-year-old man was admitted to the emergency department with a complaint of a non-dominant left hand injury. The detailed history revealed that the injury was incurred accidentally with a nail gun (Figure 1a). An entry hole was located at the hypothenar region on the palmar side of the hand. Sensory examination of the digits, pulse at the wrist, and capillary refill of the digits were normal. Movements of the 1st, 2nd, 3rd, and 5th fingers at the distal interphalangeal (DIP), proximal interphalangeal (PIP), and metatarsophalangeal (MTP) joints were normal.

The MTP joint of the 4th finger was flexed nearly 45°, and both the PIP and DIP joints were extended. The MTP joint of the 4th finger could be extended neither actively nor passively, nor could the patient flex or

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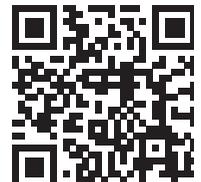
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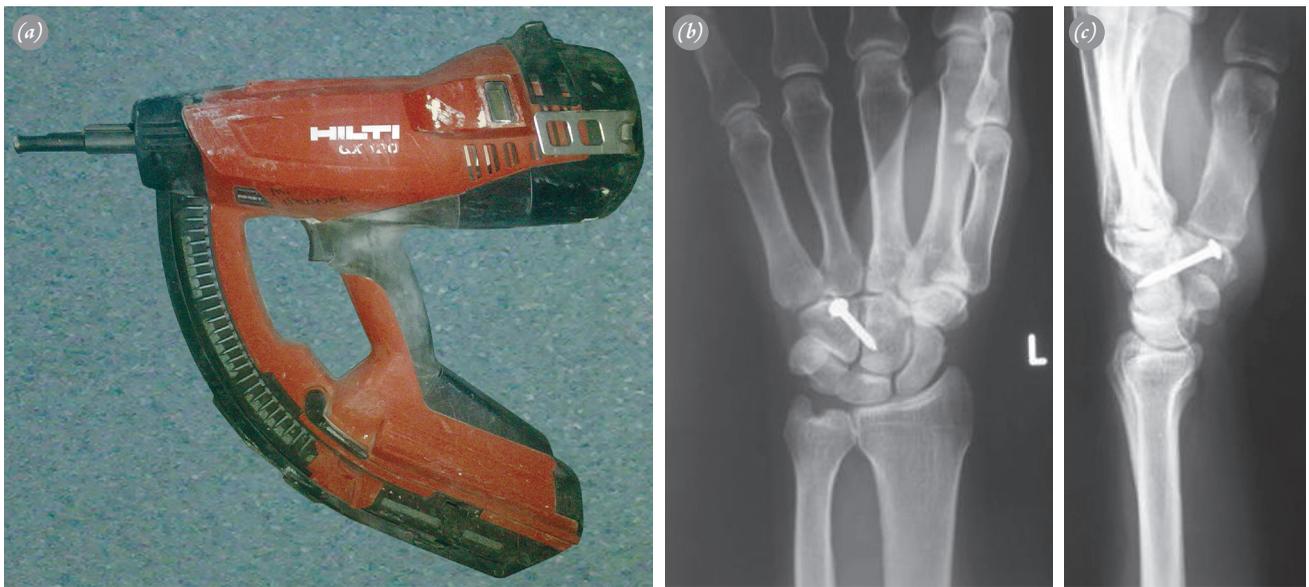


Fig. 1. (a) The nail gun. Posteroanterior (b) and lateral (c) preoperative radiographs of the hand. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

extend the interphalangeal joints of the 4th finger. Radiographs revealed that the nail was embedded in the hand in the os capitatum with no evidence of an associated fracture or barb on the nail shaft (Figure 1b, c). A tetanus vaccine was applied for immunization, and 1st-generation cephalosporin was administered intravenously. In the operating room, the carpal tunnel was opened with regional anesthesia (axillary block) and a tourniquet. The nail with a plastic washer was observed in the tunnel (Figures 2a, b). The nail was removed, and a hole in the superficial flexor tendon of the 4th finger was observed (Figure 2c, d). After irrigation and debridement, the superficial flexor tendon of the 4th finger was partially repaired (Figure 2d). No fractured wrist bones were observed intraoperatively in the fluoroscopic images. The patient received follow-up examinations

at 3, 6, and 12 months. At the last follow-up examination after 12 months, the patient's hand functions and wrist radiographs were normal and there were no sequelae (Figures 3, 4).

