ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 10, 2023

TISSUE SCAVENGING IN MUTILATING HAND INJURIES - SPARE PART SUGERY

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Abstract: The use of scavenged tissue for reconstruction of an injured limb, called as "spare-part surgery. It allows primary reconstruction of injured part without harvesting tissue from other regions of the body and without further donor morbidity. The aim of this study is to evaluate the clinical experience and outcomes of spare parts surgery in mutilating hand injuries. Total 12 patients were included in this study from January 2022 to January 2023. In 7 patients bone from amputated part used as bone graft, 4 patients avulsed skin from amputated distal part was used as skin graft. In one patient digital nerve used as spare part for nerve. Outcomes were measured. In 75% of patients the spare part used was survived without any complications. 5 out of 7 patients with bone graft, bone graft was viable with maintenance of digit length. 3 out of 4 patients in whom skin graft was done, skin graft settled well. In 1 patient in whom digital nerve was used as nerve graft, Tinel's sign progressed and regain of touch sensation was noted in 6months follow up. Complications were noted in 3 patients (25%). Re-intervention was done in 2 patients (16%).

Introduction:

Mutilating hand injuries are injuries with significant tissue and function loss. Thumb contributes 40% of hand function. The "spare parts" are tissues harvested for reconstruction from amputated or non-salvageable parts. The use of scavenged tissue for reconstruction of an injured limb, called as "spare-part surgery". It allows primary reconstruction of injured hand without harvesting tissue from other regions of the body without further donor morbidity. These include skin grafts, nerve grafts, arterial or vein grafts, and bone grafts for reconstruction of the remaining hand or the limb[1]. The aim of this study to evaluate the clinical experience and outcomes of spare parts surgery in mutilating hand injuries.

Patients and methods:

- Study period: January 2022 to January 2023
- Patients with mutilating hand injuries involving single or multiple digits with loss of function, not amenable for replant were included in this study.
- Patients with clean cut and suitable for replant were excluded from this study.
- Total 12 patients were included in this study.

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- 6 patients were with crush injury of thumb with amputation at below the critical length (neck of proximal phalanx) in which terminal phalanx of amputated distal part were used as bone graft along with groin flap cover.
- 1 patient with crush injury right hand in which the middle phalanx from amputated middle finger was used as a bone graft for index finger for proximal phalanx bone loss.
- In 4 patients with crush injury, the degloved skin flap from amputated distal part, defatted and used as skin graft.
- 1 patient with crush injury right hand, the digital nerve in non salvageable middle finger was used as nerve graft for injured index finger
- All bone grafts were fixed with K- wire.
- Postoperative protocol followed for all patients according to institutional protocol.
- All patients were followed minimum of 6 months.
- Outcome was measured in terms of survival and length of bone graft, flap complications- infection, flap necrosis and re- intervention in patients with bone graft.
- In patients in whom skin graft was used as a spare part, graft loss, graft take and re-intervention were measured.
- In 1 patient in whom nerve graft used as spare part, sensations recovery was measured.

Results:

- In 75% of patients the spare part used was survived without any complications
- 5 out of 7 patients with bone graft, bone graft was viable with maintenance of digit length. These patients needs further procedure for sensation – neurovascular island flap.
- 3 out of 4 patients in whom skin graft used, graft settled well.
- 2 out of 7 patients in whom bone graft was used as spare part, the total resorption of bone graft was noted and both patients were diabetic.
- 4 out of 6 patients in whom bone graft along with groin flap cover was done for thumb reconstruction, bone graft taken well with callus formation and no complications were noted in the flap.
- 1 out of 2 patients with bone resorption, flap distal margin was necrosis and managed with debridement and reiset.
- 1 out of 4 patients in whom skin flap of amputated or degloved skin used as a skin graft, graft was necrosed, and debridement, spit skin grafting was done. In remaining 3 patients skin graft was taken and settled well.
- In 1 patient in whom digital nerve of amputated mid finger was used as nerve graft for index finger, Tinel’s sign progressed and regain of crude touch sensation was noted in 6months follow up.
- Complications were noted in 3 patients (25%).
- Re-intervention was done in 2patients (16%).

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Case illustrations:

Case 1: 30 year old male with avulsion injury with total avulsion of skin of left thumb. The avulsed skin defatted and used as FTSG. The skin flap used as FTSG taken and settled well with good functional and aesthetic outcome

a.  **b.**  **c.** 

d.  **e.**  **f.** 

figure: 1 .a, b: Total avulsion of skin flap of left thumb with middle 1/3rd volar skin intact, c:defattening of avulsed skin for FTSG, d: avulsed skin used as graft, e & f: dorsal and volar view showing settled skin graft.

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Case 2: 45 year old male with cutting machine injury with amputation of left thumb at PPX base with non salvageable distal part. The TPX bone in distal part was used as bone graft along with groin flap. The bone graft taken well with no bone resorption was noted at 6 months follow up. The flap settled well . Patient planned for neurovascular island flap.

