Re-implantation of a Degloving Amputation of Distal Index Finger Caused by Fireworks: A Case Report and Literature Review

Q Zhang, XC Cao

ABSTRACT

Amputations associated with fireworks are customarily treated by stump revision resulting in permanent disability. In this case report, we present an eight-year old boy who suffered an amputation of his right distal index finger at the level of the epiphyseal disk with degloving injury of the amputated finger caused by fireworks. Successful re-implantation was achieved. Two-year follow-up revealed fair cosmesis and acceptable functional and aesthetic recovery though the free distal phalanx had been absorbed completely. Re-implantation of a degloving amputation finger caused by fireworks is possible and can provide good distal soft tissue coverage and recovery of sensory and motor functions.

Keywords: Degloving amputation, fireworks, re-implantation

Re-implantación de una Amputación por Desguantamiento de un Dedo Índice Distal Causada por Fuegos Artificiales

Reporte de Caso y Revisión de la Literatura

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RESUMEN

Las amputaciones relacionadas con fuegos artificiales son tratadas habitualmente por revisión de muñón, lo que trae como resultado una discapacidad permanente. En este reporte de caso, presentamos a un niño de 8 años que sufrió una amputación de su dedo índice derecho distal a nivel del disco epifisario con lesión por desguantamiento del dedo amputado causada por fuegos artificiales. Se logró una re-implantación exitosa. Los dos años de seguimiento revelaron una corrección quirúrgica cosmética satisfactoria, así como una recuperación funcional y estética aceptable, aunque la falange distal libre había sido absorbida completamente. La re-implantación de un dedo amputado por desguantamiento causado por fuegos artificiales es posible y puede proporcionar buena cobertura de tejido suave distal y recuperación de las funciones sensoriales y motoras.

Palabras claves: Amputación por desguantamiento, fuegos artificiales, re-implantación

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INTRODUCTION

China residents celebrate the Spring Festival and other festive occasions with fireworks. During this period, many patients present to hospital with injuries due to fireworks and children who lack safety awareness and adult supervision make up a disproportionately large number of those injured. Injury types include burns, abrasions, lacerations and so on. Amputation associated with fireworks is a common type of injury and often leads to disfigurement and functional disabilities because of low survival rate of re-implantation. In a study by Coulet *et al* (1), the authors reported a series of hand injuries associated with fireworks. Five hands presented with an amputation of the thumb together with the index finger and in three of them the long finger was involved as well. Only one thumb was revascularized successfully.

Here, we present the case of an eight-year old boy who suffered an amputation of his right distal index finger at the level of epiphyseal disk with degloving injury of the amputated finger caused by fireworks; successful re-implantation was achieved. The functional and aesthetic recovery and the

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bone growth of the replanted finger two years after the operation are described.

CASE REPORT

An eight-year old boy ignited a firecracker and it exploded in his right hand before he was able to throw it. The boy was transferred to our hospital with his amputated finger wrapped in dry dressings. At surgery, he presented with localized burns and swelling of the right hand and a distal amputation of his right index finger at the level of the epiphyseal disk with degloving injury of the amputated finger. The amputated finger had two parts: one was the distal phalanx with complete detachment from soft tissue and the other was degloved skin and subcutaneous tissue of the distal index finger. The fingernail was avulsed and the nailbed was lacerated (Figs. 1A, B). The epiphysis was exposed in the proximally amputated stump and separated into two parts. The volar part was attached to the articular capsule of the distal interphalangeal joint and the dorsal part was attached to the extensor tendon. The flexor tendon was avulsed from the metaphysis of the distal phalange and retracted into the peritendineum. Fortunately, the digital nerves and artery were not found avulsed from the proximal stump. Radiographs of the right hand revealed a terminal phalanx defect distal to the epiphyseal disk and an epiphyseal fracture (Fig. 1C).

