



## Case series of: Iatrogenic digital compression ischaemic injury in the emergency department

Sakari Pietiläinen, M.D.<sup>a,c,\*</sup>, Anthony Truong, M.D., BPhy<sup>a,b</sup>,  
Randy Bindra, MBBS, MS Orth, FRCS, MCh Orth, FAAOS, FRACS<sup>a,b</sup>

<sup>a</sup> Department of Orthopaedics, Gold Coast University Hospital, 1 Hospital Blvd, Southport, QLD 4215, Australia

<sup>b</sup> Griffith University, Gold Coast, 1 Parklands Dr, Southport, QLD 4215, Australia

<sup>c</sup> Department of Orthopaedics and Traumatology, Turku University Hospital, Kiinamyllynkatu 4-8, 20521 Turku, Finland

### ARTICLE INFO

#### Article history:

Received 15 July 2021

Received in revised form 1 September 2021

Accepted 9 September 2021

Available online xxxx

#### Keywords:

Iatrogenic digital injury

Hand injury

Digital tourniquet

Iatrogenic digital ischemia

Hand surgery

### ABSTRACT

This brief report is a retrospective review of three cases of iatrogenic digital ischemia and clinical outcome at six months. Hand injuries are one of the most common injuries that occur in the working population. Iatrogenic digital ischemia is a rare condition that can be avoided by proper wound management. After the correct initial treatment is provided, it is important to apply the wound dressing correctly to avoid iatrogenic trauma or ischemia. Currently, there is no consensus regarding the best treatment for these injuries. Our aim is to remind clinicians of this rare condition, and to highlight prevention and treatment strategies.

© 2021 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

### 1. Introduction

Iatrogenic injuries are unintended complications from medical treatment, and the causes and the severity of the injuries vary. Common causes of iatrogenic ischaemic digital injuries include self-adherent dressings, tubular gauze, buddy-strapping and forgotten tourniquets [1,2]. These types of injuries are uncommon but can cause significant pain, neurapraxia and when left untreated can lead to digital necrosis [3].

### 2. Case 1

The first patient was a 35-years old gentleman who sustained a left middle finger open nail bed injury with an underlying tuft fracture following a crush injury from a dumbbell. The nail bed was irrigated, debrided and repaired under digital ring block and finger tourniquet in the Emergency Department (ED). He represented to the ED 72 h later due to persistent severe pain. He had a severely swollen and blistered left middle finger with the finger tourniquet still wrapped around the proximal phalanx, which was immediately removed (Fig. 1). There was an absence of sensation distal to the finger tourniquet. The finger had an SpO<sub>2</sub> of 97% and detectable arterial flow on doppler ultrasonography.

He was admitted to hospital to commence on therapeutic enoxaparin, the finger was wrapped in heparin-soaked gauze and a warming blanket system (3 M™ Bair Hugger™) was applied. At six days mark, the patient lost pulse in doppler ultrasonography of the finger and underwent an emergency decompressive fasciotomy for compartment syndrome secondary to venous congestion. Intra-operatively the ulnar and radial digital artery were pulsatile but constricted.

A periarterial sympathectomy, where the sympathetic nerves surrounding the digital arterial are excised, was performed to help promote vasodilation. Two days after the initial surgery, the fingertip was debrided due a necrotic tip and delayed primary closure of the fasciotomy incision was performed. After four weeks, he had preserved capillary refill but still had no sensation distal to the injury. He had no wound healing complications and commenced hand therapy. His middle finger active range of motion (ROM) at the metacarpophalangeal joint (MCPJ) 0–90°, proximal interphalangeal joint (PIPJ) 0–60° and distal interphalangeal joint (DIPJ) 0–30°. His six months Disabilities of the Arm, Shoulder and Hand (DASH) score was 56.7 and still had absent sensation in the finger (Fig. 1).

### 3. Case 2

The second patient was a healthy 38-year old female who sustained a work-related injury from a kitchen knife to her left index finger nailbed. She sustained a two-centimeter wound to the radial part of

\* Corresponding author at: Aninkaistenkatu 12 E121, 20100 Turku, Finland.

E-mail addresses: [sakari.pietilainen@gmail.com](mailto:sakari.pietilainen@gmail.com) (S. Pietiläinen), [anthony.truong@health.qld.gov.au](mailto:anthony.truong@health.qld.gov.au) (A. Truong).



**Fig. 1.** Case 1: Three days post a forgotten finger tourniquet (left) and six months post injury (right).

the index finger nailed with a partial amputation of the fingertip. She was initially treated in the local ED. The nail was removed under ring block, with the help of a digital tourniquet. The partially amputated fingertip was considered viable, and after debridement it was sutured in place with absorbable sutures. The tourniquet was then removed.

