



SINGLE STAGE THUMB RECONSTRUCTION OF TRAUMATIZED THUMB USING LOCAL FLAPS

Plastic Surgery

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ABSTRACT

AIM : 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 study we aim to study the reconstruction of thumbs with various local flaps and its functional and aesthetic outcome.

MATERIALS AND METHODS : 12 patients of single stage thumb reconstruction done in our centre over the period of last 3 years form the study group. All patients who had post traumatic thumb loss, who were not willing for Toe Transfer and who preferred a single stage over a multi-staged procedure were included in the study. Patients underwent various reconstructive options like, FDMA Flap and Neuro-Vascular Island Flap, Posterior interosseous artery flap and Neuro-Vascular Island Flap, Double Neuro-vascular island flap. Patients underwent bone grafts when required. Follow up period ranged from 3 months to 3 years.

RESULTS : All reconstructed patients healed in about 2-3 weeks. All reconstructed thumbs were viable, sensate and functional. More than 60% of patients returned to their original work. Patient felt the reconstructed thumb was aesthetically pleasing except for absence of nail. One patient had marginal flap loss, which was managed.

CONCLUSION: Single stage thumb reconstruction using local flaps offers patients an early and nearly comprehensive option for thumb reconstruction. In using the local tissues, the colour and tissue match, along with comparatively minimal donor site morbidity, makes it a good option for patients. Such procedures can be done, even in centres where microsurgical facilities or expertise is less.

KEYWORDS

INTRODUCTION:

Loss of Thumb following trauma is a devastating injury, as it leads to loss of grasp and pinch. In view of this, the challenge of thumb reconstruction has captured the attention of plastic surgeons, inspired innumerable innovations and played a pivotal role in developing the art of plastic, reconstructive and microsurgery.

Thumb is critical to overall hand function, contributing to approximately 40 % hand function. The prehensile function allows precision and power grips. Thumb has a unique capacity of opposition and circumduction. As said by John Napier, The hand without a thumb is at worst nothing but an animated fish-slice, and at best a pair of forceps whose points don't meet properly (1).

MATERIALS AND METHODS:

Over the last 3 years, 12 patients underwent single stage thumb reconstruction, following a traumatic loss. Patients were followed up for a period of 3 months to 3 years. The inclusion criteria was post-traumatic thumb loss distal to metacarpal phalangeal joint, not willing for free tissue transfer or staged osteoplastic reconstruction and willing for other single stage procedures. The functional and aesthetic outcome of these reconstructions were evaluated.

The goal of thumb reconstruction remains as providing sensation, stability, adequate length, mobility, pain free function, sufficient strength, ensuring aesthetics and durability. The choice of reconstruction depends on level of amputation and defect size.

The various reconstructive options used were First dorsal metacarpal artery flap and Neuro vascular island flap (Fig 1), posterior interosseous artery flap and neuro vascular island flap (Fig 2), double neurovascular island flap (Fig 3). Ulnar Bone grafts or native bone was used for reconstructing the osteogenic component of thumb (Fig 4).

RESULTS:

12 patients underwent single stage thumb reconstruction in the study. All were male patients, age ranging from 19 to 45, mean age being 32. All the patients were right hand dominant. There were equal number of right and left thumb injuries, 6 in each. The aetiology of the injuries were 9 industrial accidents, 2 following a fall of heavy object and one following a door crush injury. All the reconstructed patients healed within a period of 3 to 4 weeks. All the reconstructed thumbs were sensate and functional. About 60% of patients(7) returned back to their original work. In one patient there was a marginal loss of 0.5 cms flap with exposed bone, which was nibbled and closed. Patients were

pleased with reconstructed thumb, except for absence of nail.

DISCUSSION:

The goals of thumb reconstruction include the restoration of thumb length, strength, position, stability, mobility, sensibility, and aesthetics. It is a rare case when all of these objectives can be achieved, and prioritization should be based on the goals and functional demands of the patient. Reconstructive techniques vary widely, not only in their potential to achieve the above goals, but also in their length of process, burden to the patient, and psychosocial implications. Patient education, shared decision-making, and mutual commitment to a reconstructive plan are absolutely critical.

In a traumatized thumb, replantation offers superior results with respect to all of the stated goals of reconstruction, without any donor-site morbidity. Overall survival of replanted thumbs may exceed 90 percent at large centers performing a high volume of replantation procedures,(2,3) although some variability is expected based on the candidate population and the judgment and experience of the surgeon. Despite the ever-increasing reliability of thumb replantation, there are cases when revision and reconstruction is a better option. These include (among others) significant crush injury and patients who are currently unfit to undergo a long surgical procedure. These are circumstances that require careful and detailed discussion with the patient, as many arrive with the expectation that replantation can and will be accomplished.

Amputation proximal to the midportion of the proximal phalanx decreases hand span, creating difficulty with pinch dexterity and the grasping of large objects. The complexity of these injuries varies widely with the preservation or destruction of the thenar musculature, and augmentation of any reconstruction with tendon transfer may be required to achieve functional opposition.