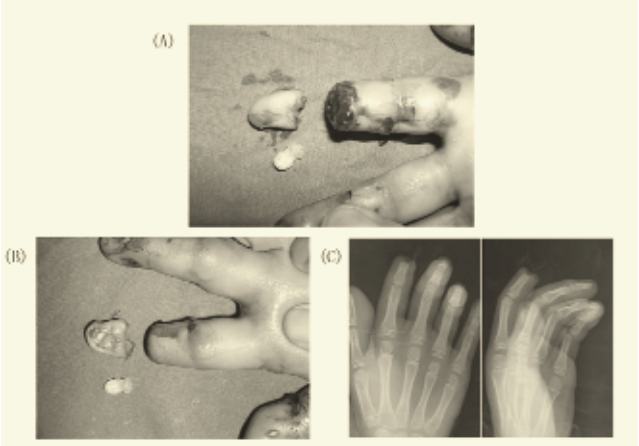

Fig. 1: (A) Amputation of the right distal index finger and the degloved skin and subcutaneous tissue. (B) Dorsal view. (C) Anterior-posterior and oblique radiograph.

Re-implantation was performed under general anaesthesia and brachial plexus block four hours after the accident. Following thorough cleaning of the wound, devitalized tissues were carefully undertaken under the microscope. With a midlateral incision, the ulnar digital artery, ulnar digital nerve and a volar subcutaneous vein were dissected and evaluated carefully by microscope. The separated epiphysis was reduced and fixed with suture and the avulsed flexor tendon was attached to the repaired epiphysis with suture. The free distal phalanx was fixed with the repaired epiphysis and the middle phalanx using a longitudinal Kirschner wire. The degloved tissue was then pulled over the denuded skeleton and the ulnar digital artery and the volar subcutaneous vein were anastomosed with an end-to-end tension free anastomosis using 11−0 monofilament nylon sutures. The ulnar digital nerve was anastomosed with a 8−0 mono-filament nylon suture. The wound was closed and dressed. Immobilization with a dorsal long-arm splint was performed. The injured child was given prophylaxis for tetanus, broad spectrum antibiotics, low molecular weight dextran (250 ml per day) and cardoverine (20 mg per six hours). The wound healed without infection and the re-implanted digit survived (Fig. 2A).

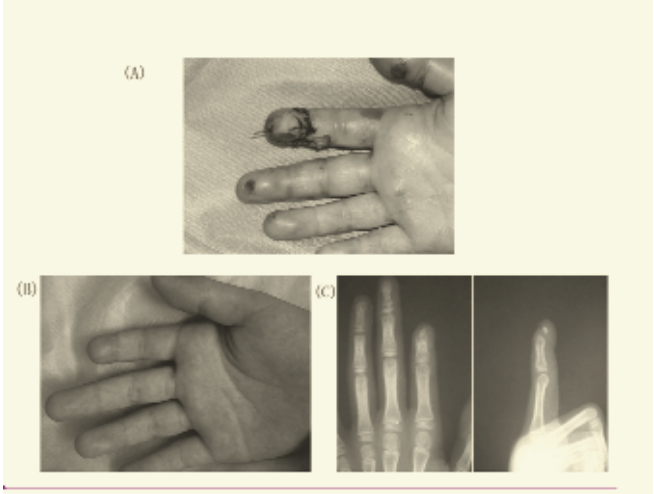

Fig. 2: (A) The re-implanted digit survived completely; (B) The re-implanted segment had moderate atrophy two years after surgery; (C) Anterior-posterior and lateral radiograph showed that the free phalanx had been absorbed completely.

Clinical and radiological evaluation was made two years after the re-implantation. The re-implanted finger had moderate atrophy and the new fingernail grew and showed moderate deformity. The longitudinal growth rate of the re-implanted distal index finger relative to contralateral distal index finger was 58.3% (Fig. 2B). Range of motion in the distal interphalangeal joint of the re-implanted digit was 15 degrees and the total active movement (TAM) of the index finger was 205 degrees. The grip strength was 70% of the normal side and the pinch strength was 76%. Sensory recovery of the digit was satisfactory. The re-implanted finger regained sensation with two-point discrimination of 4 mm static and 3.2 mm moving and cold intolerance was slight. A radiological plane showed that the epiphysis of the distal phalanx was smaller with higher density and the free distal phalanx had been absorbed completely (Fig. 2C). Despite that, the injured boy was able to use the re-implanted digit successfully in his daily life and he and his parents were satisfied with the functional and aesthetic recovery.

