An Insight about Management of fingertip injuries

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Abstract

Proper management of nail bed lacerations and fingertip avulsions requires careful evaluation, including assessment for associated injuries and plain radiographs, prior to definitive care. There are various presentations of fingertip injuries that may end up with post-traumatic fingertip amputation; laceration, Subungual hematoma, or even Finger amputation. Anterior-posterior (AP) and true lateral plain radiographs of the affected finger and, for amputations with possible loss of bone, any intact amputated tissue, are necessary before repair of a fingertips laceration or fingertip amputation. The three main goals of treatment are the restoration of sensation and durability in the tip and assuring proper bone support to allow for nail growth. Simple lacerations of the nail bed can be managed by suturing the damaged structures, and this procedure can be done in an emergency department setting. Avulsion or severe crush finger injuries may require grafting for optimum outcome. Tuft fractures are commonly associated with nail bed lacerations which can often be managed with the repair of the nail bed and surrounding structures. Trephination (bur hole to relieve pressure) is recommended for all hematomas without disruption of the nail matrix. The majority of fingertip losses are adequately treated with VY advancement and cross-finger flaps. To minimize loss of bone support and fingertip length, a vascularized bone graft can be obtained as part of a VY flap to reconstruct the fingertip while preserving length. Moberg flap is a good choice providing sensate glabrous tissue for volar oblique defects measuring up to 2 cm over the distal third of the thumb.

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Proper management of nail bed lacerations and fingertip avulsions requires careful evaluation, including assessment for associated injuries and plain radiographs, prior to definitive care **(1).**

1- History

Proper history is important in fingertip injuries assessment. The key historical elements in fingertip injurie are summarized in table 1 **((1).**

Table (1): Key historical elements in fingertip injuries **(1).**

Key historical elements include: 1) Age and skeletal maturity. 2) Mechanism and time of injury. 3) Digit position during injury (flexed versus extended). 4) Dominant hand. 5) Occupation. 6) Prior hand conditions, injuries, or interventions – Prior hand injuries that have impacted baseline finger function and the presence of any residual foreign bodies from prior procedures.

2-Presentation and diagnosis

There are various presentations of fingertip injuries that may end up with post-traumatic fingertip amputation **(2)**.

Laceration

Finger lacerations are common injuries with either blunt or penetrating mechanisms. Given the superficial location of tendons and ligaments, care must be taken when evaluating and repairing these injuries. Those with finger lacerations should be evaluated for injury to tendons or ligaments. Plain radiography can be useful if there is concern for foreign body retention. Nail matrix laceration or disruption can result in permanent nail deformity and should be discussed with patient prior to treatment as this can still occur after proper care **(3,4).**

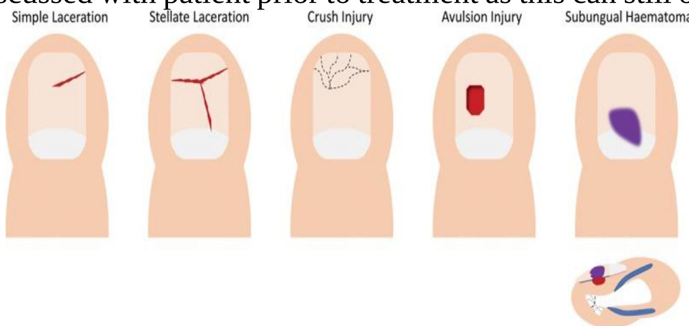

Figure (1): Schematic of the different presentations of distal tip injuries **(5).**

Subungual hematoma

Subungual hematomas is bleeding under the nail plate that is usually caused by sudden mechanical impacts during daily activities or on the job. These impacts are usually painful, thus the connection between the trauma and the hematoma appearing immediately **(6,7).**

Figure (2): Subungual hematoma of the right index finger **(8).**

Finger amputation

Appropriate management of fingertip amputations is critical to preserve the function and decrease the risk of complications **.**Management varies based on the extent of the injury to the bone, nail, nail bed, and soft tissue **(3).**

3- Physical examination

Physical examination should be performed in order to assess the extent of damage, the function of the injured finger with attention to injury to the nail, nail folds, nail bed, and germinal matrix and evaluate for associated proximal injuries to the finger or hand by testing neurovascular status and range of motion. It is usually performed without anesthesia to assess the sensory and motor function of the fingertip accurately **(1).**

Given the density of critical structures in the fingertip, it is prudent to exclude flexor tendon, digital nerve, or artery laceration in open injuries of the pulp. Although distal digital nerve repair does not predict sensory recovery**,** it is worth documenting and repairing neurotmetic injuries in clinical practice for which medicolegal risks are high **(9).**

