

Case Report

Second toe-to-thumb transfer for reconstruction of a mutilated hand following firecracker blast injury – a case report

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ABSTRACT

Firecracker blast injuries to the hand often result in severe mutilation with loss of the thumb, significantly impairing hand function. Restoration of thumb is critical for opposition and prehension. A 30-year-old right-hand dominant male presented with a mutilated right hand following a firecracker blast injury, with amputation of the thumb at the metacarpophalangeal joint, index finger amputation, and middle finger loss at the carpometacarpal level. Initial management included emergency debridement, skeletal stabilization, and soft tissue coverage using a groin flap. First web space deepening was performed at 6 months. Definitive reconstruction with a left second toe-to-thumb transfer was carried out one year after injury using a two-team approach. The postoperative course was uneventful with complete flap survival. At 1-year follow-up, the patient achieved functional opposition and was able to perform activities such as writing, holding objects, and riding a bike. Second toe transfer is a reliable option for thumb reconstruction in mutilated hands, even in delayed settings. A staged approach facilitates optimal functional outcomes.

Keywords: Thumb reconstruction, Second toe transfer, Firecracker injury, Mutilated hand, Microsurgery, Toe-to-hand transfer

INTRODUCTION

Injuries to the hand caused by firecracker blasts represent a unique subset of high-energy trauma, frequently resulting in complex mutilating injuries involving soft tissue, bone, and neurovascular structures. Such injuries are particularly relevant in countries like India, where firecracker-related accidents are commonly encountered during festive seasons. These injuries often lead to loss of multiple digits, with the thumb being most critical for functional restoration.

The thumb contributes to approximately 40-50% of overall hand function, playing a vital role in opposition, pinch, and grasp.¹ Loss of the thumb significantly impairs hand utility and severely affects activities of daily living. Therefore, thumb reconstruction remains a primary goal in the management of mutilated hand injuries.

Various reconstructive options have been described, including pollicization, osteoplastic reconstruction, and microsurgical toe-to-thumb transfer.²⁻⁴ Among these, toe transfer has emerged as a gold standard for traumatic loss and is a reliable and widely accepted technique due to its favorable balance between functional restoration, aesthetic outcome, and minimal donor site morbidity.⁵

Management of mutilated hand injuries often requires a staged reconstructive approach, beginning with initial debridement and stabilization, followed by soft tissue coverage and delayed definitive reconstruction. Delayed microsurgical reconstruction allows for optimization of the recipient bed, resolution of inflammation, and improved planning for functional restoration.⁶

In this report, we present a case of a severely mutilated hand following a firecracker blast injury, managed with

staged reconstruction culminating in a delayed second toe-to-thumb transfer, resulting in satisfactory functional recovery.

CASE REPORT

A 30-year-old male, presented to our department with history of accidental firecracker blast injury, while he was lighting the firecracker during a festival and it accidentally blasted on his right hand near his house in Surendranagar on 15 November 2023.

On clinical examination: patient had a crush injury over volar and dorsal aspect of his right hand with amputation of thumb at metacarpophalangeal joint, complete amputation of the index finger, amputation of middle finger at proximal interphalangeal joint.

The injury resulted in a severely mutilated hand with multiple digit loss and associated soft tissue and bony damage (Figure 1).



Figure 1 (A-C): Preoperative photograph showing mutilated right hand with loss of thumb, index, and middle fingers.

Patient was operated for emergency debridement, bony fixation with K wire. After debridement defect was covered with a groin flap (Figure 2).



Figure 2 (A-C): Post-debridement defect covered with groin flap.

6 months later, patient was operated for first web space creation, Following are the images showing post operative images of first web space creation (Figure 3).

Next the patient was planned for left second toe to right thumb transfer after 1 year of injury.

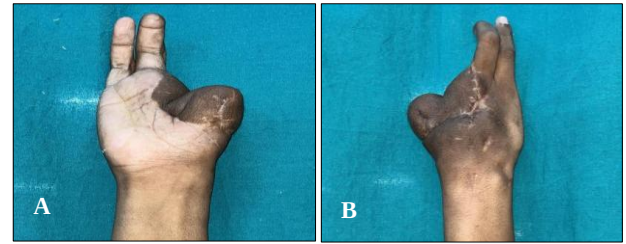


Figure 3 (A and B): Postoperative image following first web space deepening.

Operative technique

Under general anaesthesia and tourniquet control, two team approach for simultaneous preparation of donor and recipient site.