Self-adherent gauze dressings were circumferentially applied in two layers with an additional layer of crepe bandage. She was instructed to leave the dressing on for four days until the first wound review. The patient developed severe tightness and pain in the whole finger during these four days, but she considered this as normal post-procedural pain.

When the bandage was removed, a circumferential injury was observed with significant erythema of the entire digit and well-demarcated zone of injury (Fig. 2).

On the following day the patient began to develop blisters and increasing pain represented to the hospital. She was admitted for monitoring and pain relief. On day nine from the injury she was seen at our specialist hand clinic. Her finger was constantly painful with a Visual Analogue Scale (VAS) of 5. Sensation was decreased in the whole finger and excessive blistering originating from ischemic compression injury was observed (Fig. 2). Pulse oximetry demonstrated good perfusion with SpO<sub>2</sub> of 97%, and Doppler Ultrasound confirmed that both radial and ulnar digital arteries had good blood flow. The blisters were decompressed and she was referred to hand therapy for wound care and range of motion exercises.

She presented for a review six weeks from the initial injury. She described absent sensation distal to the PIPJ. PIPJ ROM was  $-30-80^{\circ}$  and DIPJ was  $0-20^{\circ}$ . At the six-month review, all the wounds have healed and her nail has regrown (Fig. 2). She had returned back to full time work. She achieved a ROM of  $20-100^{\circ}$  at the PIPJ and  $0-90^{\circ}$  at the DIPJ. She complained of crepitus with movement and this led to the finding of post-traumatic arthritic changes at the PIPJ and DIPJ on XRAY. Her DASH score at six months was 10.8.

#### 4. Case 3

The third patient is an otherwise healthy 35-years old gentleman who sustained a right thumb laceration from a mandolin blade while slicing vegetables. There was no underlying fracture. The local ED managed the venous bleeding with silver nitrate and adrenaline-soaked

gauze. The thumb was dressed, and the patient was discharged on oral antibiotics. He represented to the ED 24 h later with a severely swollen and blistered right thumb due to a constrictive circumferential dressing around the proximal phalanx of the thumb (Fig. 3). There was an associated neurapraxia of the common digital nerves of the thumb distal to the site of the circumferential dressing. The thumb had an SpO<sub>2</sub> > 95% and detectable pulse on doppler ultrasonography.

Blisters were deroofed at the one-week mark. Daily topical glyceryl trinitrate and weekly silver dressings were applied. The skin had re-epithelized and mild sensory recovery was achieved after four weeks and the patient was able to commence hand therapy. At this time, he had a minimal interphalangeal joint (IPJ) ROM and a Kapanji score of 1/10. After five years, he has an IPJ ROM  $0-50^{\circ}$  and Kapanji score of 9/10. His DASH score was 3.3.

#### 5. Discussion

We wish to present this case series to remind clinicians of the importance of proper management of digital injuries in the emergency department. The combination of an anaesthetised finger post traumatic swelling and tight dressings or a forgotten tourniquet creates the perfect environment to develop digital ischemia.

According to Safe Work Australia there were almost 28,000 work related hand or arm injuries that resulted with one week or more off work in 2020 in Australia [4]. Despite this, the literature concerning iatrogenic digit ischemia is scarce. The first report of this condition was published in 1975 by Miller et al. who described four patients with iatrogenic digital ischemia due to excessively tight circumferential tubular dressings [5].

Elastic materials, such as Coban™, are considered to be more dangerous if improperly used than conventional dressings because the tourniquet effect is more likely [6]. When properly used elastic dressings are useful for the care of isolated digital injuries [7]. The risk of over tightening should, however, be remembered especially in paediatric population, because of the inadequate communication of symptoms by children [8].

Spruiell et al. reported a case where patient had no capillary refill and impairment of perfusion 72 h after injury due to a tight dressing. Urgent decompression with a longitudinal dorsal Bruner-type incision was



Fig. 2. Case 2: Four days after tight circumferential dressings (left) and six months after injury (right).



Fig. 3. Case 3: Day one after tight circumferential dressings (left) and five years after injury (right).

performed. Authors noted a return of circulation and patient was reported to make almost full recovery with functional finger after a 12 week follow-up [9].