4- Investigations

Plain radiographs

Plain radiography can be used, if there is suspected distal phalanx or tuft fracture **(3).**Anterior-posterior (AP) and true lateral plain radiographs of the affected finger and, for amputations with possible loss of bone, any intact amputated tissue, are necessary before repair of a fingertips laceration or fingertip amputation **(1).**

Distal tuft fractures are the most common associated fractures seen with fingertip injuries**.** Although technically an open fracture, tuft fractures do not significantly alter the immediate management, though they require splinting of the fingertip after repair **(1).** In children distal tuft fractures account for 80% of hand fractures in children under 4 years old **(1).**

Radiological findings of interest including (**1):**

- ✓ Unstable fractures or dislocations, or fractures
- ✓ In children, a Salter-Harris epiphyseal fracture (ie, Seymour fracture)
- ✓ For fingertip amputations, degree of bone loss

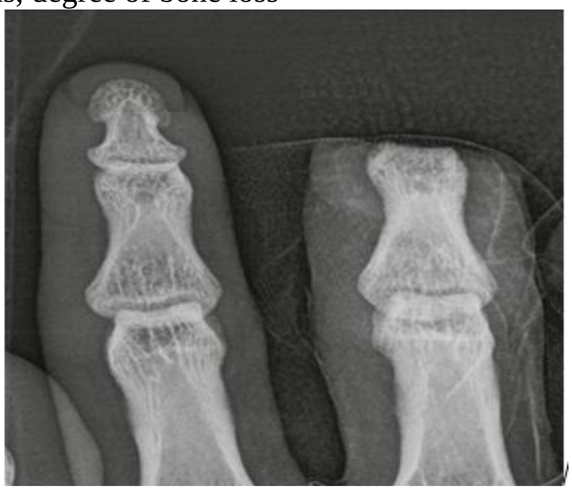

Figure (3): X-ray for fingertip amputation **(10).**

<u>Goal of treatment</u>

The three main goals of treatment are the restoration of sensation and durability in the tip and assuring proper bone support to allow for nail growth **(7).**The fingertip is vital for sensation since it has a high concentration of sensory receptors; hence, restoration of sensation is the preeminent focus of the treatment **(11).**

Moreover, the durability of the tip is essential for finger motion as well as hand action, and, finally, the allotment of nail growth is a key factor in maintaining appearance **(7).**Improper treatment of fingertip amputations may lead to defects in the appearance such as hook nail deformity, and intolerance to cold, and skin tenderness **(11).**

Deficiencies may also present in the form of stiffness and long-term functional loss **(7).**At the completion of treatment, the pulp should be stable and pain free, and the nail plate geometry should permit the manipulation of small objects **(9).**

<u>Preparation before treatment</u>

Primary care

Irrigation of the wound with either saline or tap water should be performed to explore the wound. Local anesthetic should be used (regional or digital block) of the affected digit. Tetanus immunization status should be checked. A booster dose should be given, if patient has not received a dose within 10 years for minor and clean wounds and 5 years for major and non-cleaned wounds Tetanus immune globulin (TIG) is only recommended in combination with tetanus toxoid for people with unknown immunization status or <3 tetanus toxoid immunizations and a non-cleaned and major wound. Antibiotics should be started for any injury with exposed bone **(3).** A tourniquet can be used for bleeding control **(3).**

Local anesthesia

For most patients (including older children and adolescents), a digital nerve block (without procedural sedation) is suggested. Because it is less traumatic, that may be subcutaneous (preferred in children) or transthecal technique**(1).** The digital nerve block is generally superior to local infiltration due to the reduced amount of anesthetic required **(12:15).**

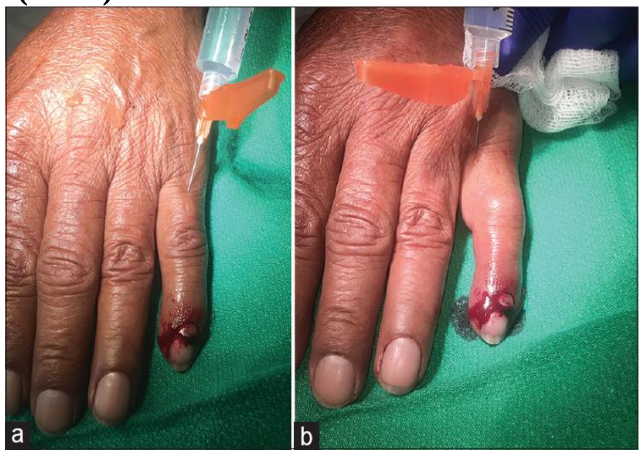

Figure (4): Dorsal injection of local anaesthetic in the (a) *middle* and (b) radial side of the injured finger **(13).**

