Case Report

A rare case of closed degloving injury of the fifth toe

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ABSTRACT

Empty toe injury is a rare type of closed degloving injury; limited cases have been reported previously, with controversial outcomes. Our case is a 22 year old male who was injured by a trolley bus. The patient presented at our emergency department with extensive swelling of the right foot, deformity of the fifth toe, bruising and intact skin. On clinical examination the phalangeal bone could not be palpated in the fifth toe and there was no capillary refill. The patient underwent open reduction combined with fasciotomies. The toe regained perfusion after the reduction and was under close observation to ensure its viability. Finally the distal and part of the middle phalanx of the toe was amputated. The purpose of this report is to inform health providers about this unique type of injury and contribute to a more sufficient treatment plan.

Level of evidence: IV.

Introduction

Closed degloving injuries are rare and occur as a result of a violent shearing force applied across the skin surface that separates the skin and subcutaneous soft tissue from the deeper fascia planes without rupture of the dermal or epidermal tissue plane. The shear force transects the perforating vessel anastomoses between the tissue planes, creating a resultant void, liquefied fat necrosis and vascular injury [1,2]. The management of closed degloving injuries is not as well established as in open degloving injuries due to the rarity of such cases.

To the best of our knowledge only limited cases have been documented describing “empty-toe” and “closed degloving injuries” specific to the lower extremity and only one case of “empty thumb”. According to the literature in four cases amputation of the toe was the final outcome.

Case presentation

A 22 year old male motorbike driver presented in the emergency department (ED) because his right foot was crushed by a trolley bus, with no other injuries. His foot had significant oedema, with a deformity of the fifth metatarsal and of the fifth toe but the skin was intact. The fifth toe was extremely flexible, insensate and with no capillary refill. The dorsalis pedis artery was palpable, but the digital arteries of the fifth toe could not be found on Doppler ultrasonography. The patient presented to the ED approximately 2 h after his injury.

Plain imaging identified a dislocation of the fifth toe with only the distal phalanx being contained under the skin (Fig. 1). There...
was also a nondisplaced fracture of the fourth metatarsal. Time from patient arrival in the ED till the completion of diagnostic test (clinical examination, radiographs, Doppler ultrasonography) was approximately 20 min.

The patient underwent immediate open reduction and fasciotomies of the foot compartments, in the operating theatre. Perioperative antibiotics prophylaxis with second-generation cephalosporin and teicoplanin intravenously, was administered. Time from injury to fasciotomy was approximately 4 h. After reduction the skin color immediately improved and digital artery pulses were identified by Doppler (Fig. 2). The patient could feel the touch of a needle in the whole dorsal and plantar area of the foot including the fifth toe. The foot was placed in a cast and elevated.

However, 48 h after the operation the distal phalanx of the fifth toe displayed signs of inadequate perfusion and necrosis as there was no capillary refill and no sensation of the plantar area of the distal phalanx, while the rest of the toe seemed normal. We decided

**Fig. 1.** Initial anteroposterior radiograph. Note the displacement of the 5th proximal and part of middle phalanx in the web space. There is also a fracture of the neck of the fourth metatarsal.

**Fig. 2.** Clinical picture after the reduction and fasciotomy. Use of the shoelace technique for wound closure. Note the normal color of the fifth toe indicating adequate return of perfusion.
to wait and observe the progress of the necrosis. Five days postoperatively the patient was discharged and he was followed up as an outpatient every three days. He was non-weight-bearing for the first two weeks postoperatively and was under enoxaparin 4000 IU and acetylsalicylic acid 100 mg once per day.

He started hyperbaric oxygen therapy ten days after the fasciotomies. He completed three sessions within twelve days. The toe was checked for edema, sensation, and temperature in the follow up visits. One month after injury the necrotic area of the middle and
distal phalanx which included the nail-bed was amputated (Figs. 3 and 4). The patient had uneventful wound healing and has had painless ambulation on the affected limb at the six month postoperative visit (Figs. 5 and 6).

Discussion

Emptytoeinjuryisanextremelyraretypeofinjurythatcouldprovokeagreatamountofdisability. Closed crushing injuries of the foot have to be under very close neurovascular monitoring. However, even if an appropriate management was performed, digits or limb may be amputated.

Reviewing the literature only limited similar cases of “empty thumb” were reported (Table 1). The earliest case was reported by Metallic and Manoli in 1994 [3]. A crush injury with degloving and translocation of the fifth digit into the fourth web space was described, treated with closed reduction which led to immediate restoration of perfusion. The patient was placed in a walking cast for one week, after which he returned to his normal activities with no subsequent complications [3]. In 1998 Flaherty et al. reported a similar injury of the second toe. A forklift truck ran over the patient’s left foot, distal circulation was absent, the digital soft tissue envelopes were unsalvageable, and the patient underwent transmetatarsal amputation [4]. Another case was reported by Singh et al. [5]. A 33 year old female, had her right foot run over by a truck with injury of the fifth toe. The capillary refill was sluggish and the toe was amputated. Moreover, Tang CL, et al. reported a case of a 20-year-old scooter passenger with dismal outcome, since the fifth toe was eventually amputated [6].