In 2010, the United Kingdom National Patient Safety Agency and Royal College of Surgeons released a report on the use of digital tourniquets in surgery [10]. They stated that gloves should not be used as tourniquets and have made recommendations to include tourniquets in the surgical checklist. There are no such recommendations for digital tourniquets in the ED setting. There are studies on digital tourniquet devices that are “unforgettable”, but most are not commonly accessible. In our ED, digital tourniquets and self-adherent dressings are now prohibited. Patients are educated to represent to hospital urgently if they have numbness, paraesthesia or pain that is not relieved by painkillers post procedure.

Pulse oximetry can be used to assess the capillary circulation, and patients should be referred urgently to a surgeon for further evaluation. Doppler ultrasound can provide useful information of the patency of the digital arteries. The treatment principles utilised at our institution involves close observation for compartment syndrome, reduce venous congestion, promote vasodilation and prevent infection. This can be achieved by immediate removal of all bandages or tourniquets from the digit. Medications such as glyceryl trinitrate, aspirin, enoxaparin and heparin aim to improve blood flow and prevent thrombosis. Infection can be prevented with the appropriate use of antibiotics, wound care and debridement of necrotic tissue. Surgical fasciotomy should be considered if there are any concerns for vascular compromise.

Further management requires close follow-up in liaison with hand therapists to help regain the function and the range of motion of the

finger. The importance of careful application of post-procedural digital dressings cannot be over-emphasized. We recommend performing a longitudinal cut to the dorsal side on the proximal part of the bandage to prevent the proximal end curling up and forming a tourniquet.

Excessively tight bandage can lead to devastating consequences to the patient and might cause long-term impairment and neurogenic pain or, in more severe cases, even amputation. [1,6,8,9]

#### Author contributions

SP and AT wrote the manuscript and collected the data. RB had the idea for the article. RB identified and managed the cases and arranged the follow-up. All authors contributed to the revision of the manuscript.

#### Ethics, funding and potential conflicts of interests

Ethics approval for this study was applied from Gold Coast Hospital and Health Services (GCHHS) Human Research Ethics Committee (HREC). As it was a case study, HREC review was not required (HREC reference: HREC/2021/QGC/75772). Written consent was obtained from all patients. The authors have no conflicts of interests to declare. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### References

- [1] Delgado-Miguel C, Muñoz-Serrano AJ, Miguel-Ferrero M, Rodríguez KE, Velayos M, Triana P, et al. Iatrogenic compartment syndrome secondary to burn dressing in a 2-year-old child. *Eur J Pediatr Surg Rep*. 2019;07:e72–4. <https://doi.org/10.1055/s-0039-1698403>.
- [2] Lee TG, Chung S, Chung YK. A retrospective review of iatrogenic skin and soft tissue injuries. *Arch Plast Surg*. 2012;39:412–6. <https://doi.org/10.5999/aps.2012.39.4.412>.
- [3] Makarewich CA, Lang P, Hutchinson DT. Digital ischemia after application of self-adherent elastic wrap dressing: a case series. *Pediatrics*. 2018;141:1–8. <https://doi.org/10.1542/peds.2016-3067>.
- [4] Safe Work Australia. Key WHS statistics Australia. <https://www.safeworkaustralia.gov.au/sites/default/files/2020-11/Key%20Work%20Health%20and%20Safety%20Stats%202020.pdf>; 2020. [accessed 15 June 2021].
- [5] Miller TA, Haftel AJ. Iatrogenic digital ischemia. *West J Med*. 1975;122:183–4.
- [6] Corre KA, Arnold A. Iatrogenic digital compromise with tubular dressings. *West J Emerg Med*. 2009;10:190–2.
- [7] Quinlan CS, Hevican C, Kelly JL. A useful dressing for isolated digit injuries. *Eur J Orthop Surg Traumatol*. 2018;28:999–1000. <https://doi.org/10.1007/s00590-017-2081-y>.
- [8] Bjorklund KA, Rice DM, Amalfi AN. Pediatric digital necrosis secondary to dressing application: a case series. *Hand*. 2018;13:NP14–6. <https://doi.org/10.1177/1558944718772387>.
- [9] Spruiell MD, Messina MJ, Mitchell JJ, Scott FA. A deadly digital dressing: a case of surgical decompression for finger ischemia due to circumferential finger dressing. *J Emerg Med*. 2014;46:655–8. <https://doi.org/10.1016/j.jemermed.2013.09.035>.
- [10] Lamont T, Watts F, Stanley J, Scarpello J, Panesar S. Reducing risks of tourniquets left on after finger and toe surgery: summary of a safety report from the National Patient Safety Agency. *BMJ*. 2010. <https://doi.org/10.1136/bmj.c1981>.