



DOUBLE NEUROVASCULAR ISLAND FLAP FOR THUMB RECONSTRUCTION

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ABSTRACT Amputations of the thumb occur commonly following industrial accidents, road traffic accidents, after assault and less frequently in house-hold injuries. The ideal method of reconstruction of thumb has remained elusive to plastic surgeons. With various options attempted, explored and performed, thumb reconstruction is still an art to be perfected. In this case report we present the functional and aesthetic outcome of single stage reconstruction of thumb treated with double neurovascular island flaps, which can be used in specific situations. We report a case of single stage reconstruction of thumb by a new technique of using double neurovascular island flaps. The reconstructed thumb had adequate length, sensation, good functional outcome and reasonable aesthetic appearance. The donor site settled well with no functional deficit, excepting contour deformity. This procedure offers an another alternative safe option for thumb reconstruction.

KEYWORDS : Thumb, single stage reconstruction, double neurovascular island flap, first dorsal metacarpal artery flap (FDMA)

Introduction:

The presence of an opposable thumb has provided man with unique functional hand capability. Thumb contributes to approximately 40% of hand function. Daily tasks involving pinch, grasp, grip, and precision handling are most easily accomplished with an opposable thumb. Thumb has the unique capacity of circumduction and opposition.

CASE REPORT

The present case report is about a 37 year old male driver from Bihar who sustained total crush amputation at the level of proximal phalanx of right thumb (distal to metacarpophalangeal joint) following lorry door shutting injury. Dissection of the distal part revealed crush avulsion injury with absence of nail and nail complex at the level of terminal phalanx. The terminal phalanx was found shattered into three pieces with soft tissue attachment. Hence Replantation was deferred. X ray of the right hand showed loss of the terminal phalanx of the thumb. Initially he underwent wound debridement and soft tissue defect measured 3.5 cms × 2 cms. Injured thumb was compared with contralateral thumb and thumb length deficit was measured and bone defect measures 3 cms. Patient was explained about the types of single stage thumb reconstruction, osteoplastic thumb reconstruction with tubed groin flap and toe transfer. Patient was not willing for staged reconstruction with groin flap and toe transfer. Hence single stage thumb reconstruction was done in our centre with a new technique of double neurovascular island flaps and ulna bone graft under regional anaesthesia.

Steps followed in single stage reconstruction in our case were

1. Preparation of ulnar bone graft harvest from right forearm (4 cms long).
 2. Harvesting double neurovascular island first from ulnar side of mid finger (4cms × 2.5cms) followed by radial side of ring finger (4cms × 2.5cms) based on common digital artery from third web space in the same dissection. The flaps were designed from the ulnar border of middle phalanx of mid finger and on the radial side of middle phalanx of ring finger.
 3. Fixation of bone graft by pegging to the proximal phalanx.
 4. Double neurovascular island flaps with flap to flap inset provided water tight closure for the bone graft.
 5. Donor site closure with split skin graft.
- At 6 months follow up he had an excellent mobile, sensate thumb, with an adequate length. Donor site settled well without any deficit.

Discussion

The key factors that determine the success of a reconstructed thumb are the level of amputation, the size of the defect, the age and occupation of the patient, and the status of the other fingers.

The goals of reconstruction described by Littler are the provision of length, stability, mobility, sensibility and aesthesia.

CLASSIFICATION

TYPE I

Amputation at tip of the thumb to the proximal third of the nail complex

Options:

Replantation Transverse amputations : Staged Island Flap of Prof. R. Venkataswami Amputations with more dorsal loss : First Dorsal Metacarpal Artery Flap Amputations with more volar loss : Littler's neurovascular Island Flap

TYPE III

Amputation proximal to the neck of the proximal phalanx, upto the metacarpophalangeal joint Options Replantation, Osteoplastic reconstruction, Toe to thumb transfers, Metacarpal Lengthening,

TYPE IV

Amputation proximal to the metacarpophalangeal joint to the base of the metacarpal bone with intact carpometacarpal joint Options : Replantation, Pollicisation, Toe to thumb transfers

TYPE V

Amputation through the carpometacarpal joint with destroyed joint Options : Pollicisation, Toe to thumb transfers Various methods have evolved over the years and the following methods have emerged as the preferred ones:

