Closed Ring Avulsion Injury With Isolated Arterial Insufficiency

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Ring avulsion injuries are an uncommon, often catastrophic, pattern of digit injuries that result from sudden traction onto a ring-bearing digit. The reconstructive treatment of these injuries can be complex because of the characteristic involvement of nerves, muscles, vasculature, and bone. There is paucity of literature describing isolated arterial injuries in the absence of overlying soft tissue and underlying bone involvement. We present an unusual case of a closed ring avulsion injury, wherein a patient initially presented to his local urgent care center with a cool and pale digit without wounds or fractures, and abnormal pulse oximetry readings prompted his transfer to a tertiary care center for further evaluation. Surgical exploration demonstrated isolated disruption of both digital arteries and the preservation of both digital nerves. The digit was successfully revascularized with venous autografting and stripping of arterial thrombi.

Case Report

A 63-year-old otherwise healthy right-handed man presented with an injury to his left ring finger. The patient was working on his boat, when he slipped, and his wedding ring got caught on a part of the boat, leaving him suspended by only his left ring finger with minimal soft tissue injury and no underlying fracture; upon surgical exploration, he was found to have complete disruption of both the radial and ulnar digital arteries, whereas both digital nerves remained in continuity.

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proximal interphalangeal joint. A small, superficial abrasion was the only soft tissue injury. Moreover, he had full active range of motion of the digit.

The patient was taken to the operating room for surgical exploration within 4 hours of his arrival (Fig. 3). Both the radial and ulnar digital nerves were found to be in continuity at the level of

Figure 1. Photographs from the initial evaluation at the patient’s local urgent care center showed a pale and edematous left ring finger with minimal soft tissue injury. The radiographs were negative for a fracture or dislocation.

Figure 2. Upon transfer to our institution, repeat examination revealed ecchymosis and dusky appearance of the left ring finger at the proximal interphalangeal joint.
the injury. The radial digital artery was intact but occluded with a thrombus. The ulnar digital artery was transected with a 1.5-mm gap. Reconstruction of the ulnar digital artery was performed with vein grafting from the distal volar forearm. The digit was revascularized using a vein graft to bridge the gap in the ulnar digital artery (bottom).

Discussion

Ring avulsion injuries encompass a broad spectrum of injury patterns, with presentations ranging from simple soft tissue compression to complete degloving or digital amputation. As such, several classification systems have been developed to standardize their reconstructive management based on specific injury patterns. The initial classification system proposed by Urbaniak et al. in 1980 stratified ring avulsion injuries into 3 classes based primarily on the adequacy of vascular circulation and the extent of soft tissue and bone damage. Class I injuries were defined as those with preserved circulation, in which standard soft tissue and bone care were sufficient for the restoration of function. Class II injuries were defined as those with inadequate circulation, necessitating vessel repair for the preservation of digit survival and function. Finally, class III injuries were defined as those that resulted in the complete amputation or degloving of the involved digit, which require complex management. Nissenbaum expanded upon the classification system established by Urbaniak et al., introducing classes IIA and IIB; class IIA injuries have isolated arterial insufficiency, whereas class IIB injuries involve inadequate circulation plus a bone, tendon, or nerve injury.

The subtle presentation of class IIA injuries may lead to increased risk of missed diagnoses because patients initially present with near-normal range of motion and nonspecific symptoms, such as decreased temperature and mild loss of sensation in the affected digit. Such injuries can be remedied using straightforward microvascular repair, with a reported average total arc of motion of 240° for class IIA injuries specifically and 187° for class II injuries, broadly, with a 91% success rate. Recently, in a systematic review, Sears and Chung reported a mean total arc of motion of 199° in patients who underwent revascularization for the treatment of incomplete avulsion injuries. The study defined incomplete avulsion injuries as those involving inadequate arterial or venous circulation without complete degloving or amputation. Although a highly effective treatment for these injuries exists, missed diagnoses can be devastating, leading to total ischemia and the loss of the affected digit.

In our case, the patient presented with a classic history of a ring avulsion, with a forceful traction injury to his left ring finger; however, he had only a superficial skin abrasion, had no underlying fracture or dislocation, and had completely preserved range of motion. In our initial phone conversation with the referring provider in Alaska, the reported clinical examination was somewhat equivocal, especially in the description of the improvement during their period of observation. We requested that they send us photographs and measure the oxygen saturation of the digit using pulse oximetry, both of which raised concerns for a vascular compromise and prompted the patient's transfer for surgical exploration.

For emergency and urgent care providers in the community, the presentation of class IIA ring avulsion injuries might be ambiguous and at risk of misdiagnosis. Classically, a suspected isolated arterial insult to the digits is confirmed through doppler studies or intravenous digital subtraction angiography. More recently, the use of pulse oximetry for the quantification of vascular injuries in the hand has greatly simplified this diagnostic evaluation, especially because it is noninvasive and widely available. Tarabadkar et al. demonstrated that digits with a pulse oximetry reading lower than 84% had an ischemic injury and required a surgical intervention, whereas readings of 95% or higher were not suggestive of ischemia. Hand surgeons must remain vigilant, particularly during phone consultations in which clinical decisions are often made with incomplete information provided by outside providers with varying degrees of expertise in hand injuries. In addition to radiographs, objective information including pulse oximetry and photographs are useful adjuncts for assessing a patient, and in this case, these resulted in the patient's appropriate transfer and the surgical management of his dysvascular finger secondary to a ring avulsion injury.
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