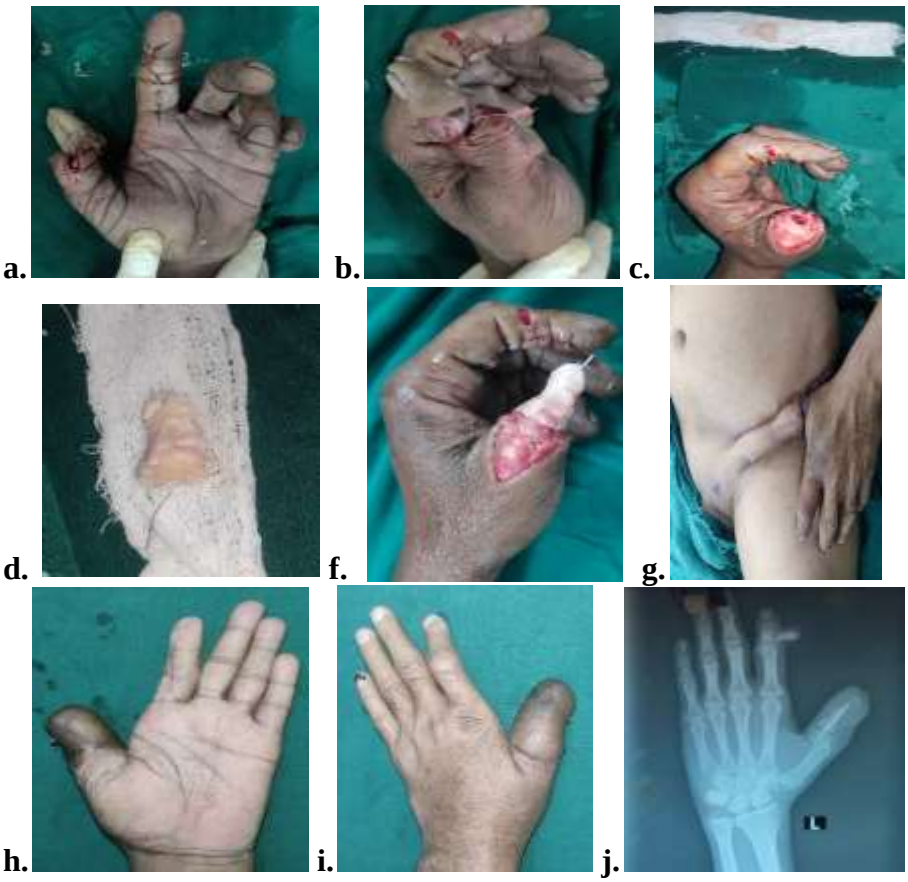

figure 2: a, b: preoperative images showing distal thumb not viable and not replantable, c: post debridement, d:bone graft from distal non viable part, f: bone graft fixation with k-wire, g: picture showing groin flap, h, i: follow up images showing well settled flap, i: xray showing Tpx bone graft with k-wire.

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Case 3: 30 years male with crush injury right hand , with partial amputation of right middle finger , right index with radial digital nerve loss. The digital nerve from amputated middle finger used as a nerve graft for index finger.

a.  **b.**  **c.** 

figure 3: a: preoperative image showing non-salvageble right middle finger, b: loss of radial proper digital nerve of index finger, c:nerve graft taken from middle finger used for index finger.

Case4: 25 years male with chain sprocket injury with total amputation of left thumb at inter phalangeal joint level with avulsed both pedicles in distal part – not replantable. The skin flap in distal part defatted and used as FTSG . On due course the FTSG necrosed, but the wound well granulated and SSG was done.

a.  **b.**  **c.** 

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d.  **e.** 

figure 4: a.b: left thumb total amputation at IPJ level, distal part not replantable, c: defatted skin flap from distal part, d:skin from distal part used as FTSG, - necrosed, f: secondary procedure - SSG.

Discussion:

Amputated or non salvageable components of hand can be used as sources of tissue grafts**.** The primary goal is early restoration of function with the minimum possible number of procedures and low donor site morbidity .

Prerequisite for spare part surgery[2, 3]:

The spare parts need to have anatomical integrity and should preferably lie outside the zone of direct trauma. Reconstruction should offer better global function than primary amputation. The spare part should serve a greater function when used for reconstruction of other parts Use of spare parts should not exclude harvesting healthy tissue if it is necessary to obtain maximal hand reconstruction.

Autografts from amputated phalanges can be used as valuable reconstructive tools for a selected group of patients [4]. In spare part surgery normal tissue other than injury zone can be used as a flap, and tissue in the injury zone is used as a graft[5,6]. Katsaros[7] described the use of the great toe from a foot being amputated for chronic osteomyelitis to reconstruct the thumb. In our study thumb reconstruction was done in 6 patients by using bone graft in which 4 patients the bone graft survived and thumb length was maintained. Fillet flaps from non salvageble digits have been used as a skin graft in spare parts concept[8] . In our study in 4 patients the skin flap in amputated/ avulsed distal part used as skin graft , out of which in 3 patients skin graft settled well. In one patient graft necrosed completely and SSG was as a secondary procedure. In our study in 1 patient nerve graft used as spare part. The concept of spare part surgery allows the surgeon to carry out primary reconstruction of the limb without resorting to harvest tissue from other regions of the body. These include skin grafts, nerve grafts, arterial or vein grafts, and bone grafts for reconstruction of the remaining hand or the limb. It can be used alone or in combination with other reconstructive procedures. Transposition of digits is an important concept of spare part surgery in patients with multiple digit amputations, where some of the amputated digits are deemed non salvageable.

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Conclusion:

Spare-part surgery addresses primary reconstruction while obviating donor-site morbidity, and should be used whenever possible. The non salvageable scavenger digit can provide skin, nerve, vein, artery, or bone as spare part or whole digit for transposition. It follows Sir Harold Delf Gillies principles of Never throw anything away – a preserved piece may be used later and replace the loosed tissue with same kind.

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