In addition, two cases were reported by Bingham et al. [7]. The first case, was a crush injury with dislocation of the right interphalangeal joint and translocation of the second digit, also complete translocation of the third digit with reentry into the second digit soft tissue envelope and of the fifth digit into the fourth digit soft tissue envelope. After the initial management, at about seven months the patient agreed to transmetatarsal amputation due to complex regional pain syndrome. The other case was a crush injury with transposition of the fifth digit into the fourth web space and distal tuft fractures of the distal phalanges of digits 3 through 5. The toe was not amputated after 16 months follow up, but the patient complained of chronic pain and disability. Moreover, auto-amputation was the final outcome in the case described by Tarleton et al. [8].

Our patient had eventually a painless partial amputation of the fifth toe. In the event this occurs, the neurovascular status should be carefully monitored. Most of these injuries occur from stubbing or crushing mechanisms. As our case demonstrates, though, a closed degloving injury is not a simple fracture of the phalanx; it can be a toe-threatening injury. In the event this occurs, the neurovascular status should be carefully monitored. Stütz et al. suggested that clinicians should meticulously assess the blood flow of injured fingers by capillary refill, digital Allen test, Doppler monitoring, and/or digital subtraction angiography [9].

Because of the severity of these degloving injuries, attempts to salvage traumatized limbs commonly end with devitalized tissue and unpreventable amputation. Consequently the degloving injuries that are not severe do not need an amputation. The outcomes of both reconstruction and amputation have been found to be equally satisfactory at the 2-year follow-up point [10]. Patients prefer their own foot, even with a deformity, to a prosthesis, although the return to work activities might be quicker with amputation [11].

According to the literature, the initial management is the check of general conditions of the patient, after that the examination of the limb condition and finally the management of the injury. The status of the vasculature to the toe is likely the key determinant of toe survival. Treatment strategy includes surgical reduction, fasciotomies (if needed), hematoma evacuation, surgical debridement, and amputation.

However, if salvage of the useful portion of the foot with appropriate bone length and soft tissue coverage is possible, it is strongly
Additional treatment options include serial drainage, segmental grafting, and hyperbaric oxygen therapy from day one. Many emergency departments have protocols for diagnosis and treatment of lesser-toe injuries that refrain from performing radiographic visualization of suspect fracture or dislocation of the toes [13]. Furthermore, in our case, hyperbaric oxygen management was used and this supported by the literature [14,15].

The devolving nature of the injury and the degree of the initial soft tissue trauma seems to be the most important factor in determining viability of tissues. However in borderline cases time to reduction and restoration of blood flow by means of anatomic reapportion of tissues and removal of any possible impediments (fasciotomy, severe haematomas, tight dressings or cast) can significantly influence outcomes both in terms of tissue viability as well as functional outcomes post intervention.

Conclusion

In conclusion prompt recognition and treatment (prompt restoration of circulation and avoidance of compartment syndrome) can affect both viability and clinical outcomes in a number of cases, as well as the eventual need for amputation and the amount of tissue removed.

CRediT authorship contribution statement

Concept: Konstantinos Kateros
Design: Konstantinos Kateros, Georgios Kyriakopoulos
Definition of intellectual content: Georgios Kyriakopoulos, Maria Vlachou
Literature search: Georgios Kyriakopoulos, Maria Vlachou, Leon Oikonomou
| Author                       | Age | Sex | Mechanism of injury                                      | Injured toe/finger | Vascular status                                                                 | Treatment                  | Outcome                                      |
|------------------------------|-----|-----|----------------------------------------------------------|-------------------|---------------------------------------------------------------------------------|----------------------------|----------------------------------------------|
| Matelic TM and Manoli A [2]  | 38  | M   | His left foot and leg were caught under the wheel of a forklift | Fifth toe         | No evidence of capillary refill but regained normal color after open reduction | Open reduction             | Returned to normal activities as tolerated   |
| Flaherty JD, et al. [3]      | 46  | M   | A forklift truck ran over his left foot                  | Secondary toe     | Distal circulation was absent                                                   | Closed reduction           | Amputated                                   |
| Singh HP and Downin ND [4]   | 33  | F   | A truck ran over her right foot                          | Fifth toe         | Capillary refilling was sluggish                                                | Open reduction             | Amputated                                   |
| Tang CL, et al. [5]          | 20  | F   | Foot was stuck between 2 collided motorcycles            | Fifth toe         | Capillary refilling was sluggish                                                | Open reduction             | Amputated                                   |
| Bingham AL, et al. [6]       | 27  | M   | Foot was crushed by train car wheel                      | Dislocation of hallux interphalangeal joint, translocation of toes 2,3,5 | Intact biphasic dorsalis pedis and posterior tibial pulses | Open reduction and K-wires | Transmetatarsal amputation                   |
|                             | 60  | M   | A hydraulic fork lift was driven over his left foot      | Fifth toe         | Dorsalis pedis and posterior tibial arteries were intact                        | Closed reduction, K-wire   | Non amputated-chronic pain                  |
| Tarleton AA, et al. [7]      | 25  | M   | Twisting injury in a motorcycle accident                 | Fifth toe         | Dorsalis pedis and the posterior tibial pulses were intact                     | Open reduction and K-wire. | Gangrene auto-amputated                      |
| Our case                     | 22  | M   | Road traffic accident                                    | Fifth toe         | The digital arteries of the fifth toe could not be found on Doppler scan       | Open reduction             | Partial amputation                          |
Clinical studies: Georgios Kyriakopoulos, Spyridon Galanakos
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Guarantor: Konstantinos Kateros

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Declaration of competing interest

The authors declare that they do not have any competing interests.

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