DISCUSSION

In review of the literature, cases with re-implantation of complete degloving amputations (type III ring avulsion in-

jury) have been reported. Hyza *et al* (2) re-implanted six cases of ring avulsion injuries. They resected the damaged part of the artery radically and repaired the artery with primary vein grafting. All of the six re-implanted fingers survived and the functional results were good. They considered that it was important to carry out primary vein grafting for the re-implantation of the ring-avulsed finger. Adani *et al* (3) reported a series of 10 patients with ring avulsion injuries. They advocated that complete degloving injuries leaving the tendons intact and amputation distal to the insertion of the flexor digitorum superficialis tendon injuries should be re-implanted and stump revision preferred for amputation proximal to the insertion of the flexor digitorum superficialis tendon. The injury mechanism of the above cases was crush or avulsion and all patients were adult. However, to the best of our knowledge, this study is the first case report of re-implantation of an amputated finger with degloving injury caused by blast in a child. Moreover, the distal phalanx in the index case was completely detached from the epiphyseal disk and the degloved soft tissue. Because the mechanism of injury due to a fireworks blast is characterized by combined thermal and crush destruction of the tissue, it is more difficult to re-implant this kind of amputated finger.

The success of re-implantation depends on the condition of the capillary bed, the feasibility of microvascular anastomosis and profound skills in reconstructive and microvascular surgery. On the other hand, many complicated injuries that are contraindicated for re-implantation in adults can be surgically repaired in paediatric patients because of their anatomical and physiological characteristics (4). Paediatric patients have small vessels, but the relative size of the vessels when compared with their bodies is greater than that of adults. Paediatric vessels have good elasticity and their soft tissues possess a vigorous vitality. The absence of diabetes mellitus, atherosclerosis and hypertension confirms the safety and effectiveness of the microsurgical procedure in children (5). In the described case, the location of the amputation was at the level of epiphyseal disk of the distal phalanx and the digit was re-implanted with a good functional result. We carefully judged the degree of the artery and vein injuries with microscopic magnification and found that the condition of the ulnar digital artery and a volar subcutaneous vein was good enough for microvascular anastomosis.

After two years of follow-up, the recovery of sensitivity was excellent with two-point discrimination of 4 mm static and 3.2 mm moving. A digital nerve anastomosis and the strong regenerating power in children are important factors favouring excellent result. Faivre *et al* (6) stated that children sometimes may not require reconstruction of the nerves after distal digital re-implantation because spontaneous neural formation is possible. Flexor tendon re-insertion, the re-implantation site and the ability for adaptation and rehabilitation in children provided the preservations of TAM, grip strength and pinch strength.

Another rare phenomenon was that the free distal phalanx had been absorbed completely. It was demonstrated by the follow-up radiological plane two years after the operation and explained why the re-implanted finger showed a certain degree of atrophy and the fair cosmesis recovery. Creeping substitution is a process of bone remodelling by osteoclastic resorption and creation of new vascular channels with osteoblastic bone formation resulting in new Haversian systems. The distal phalanx had detached from the soft tissue and the epiphyseal disk completely and avascular necrosis occurred. In addition, the distal phalanx did not get creeping substitution from the surrounding bone. So it was absorbed and finally disappeared. On the basis of our review of the literature, this kind of phenomenon was only noted by Obert *et al* (7) in a French case report. They reported a case of microsurgical re-implantation of a degloved finger. Four months following re-implantation, avascular necrosis of the middle and distal phalanges was apparent. But the case did not show a dislocation of the interphalangeal joint and the author performed a follow-up for four months. The necrotic phalanges were not absorbed in such a short period.

In conclusion, this case illustrates that the degloving amputation caused by fireworks can be re-implanted successfully in children. The operation may provide good distal soft tissue coverage and obtain satisfactory recovery of sensory and motor functions. Re-implantation of amputations in children that is beneficial to them both physically and psychologically should be embarked on by surgeons no matter the injury mechanism.

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