Discussion

Nail gun injuries are not rare and are frequently encountered among workers in the construction industry.^[3,5] Nail gun injuries have been reported at various sites including the head, neck, chest, abdomen, vertebral column, spinal cord, and extremities, but the hand is the most common site of injury.^[5,6] Direct bony injuries to the phalanges, metacarpals, carpus, radius or ulna and penetrating injuries of interphalangeal and radiocarpal joints have been observed.^[2,7-10] Several reports have described tendon injuries in which residual disabilities



Fig. 2. (a) Black arrow: Nail entry hole at the hypothenar region; white arrow: Nail. (b) The nail with plastic washer. The hole at the substance of the superficial flexor tendon of the 4th finger (c) and partial repair of the tendon (d). [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]



Fig. 3. Hand functions at the last follow-up examination. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

have occurred despite repair with nail gun injuries.^[5] Neurovascular injuries are uncommon.^[5]

When a patient presents a puncture wound of the hand, the physician must consider the possibility of a residual foreign body in the tissues.^[11] In our practice, we routinely determine the status of tetanus immunization, provide appropriate prophylaxis if indicated, and determine neurovascular conditions including pulses, capillary refill, and digit sensation.

The patient's non-dominant left hand was injured in our case, possibly resulting from use of the non-dominant hand to grip materials to be fastened in areas near the nailing point.^[2]

The MTP joint of the 4th finger could be extended neither actively nor passively, nor could the patient flex or extend the interphalangeal joints of the 4th finger even though the nail penetrated only the superficial flexor tendon of the 4th finger. The tenodesis effect appeared to result from the plastic washer, which was not observed in the radiographs.

Nonmetallic foreign bodies must also be considered when treating nail gun injuries; clotting, skin, paper, adhesives, and plastics may all be carried in to the wound with the nail.^[3,5,10] The head of the nail can remove a small band of skin or clothing as it is driven into the body and deposit it deep into the wound.^[3,8,12] The plastic washer may also be deposited, as in this case.

Treatment options range from simple nail removal to extraction and meticulous irrigation debridement in the operating room.^[1,3,8,13,14] If a visible foreign body is lodged within the wound, the material may be removed under sterile conditions in the emergency department; as long as the foreign body is visible through the existing wound, no additional skin incisions are required for exposure, and no additional surgical exploration in the operating room is needed to repair tendinous or neurovascular lesions.^[11] In the absence of infection, intra-articular involvement, or neurovascular compromise, the

wound can be managed with minimal debridement and a short course of an oral 1st-generation cephalosporin.^[3] Cases with grossly contaminated wounds, neurovascular compromise, or clear penetration of a joint are candidates for open surgery with debridement irrigation.^[3] A tendinous injury observed during physical examination is another indication for surgery. However, there is no consensus concerning treatment strategy in injuries with joint involvement (simple removal of nail with or without intra-articular irrigation).^[12,13,15] We believe that surgeons should open the joint for debridement irrigation in the case of clear joint penetration or suspicion of joint penetration.

Some nails are barbed; thus, retrograde removal of the nails can cause additional iatrogenic damage to the vital surrounding structures.^[5,9,15] Keen attentiveness



Fig. 4. Posteroanterior and lateral radiographs at the last follow-up examination.

can prevent further vascular or neurological damage.^[9] Open surgery or head removal and antegrade extraction is advised for barbed nails.^[7,15,16]

Nail guns should be used carefully by specially trained staff wearing protective clothing. Surgeons should carefully assess each patient and tailor treatment according to the circumstances of the specific case. In addition to usual hand injury treatment principles, surgeons should consider nonmetallic foreign bodies, which may be carried into the wound with the nail, and nail characteristics such as barbs.

Conflicts of Interest: No conflicts declared.

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