Flap markings

Midpoint of the first and second web marked. A V-shaped skin flap was marked, with the tip of the V being at centre over the second metatarsal about 4 cm proximal to the metatarsophalangeal joint. Plantarly, a similar V flap is marked with the apex directed longitudinally in the non-weight bearing area that lies between the metatarsal heads (Figure 4).

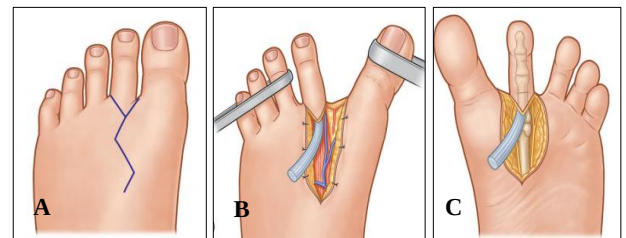


Figure 4 (A-C): Flap markings on donor foot.

Recipient site

A V-shaped skin flap was elevated with meticulous dissection, ensuring preservation of the underlying venous network to maintain adequate venous drainage.

The incision was extended proximally in a lazy S-shaped manner, allowing adequate exposure. Two suitable veins were identified, selected, and dissected to the required length for microvascular anastomosis.

Donor site

The extensor digitorum longus (EDL) tendon of the second toe was identified and isolated, and the extensor hallucis brevis (EHB) was divided to facilitate exposure.

At the first web space, the lateral digital artery of the great toe and the medial digital artery of the second toe were identified and dissected approximately 1 cm proximally.

The T-junction at the division of the first dorsal metatarsal artery (FDMA) was identified, confirming a dorsally dominant vascular system. Dissection was then continued in a retrograde fashion up to the base of the metatarsal shaft to obtain adequate pedicle length.

Plantar dissection, tendon, nerve preparation

The plantar V-shaped flap was elevated, and the underlying fatty tissue was carefully excised.

The flexor tendon (FDL) was identified and divided proximally. Subsequently, the proper digital nerves were identified and isolated for coaptation later. All remaining soft tissues were meticulously elevated off the bone while preserving the vascular pedicle.

Osteotomy and flap harvest

An osteotomy of the second metatarsal was performed at the mid-shaft level, based on the required length for thumb reconstruction.

The vascularity of the flap was ensured, and the flap was allowed to perfuse for approximately 15 minutes prior to division.

Following confirmation of adequate perfusion, the vascular pedicle was ligated, and the flap was harvested (Figure 5).

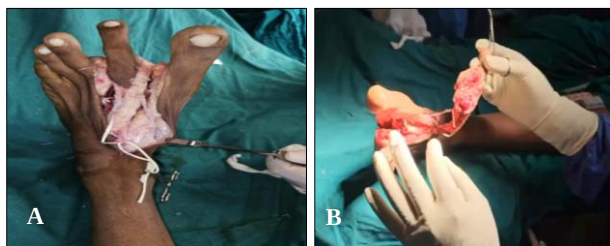


Figure 5 (A and B): Harvested second toe flap with vascular pedicle.

The harvested second toe flap was transferred to the recipient site.

Bony fixation done between the metacarpal and metatarsal bones using two 2-mm plates, ensuring appropriate alignment, length, and orientation of the reconstructed thumb.

Tendon reconstruction was performed using FDL tendon to the flexor pollicis longus (FPL) tendon and Opponensplasty done using flexor digitorum superficialis tendon of middle finger extensor digitorum longus tendon to extensor pollicis longus tendon.

Microvascular anastomosis was then carried out. Dorsalis pedis artery anastomosed end to end with radial artery. Dorsal vein anastomosed end to end with cephalic vein.

Nerve coaptation was performed between digital nerve and radial sensory nerve and between digital nerve and branch of median nerve (Figure 6).

Following confirmation of satisfactory perfusion, the flap inset done. The donor site was closed in layers.

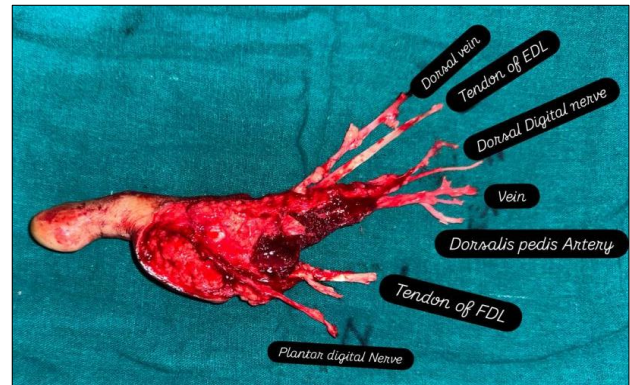


Figure 6: Intraoperative image showing nerve coaptation and vascular anastomosis.



