

CASE REPORT

Surgical Salvage of a Mangled Thumb – A Case Report

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Introduction: The reconstruction of mangled extremities is a heavily contentious topic, particularly when the thumb is involved. Thumb reconstruction is attempted at a rate that falls below the recommended guidelines, despite the digit's significance. This article reviews leading research and concurrent guidelines, alongside a case presentation, in order to offer a distinct perspective on the management of mangled thumbs.

Contraindications to Salvage of a Thumb: There are several contraindications to the reattachment to any digits, which can be broadly categorised as follows:

- General absolute contraindications
 - Life-threatening associated injuries
 - Severe systemic illness
- Local absolute contraindications
 - Extensive contamination
 - Wrong conservation of amputated part
- Relative contraindications
 - Comorbidities
 - Advanced age
 - Psychosis
 - Avulsion injuries
 - Multiple-level injuries

Clinical Case: A 21-year-old precision lathe operator sustained a mutilating industrial accident to his left thumb, which was heavily contaminated by grease and paint. The patient underwent 10 hours of surgery, and several failed attempts at revascularisation; however, the thumb survived completely. Necrosis of the volar skin had to be debrided and repaired a month after discharge, but the flap healed nicely, and the patient recovered with minimal difficulties and returned to his occupation.

Discussion and Conclusion: A tailored, comprehensive biopsychosocial approach is recommended when considering the reattachment of the thumb. In many cases, an attempt to reattach the thumb should be undertaken despite certain contraindications and the severity of the injury, as the benefits of a successful procedure will likely outweigh the potential damage done by a failed operation.

Keywords: Mangled thumb; salvage; reconstruction; replantation; revascularization; case study

Introduction

The reconstruction of mangled extremities is a heavily contentious topic, particularly when the thumb is involved. The justification for this discord is clear: although the thumb is a vital element of day-to-day life, success rates of reattachment surgeries remain unfavourable, as approximately only half of replanted digits survive [1].

The value of the thumb is emphasised clearly in the Guidelines to the Evaluation of Permanent Impairment, fifth edition, released by the American Medical Association

(**Table 1**). The guidelines offer a statistical analysis into the functional contribution that each digit provides to their respective hand, the upper extremity and the body as a whole. The loss of a thumb presents with a minimum reduction in hand function of 40%, and a 22% loss of whole body function, which is deemed equivalent to the loss of an eye [2].

Yet the completion of prehensile tasks is not the sole function of the thumb: it equally possesses inherent social and cultural significance [2]. From an evolutionary perspective, human ascent from other lifeforms is not solely ascribed to our superior intellect, but the presence of opposable thumbs [4]. Furthermore, the loss of certain digits is associated with crime in many societies, none more so than the thumb, resulting in ostracism of the individual [5].

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Table 1: Guides to evaluation of permanent impairment [3].

	% Impairment		
	Amputa- tion hand	Upper extremity	Whole body
Index or longer finger	20	18	11
Ring or little finger	10	9	5
Thumb	40–50	36–45	22–27
Hand	–	90	54
Upper extremity	–	–	60

Despite the irrefutable significance of the thumb, and despite an overwhelming trend in literature suggestive of the fact that thumb salvage should be the gold standard even in unfavourable conditions [5–7], there is still a discrepancy as to whether reconstruction should be undertaken. In the United States, fewer than 40% of thumb amputation injuries are replanted, with limited knowledge regarding the probability of whether replantation will be undertaken in a given circumstance [7].

We would hereby like to present a case with the hopes to cement the notion that an attempt to reattach the thumb should be undertaken in almost all instances, excluding those with explicit contraindications.

Contraindications to the Salvage of a Thumb

There are several contraindications to the reattachment of any digit, which were broadly categorised by Tos et al. as follows [5].

General absolute contraindications include life-threatening associated injuries, or severe systemic illness which would prevent the patient from withstanding a prolonged procedure. These factors are of utmost importance, and salvage should not be attempted until the patient is stabilised.

Under *local absolute contraindications* fall injuries that are extensively contaminated. Chen et al. argue that contamination by glue, paints, solvents and lubricating are an absolute contraindication for replantation [8]. Wrong conservation of the amputated part is also of clinical significance, as damage from formaldehyde, alcohol or freezing may prevent replantation or revascularisation [9]. Whether these factors should indeed be classified as absolute is unclear, as highlighted by the clinical case below.

Factors such as comorbidities (vascular disorders, diabetes, hypertension), advanced age and psychosis, alongside avulsion and multiple-level injuries were all placed under the umbrella of *relative contraindications*. This category was considered more accommodating, enabling the patient and surgeon to determine the course of action to be taken. It is of note that single digit zone II injuries, which a wealth of literature [10–12] cite as a contraindication due to deleterious results to entire hand function, was excluded by Tos et al. when the thumb was involved,

which once more calls attention to the importance of the thumb.

Clinical Case

The following case is presented in accordance with the SCARE guidelines, first introduced by Agha et al. [13].