1. Staged osteoplastic reconstruction of thumb using skin cover, bone graft and a digital neurovascular island flap.
2. Single stage reconstruction of thumb using available local and regional flaps, bone graft and a digital neurovascular island flap.
3. Pollicisation of index finger.
4. Microsurgical reconstruction using great toe in the form of trimmed toe transfer or wrap around great toe transfer, or transmetatarsal second toe. Each of the above methods has its own indications. The staged method is preferable when there are injuries to multiple fingers or when the patient is not willing for a toe to thumb reconstruction. The single stage reconstruction is ideal for patients who do not have injuries on the other fingers and those who do not prefer a toe transfer. Microsurgical procedures like toe transfers are an ideal method of reconstruction if the patient is willing to accept the donor site deficit.

The advantages of single stage reconstruction for the thumb are that regional anaesthesia is sufficient to do entire procedure, early mobilisation of thumb is possible at CMC joint and subsequent early return to work, hence cost effective and does not require technical expertise or microsurgical facility.

Among the commonly done single stage procedures is the gold standard procedure of bone graft with Littler's neurovascular island flap and first dorsal metacarpal artery flap. The FDMA flap may be replaced by the posterior interosseous artery flap or a neurovascular flap from the ring finger. When the defect on the dorsum is larger, and an FDMA flap may not suffice, a posterior interosseous artery flap is used.

The pedicle of the double neurovascular island flaps is quiet long enough to reach the reconstructed thumb as compared to the FDMA flap making the play of the flap safe. In this patient the defect is in the terminal phalangeal region hence this option of FDMA flap may be challenging. The neurovascular island flap provides better sensation than FDMA flap. The neurovascular island flap is only used in a situation where a single pedicle dissection is enough for both flaps, and when the patient does not want a scar on the exposed dorsum of the hand. This option of raising a contiguous double neurovascular island flap on a common pedicle has not been reported so far.

Functional assessment:

Motor assessment:

Range of movements were assessed at CMC joint of the thumb.

The range of movements in the CMC joint of the reconstructed right thumb was seen to be in the range of 90% to 98% when compared to the range of movements in the normal left thumb at the end of 3 months.

Kapandji's grading system

This patient had a Kapandji score of 7 by the end of six months.

Power grip measurement

Jamar dynamometer was used to measure the power grip. Recordings were taken from both normal and reconstructed hand thrice alternatively. The power grip measured in the right hand was 70% of the grip measured in the normal left hand.

Key pinch measurement

The modified sphygmomanometer is used to measure key pinch from both the normal and reconstructed hand. The key pinch measured in the right hand was 65% of the measurement in the left hand.

Tripod pinch measurement

The digital pulp of the thumb is made to touch the pulps of the middle and index fingers. This arrangement of the index finger in pronation and middle in supination along with the thumb resembles the power drill instrument's chuck. The tripod pinch, however was seen to be only 40% of the measurement in the left hand. We could attribute it to the absence of the interphalangeal joint in the reconstructed thumb.

Sensory assessment: Two point discrimination test was done over the reconstructed contact surface of the thumb, using a two point discriminator (calibrated callipers).

Normal two point discrimination of the tip of the thumb is 3-4 mm. For these tests the central portion of the flap was assessed, and tests were repeated until a consistent result was obtained. The two point discrimination in the reconstructed right thumb was 6 mm, while the two point discrimination in the normal left thumb was 4 mm. Hence the sensation was comparatively less in the reconstructed thumb. This was achieved by the end of 6 months.

CONCLUSION :

Single stage thumb reconstruction using double neurovascular island flaps offers patient an early and nearly comprehensive option for thumb reconstruction. Less time is consumed as a single vascular pedicle needs to be dissected and there are no scars on the dorsum of the hand. It is a simple, safe and versatile option particularly where microsurgical facilities are not available. The sensory recovery was good. Providing two vascularised flaps also ensured good take of the bone graft. This method of reconstruction provides early recovery, reduces hospital stay, cost effectiveness and the down time is reduced. Majority of the criteria for an ideal reconstruction of thumb like stability, length, mobility, sensibility was fulfilled excepting for nail complex.

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