

Digital Reconstruction: Great Toe to Thumb Transfer

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Case

This right hand dominant 44 year old steel worker was transferred to the Queen Elizabeth II Health Sciences Centre from Charlottetown, Prince Edward Island after having his right upper limb injured in a steel rolling machine. At presentation to plastic surgery, approximately 9 hours after the trauma he was stable and found to have an amputated and degloved right thumb with complete disruption of the carpometacarpal (CMC) and interphalangeal (IP) joints, avulsion of the thenar musculature, a deep laceration of the palm of the right hand, and a degloving injury of the entire dorsal and volar hand skin and forearm circumferentially (*Figure 1*). He was an otherwise healthy non-smoker, with a past history remarkable only for an uncomplicated vasectomy and allergy to penicillin and bactrim.

Treatment of Hand Laceration

He was brought to the operating room emergently where the injured structures were sequentially identified and reconstructed. The deep palmar laceration had damaged several branches of the median nerve, each of which was identified and repaired. There was a traction injury to the median nerve and sensory component of the radial nerve resulting from the circumferential degloving which was also repaired. Next, the interrupted CMC joint was



Figure 1: Original crush injury

reconstructed using K-wires. Following skeletal stabilization, the thenar musculature was repaired with 3-0 Ethibond sutures. The right thumb was then replanted onto the skeleton and the digital neurovascular structures were reconstructed. The thumb was completed by using K-wires to fixate the IP joint following its reduction. The wound was copiously irrigated and fasciotomies were performed in the hand and forearm to release the underlying tissues prophylactically against compartment syndrome. Where there was insufficient overlying tissue, advancement flaps were used to affect primary closure. Surgery was concluded by dressing with Jelonet and copious amounts of padding. The viability of the severely crushed tissues was not clear.

Case Continued

During the next seven days in hospital the right thumb became necrotic from the CMC joint distally due to the severe crush injury. Two days post injury the

extent of the tissue necrosis was apparent. The thumb had completely necrosed (*Figure 2*), the skin envelope proximal to the CMC joint, the dorsal forearm, volar forearm and elbow area skin were non-viable. All necrotic tissue was débrided (*Figure 3A*). Most of the soft tissue on the dorsal aspect of the hand was non-viable, as was a full thickness 10 x 8 cm area on the forearm.



Figure 2: Demarcated wound - 1 week post-surgery.

Loss of the thumb results in a 40% decrease in ipsilateral hand function. To improve this, great toe to thumb transfer is both a well tolerated and effective reconstructive technique for treating the deficit. It was decided to conduct a series of staged surgeries with this goal.

Perforator Flap Reconstruction

During the first reconstructive surgery an anterolateral thigh musculocutaneous perforator flap was planned to cover the exposed thumb base, metacarpal and right wrist. The extensor pollicis longus tendon and flexor pollicis longus tendon were identified, mobilized and sutured to the proximal phalanx post of the thumb for the future reconstruction. The radial artery, vena comitans and cephalic vein were all dissected out approximately 5 cm proximal to the wrist joint as recipient vessels. A large eschar on the upper arm was also excised along with

approximately 30 cm of necrotic tissue over the medial aspect of the elbow.

A 20 x 6 cm anterolateral thigh flap was marked out, the margins incised and dissected down through the fascia to expose the dominant cutaneous perforator which was traced back to the descending branch of the lateral femoral circumflex artery (*Figure 3B*). The donor site was closed with 0-Ethibond suture for the fascia, 2-0 Vicryl suture for the subcutaneous tissue and running 4-0 Monocryl suture for the skin.

The flap was set onto the arm where the radial and cephalic veins were anastomosed to the flap vessels. The flap artery was approximately 2.0 mm in diameter and was anastomosed to the radial artery in end-to-side fashion with 9-0 Nylon suture in interrupted fashion.



Figure 3: Wound 2 weeks post-injury. **A.** Wound following initial débridement. **B.** Lateral thigh flap used for right hand reconstruction.

The largest flap vein was anastomosed to the cephalic vein in an end-to-end fashion and the smaller to one of the vena comitans of the radial artery in an end-to-end fashion with 9-0 Nylon suture. Skin grafts were harvested circumferentially from the right thigh and applied to the dorsal hand, dorsal forearm and medial upper arm wound with staples and 4-0 Chromic suture. The flap and all skin grafts survived. The patient did well and was discharged home on day five post operatively (*Figure 4*).



Figure 4: Healed wound with thumb amputated 7 months post-injury.

Great Toe to Thumb Transfer

Prior to the second surgery, a CT Angiogram of the right upper limb was carried out to map the vessels to be used as recipients for great toe transfer. The patient was then brought to the O.R. for microsurgical thumb reconstruction where the anterolateral thigh flap over the thumb and metacarpal was split and reflected to expose the extensor tendon, flexor tendon, digital nerves, radial artery and vena comitans of the thumb box. These structures were prepared as the recipient site and then attention was directed to the great toe where a curvilinear incision was used to capture the soft tissue under tourniquet control. This included a portion of the dorsalis pedis artery, vena comitans, extensor

hallucis longus tendon and the superficial branch of the peroneal nerve. The dissection was carried around the lateral aspect of the toe exposing the metatarsal phalangeal joint including attachments to the volar plate and sesamoid bone of the flexor hallucis longus. The toe was dissected preserving the digital nerves, digital arteries, extensor and flexor tendons and sufficient soft tissue to permit reconstruction at the recipient site (*Figure 5A*). The vascular supply to the toe was then transected and the toe transferred to the right hand (*Figure 5B*). In order to close the foot wound a rongeur was used to trim the bone at the metatarsal head and the soft tissue was advanced and closed with 3-0 Monocryl and 5-0 Nylon suture.

The toe was fixed to the thumb base with two longitudinal K-wires. The extensor



Figure 5: Great toe to Thumb Transfer 7 months post-injury. **A.** Dissection of the toe. **B.** Transfer to right hand.



Figure 6: Final Result 11 weeks post surgical toe to thumb transfer. **A.** Dorsal aspect. **B.** Volar aspect demonstrating finger to thumb opposition.

hallucis longus was repaired to the extensor pollicis and the flexor hallucis longus was repaired to the flexor pollicis longus. The two digital nerves were repaired to the digital nerves of the toe and the radial sensory nerve was anastomosed to the superficial peroneal nerve. The dorsalis pedis artery was anastomosed in end-to-end fashion to the dorsal branch of the radial artery and the dorsalis pedis vein was anastomosed to the cephalic vein in the same way. Soft tissues were closed with 3-0 Monocryl and both 4-0 and 5-0 Nylon suture. The patient progressed well and was discharged home on post operative day six with a thumb splint.

At approximately three weeks post-operatively the patient developed an incision line infection which was successfully treated with ciprofloxacin. Four days later the K-wires were

removed and he began more aggressive rehabilitation with occupational therapy. All incisions and skin grafted areas healed. The patient regained a useful range of motion (*Figure 6, A&B*). He returned to work four months after the toe to thumb microvascular transfer.

References

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