History

A 21-year-old man sustained a mutilating industrial accident to his non-dominant left hand when his thumb was caught in power press. In an attempt to extricate the hand, the thumb was nearly amputated at the interphalangeal joint.

The patient was a non-smoker, with no relevant past medical or surgical history, nor was he on any regular medication at the time of presentation. Furthermore, he was not known to have any drug allergies or any family history of import.

On examination, the thumb was badly crushed and non-viable, as well as all but amputated at the IP joint (**Figure 1**). Heavy contamination with grease and paint was present at the site of injury, a factor which meant that a reattachment procedure was contraindicated in this patient.



Figure 1: Pre-op image of mangled thumb.



Figure 2: Post reattachment image showing a poorly perfused thumb.



Figure 3: Thumb one-month post replant showing volar skin necrosis.



Figure 5: Insertion of neurovascular island flap.



Figure 4: Neurovascular island flap being raised.



Figure 6: Long term follow up of thumb.

Decision

Tse et al. suggest that for a middle third thumb injury, similar to the one this patient sustained, should be treated surgically, with either osteoplastic reconstruction, or toe-to-thumb transfer [14]. In view of the fact that the patient's occupation required a viable thumb, and undeterred by the relative contraindications to the procedure, a mutual decision was made to attempt replantation and revascularization of the digit.

Operation

The operation was performed by Dr. Skanda Shyamsundar, a fully qualified plastic surgeon with four years of experience. Only a single dorsal vein was deemed suitable for anastomosis. The digital artery on the ulnar side was chosen for an arterial anastomosis. Tendon repair was carried out with 4-0 nylon, and digital nerve repair with 10-0 nylon epineural sutures.

After the release of the arterial clamps, no flow was noted across the anastomosis, and the structure was therefore taken down to be revised. Unfortunately, there was no flow present following the revision. A vein graft was then harvested from the forearm and laid between the proximal and

distal vessels, again to no avail. The anastomosis was taken down at the distal end a further three times with the same end result. Eventually, following 10 hours of continued effort with no success in adequate perfusion of the amputated part, further procedure was abandoned (**Figure 2**).

Early post-operative period

The thumb was immobilised in the post-operative period. Not anticipating a positive result, no intensive monitoring was assigned to the thumb. However, on the 2nd post-operative day, to the astonishment of the staff, the thumb had turned pink with a small number of dark patches still present. When placed on a pulse oximeter, the probe displayed a saturation of 100 per cent.

The remainder of the post-operative period continued to be uneventful, coming to a close a majority of skin survival on the surface of the thumb. The patient was discharged on the 10th post-operative day with routine anticoagulant prophylaxis.

Late post-operative period

Although the thumb survived completely, necrosis of the volar skin appeared close to a month after the operation



Figure 7: Long term follow up of thumb.



Figure 8: Long term follow up of thumb.

(**Figure 3**). In order to replace like tissue with similar construct, the defect was covered with a neurovascular island flap (**Figures 4 and 5**). The flap healed nicely, and the patient recovered fully with minimal difficulties.

End result

The patient now has a near normal functioning, sensate thumb (**Figures 6–8**), and has returned to his occupation as a precision lathe operator – a profession requiring near normal two-point discrimination on the thumb. The patient's current two-point discrimination on the replanted thumb was last measured to be 12 mm.

Patient Perspective

The patient was devastated when he found out that the potential for amputation was real, and he was therefore adamant to try every measure possible in order to save his thumb. After the procedure, when the final outcome became apparent, he was ecstatic; to such an extent that he frequently brought the ward staff "Prasad" from his favoured shrine, a sacred food used as a religious offering in Hinduism.

Discussion and Conclusion

Reattachment of mangled extremities are regarded not only as challenging, but often futile endeavours. In the case described above, a shared decision was made to replant and revascularize the thumb, notwithstanding the severity of the injury. The principle determinant in the making of the decision was the occupation of the patient: as a precision lathe operator he requires a well-functioning thumb.

The thumb, more so than any other digit, is invaluable for most to function in society; a comprehensive biopsychosocial approach is therefore recommended when considering its reattachment. Factors including, but not limited to, culture, psychological well-being, occupation and patient's request are of comparable importance to the type of injury and functional prognosis.

While conducting the operation, although outcomes appeared to be unfavourable, the team did not relent, performing the operation to the best of their abilities. For the

patient, this made the difference between an opportunity to return to his profession, or a lifetime of morbidity.

In circumstances where patients present with similar injuries as described above, all patient factors should be weighed up in a similar fashion: the slightest possibility of success could justify an attempt at reattachment, despite the contraindications. In the presented case, had the procedure proved to be unsuccessful, the patient would not have experienced a far more undesirable outcome, bar displeasure and an extended recovery period, than had an amputation been performed from the onset. Performing the surgery would prove, more often than not, to be a difficult undertaking; however, the comfort of the surgeon should always be a secondary concern with regards to the prospect of, even if remote, a patient's superior quality of life.

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Author Contributions

Dr. Shyamsundar had carried out the procedure. Bence C. Baljer wrote and researched the article with his guidance.

Guarantor

Dr. Shyamsundar is the guarantor.

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