Figure 7 (A-F): Immediate postoperative appearance.

Post operatively, non-bulky, non-constricting dressing done, with the limb in an elevated position. Flap monitoring was done at regular intervals. Intravenous heparin drip given for 5 days, followed by oral aspirin for 10 days.

Early passive mobilization started at 2 weeks and active mobilisation at 6 weeks.

Patient's post-operative course was uneventful with complete survival of the transferred flap. Patient was discharged from the hospital on POD 12.

Donor site healed satisfactorily with no significant gait disturbances.

6 months after surgery, patient was able to carry out routine activities like holding a glass of water, writing his name, riding a bike (Figure 8).

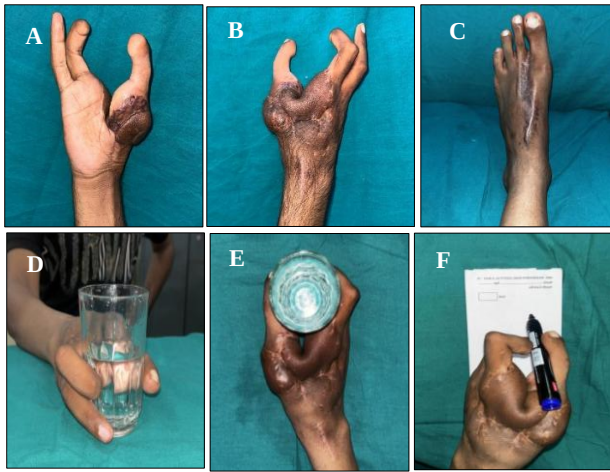


Figure 8 (A-F): Functional outcome at follow-up demonstrating pinch and grasp.

At 1-year follow-up, the patient demonstrated satisfactory sensory recovery and range of motion of the reconstructed thumb, contributing to improved functional outcomes.

DISCUSSION

Firecracker blast injuries to the hand are characterized by high-energy trauma resulting in a combination of soft tissue loss, skeletal destruction, and vascular compromise. These injuries often lead to mutilated hands, where conventional reconstructive options are limited.

Given the pivotal role of the thumb in hand function, its reconstruction is essential for meaningful functional recovery. Microsurgical toe-to-thumb transfer has consistently demonstrated reliable outcomes in complex traumatic injuries.

Since its initial description, toe-to-thumb transfer has been extensively studied with consistently favorable outcomes. Morrison et al and Buncke et al demonstrated reliable restoration of function with microsurgical toe transfer, establishing it as a standard reconstructive option in thumb amputations. Long-term studies by Ninkovic et al have further shown sustained functional outcomes and patient satisfaction following toe-to-hand transfer.⁷

Among the various techniques, second toe transfer offers several advantages over great toe transfer, including a better cosmetic match, adequate length and mobility, and reduced donor site morbidity with minimal gait disturbance.⁸ These findings are consistent with previously published literature emphasizing the functional and aesthetic benefits of second toe transfer.

In the present case, a staged reconstructive approach was adopted. Initial debridement and skeletal stabilization were followed by soft tissue coverage using a groin flap, allowing creation of a stable and well-vascularized bed. Subsequent first web space deepening further optimized the recipient site.

A key highlight of this case is the delayed reconstruction, with second toe transfer performed one year after injury. Delayed microsurgical reconstruction allows resolution of inflammation, optimization of the soft tissue envelope, and improved planning of functional restoration, as supported by existing microsurgical principles.⁹

The use of a two-team approach reduced operative time and improved efficiency. Identification of a dorsally dominant FDMA system and retrograde dissection ensured adequate pedicle length and reliable vascularity.

Functionally, the patient achieved meaningful restoration of hand utility, including the ability to write, hold objects, and perform activities of daily living such as riding a bike. This highlights the effectiveness of toe transfer even in severely mutilated hands.¹⁰

Limitations

This report is limited by its single-case design, which restricts generalizability. Although satisfactory outcomes were observed at 1-year follow-up, long-term functional and sensory outcomes could not be assessed. Objective functional measurements were not quantitatively evaluated.

CONCLUSION

Second toe-to-thumb transfer is a reliable and effective method for thumb reconstruction in mutilated hand injuries due to firecracker blasts. A staged reconstructive approach combined with meticulous microsurgical technique can result in excellent functional outcomes even in delayed settings.

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Ethical approval: Not required

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