Microsurgical toe transfer has become the standard of care for total thumb amputations distal to the carpometacarpal joint. The great toe flap is an innervated oncho-osteocutaneous flap based on the first dorsal or plantar metatarsal artery, the accompanying venae comitantes and/or the dorsal subcutaneous venous system, along with the plantar digital nerves.(4) The advantages of this technique are many, including the provision of sensate, strong, mobile, stable tissue with acceptable appearance and customizable length and position. Drawbacks include the lengthy and technically demanding nature of the reconstruction and the sacrifice of a nontrivial donor site. The significance of donor-site morbidity is debated, but delayed healing,

pain, cold intolerance, callus, phantom toe, weakness in push-off, varus/valgus deformity, and neuroma have all been reported.(5,6) Despite this, Chung and Wei reported no deficit in lower extremity function.(7) and Lipton et al. reported little change in gait on analysis both preoperatively and postoperatively.(8) Most donor-site morbidity can be circumvented by avoidance of skin grafting on the foot,(9) burial of cut nerve ends,(6) and preservation of at least 1 cm of the proximal phalanx to maintain foot span.(10)

Traditionally, great toe-to-thumb transfer has been performed as a secondary procedure following emergency coverage of the defect by another method. This approach of staged reconstruction is generally a wise choice, as it allows ample time for patient education and surgical planning before the expenditure of a critical donor site. As such, the groin flap remains an excellent option in patients who may be considered for interval great toe transfer. Furthermore, by providing abundant skin during the first stage, a groin flap facilitates interval web space reconstruction and permits minimal soft-tissue harvest from the foot, thereby allowing primary closure of this sensitive donor site.(9) Primary transfer is attractive in that it offers a one-stage reconstruction, in addition to earlier rehabilitation and return to work. Comparison of 26 primary and 96 secondary transfers revealed equivalent outcomes, and as a result, this strategy is becoming increasingly common.(11) However, it should be used selectively in well-informed, motivated, and reliable patients without contralateral or extensive ipsilateral soft-tissue deficit.

Lin et al. recently summarized the short- and long-term outcomes of 196 great toe-to-thumb transfers in a systematic review.(5) Overall survival of the transplanted great toe was 97 percent. Pinch and grip strength recovered to 81 and 84 percent of contralateral, respectively, and total active motion was 58 degrees. Static two-point discrimination averaging 11 mm was achieved, although the extent of sensory recovery seemed to depend heavily on the sensory reeducation program used.(12,13)

Given that the great toe is approximately 20 percent larger than the thumb in all dimensions, various aesthetic modifications have become common. Primary "trimming" of the flap along its medial border has improved aesthetic outcomes at the expense of only a marginal decrease in joint mobility.(14) Secondary aesthetic revision techniques include pulp-plasty (15) and bony contouring.(16)

In patients with high functional demands of their lower extremity, or in those with strong aesthetic concerns, complete sacrifice of the great toe may be objectionable. In these cases, a great toe wraparound flap or second toe transfer should be considered. Wraparound transfer, as first described by Morrison et al.,(17) entails harvest of the great toe pulp and nail with a portion of the distal phalanx. This technique can be advantageous in that it preserves a large portion of the great toe and allows for customizability of the transferred elements. It is limited, however, by the requirement of concomitant iliac crest bone grafting (or prior metacarpal lengthening),(18) which is prone to resorption, and by the lack of a transferred joint. Perhaps more than for total thumb amputation, these wraparound flaps (of the great and second toes) are finding use in degloving injuries(19) with preserved skeletal elements and in aesthetic reconstruction of more distal injuries.(20)

Although nonmicrosurgical reconstruction of injuries at this level has decreased in popularity, these techniques still play a role in special patient populations and in those patients for whom a toe donor site is unacceptable. Matev has described the technique of metacarpal lengthening, (wherein a uniplanar distraction device is used to induce distraction osteogenesis).(21) The primary advantage of metacarpal lengthening is its use of local soft tissue with native innervation. It is considered when there is adequate soft tissue to cover the bony stump and patient preferences or comorbidity favor a simple and low-risk reconstruction. Drawbacks include the long course of treatment, absence of a joint and nail, and the need for secondary iliac crest bone grafting of the distraction gap in most adult patients.

Osteoplastic reconstruction is a staged process wherein length, coverage, and sensibility are all provided by distinct tissue transfer. Although toe harvest is avoided, the drawbacks of osteoplastic reconstruction are considerable and the indications dwindling. These include bulky and aesthetically displeasing neothumbs, persistent cortical sensory representation from the donor site, and the need for multiple procedures (although a single-stage reconstruction has been

described).(22)

In our technique of single stage thumb reconstruction, patients are offered a one stage reconstruction retaining most of the goals of reconstruction. It is indicated in traumatic loss of the thumb at or around metacarpophalangeal joint level in situations where replacement with a toe is not feasible or patient desires against such a transfer. It is relatively an easier method of thumb reconstruction and does not require microsurgical expertise. Donor-site morbidity is small. Ulnar bone graft, instead of other bone grafts offers a good, stable and sufficient bone graft and also possibility of executing the procedure in a regional anaesthesia. If native bone is available, it can be harvested from the distal part of thumb and can be used as a graft.

CONCLUSION :

In conclusion, single stage thumb reconstruction offers the patient an early and nearly comprehensive option for thumb reconstruction. In using the local tissues, the colour and tissue match, along with comparatively minimal donor site morbidity, makes it a good option for patients. Such procedures can be done, even in centres where microsurgical facilities are less. These procedures are cost effective and has a relatively reduced recovery period.

FIG 1 :FDMAAND NV-ISLAND FLAP



FIG 2 :PIAAND NV-ISLAND FLAP



FIG 3 : DOUBLE NV-ISLAND FLAP



FIG 4 : NATIVE BONE GRAFT



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