<u>Different treatment modalities</u>

Simple lacerations of the nail bed can be managed by suturing the damaged structures, and this procedure can be done in an emergency department setting **(13).**

Avulsion or severe crush finger injuries may require grafting for optimum outcome. Tuft fractures are commonly associated with nail bed lacerations which can often be managed with the repair of the nail bed and surrounding structures **(16).**

In addition to closing lacerations in the repair of a fingertips injury, the eponychium should be stented to prevent the adhesion to the germinal matrix **(13).**

Closed injuries (subungual haematoma)

The 3 main considerations for closed fingertip injuries are the nail plate, pulp, and bone. The size of the subungual hematoma is thought to correlate with the degree of the nail matrix injury **(9).**

Trephination (bur hole to relieve pressure) is recommended for all hematomas without disruption of the nail matrix. If there is nail matrix disruption, removal of the nail plate with repair of the nail matrix with 6-0 absorbable suture is recommended for satisfactory healing **(3).**

Figure (5): A method of subungual hematoma drainage with a battery-operated electrocautery unit **(4).**

An arbitrary figure of 50% is considered an indication for nail avulsion and matrix repair to facilitate anatomic healing **(9).**An alternative approach, where nail trephination alone was performed regardless of the size of the hematoma, provided the nail plate was intact, yielded good pain relief with satisfactory nail plate regeneration **(5).**

The presence of a tuft fracture did not adversely affect the outcome. Patients with fractures received a splint to maintain the distal interphalangeal joint in extension for comfort **(9).**

Figure (6): 75% hematoma with intact nail plate (left). Untidy laceration with interposed hematoma (middle). Laceration is evident after clearance of hematoma (right). Nail trephination is a viable alternative in this scenario **(9).**

Allen Classification (15)

The most commonly used classification is Allen classification of amputation injuries. It classifies amputation injuries into four types based on the type of amputation, i.e. through the tissue involved (Allen, 1980). The classification is based on the level of injury

Table (2): Allen classification of amputation injuries (**Allen, 1980)** (see fig. 13)

Type	Description
Type I injuries;	They involve only the pulp of the finger.
Type II injuries;	They involve pulp and nail loss without bone fragment in the distal amputated fingertip.
Type III injuries;	They means partial loss of the distal phalanx plus corresponding loss of the pulp and nail.
Type IV injuries;	They include amputation proximal to the the germinal matrix

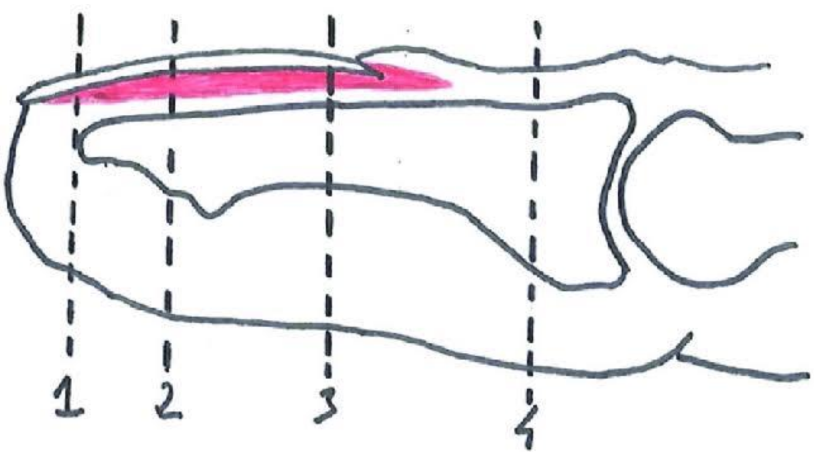

Figure (7): Allen classification of amputation injuries

Open injuries

Allen's type 1 and 2 amputations could be managed **(17).**

1) Semiocclusive dressing (allowed healing by secondary intention),
2) Palmary V-Y plasty
3) Lateral V-Y plasty
4) Moberg flap
5) Venkataswami (Oblique) flap.

❖ Allen's type 3 amputation (**17).**

1) Nail bed graft,

2) Cross finger flap
3) Thenar flap
4) Homodigital flap
5) First Dorsal Metacarpal Artery flap.

- Allen's type 4 could be treated by (**Jerome & Malshikare, (17).**
    1) Cross finger flap
    2) Thenar flap
    3) Microsurgery replantation

The next algorism summarizes the <u>different</u> modalities for treatment of fingertip injuries according to Allen`s classification.

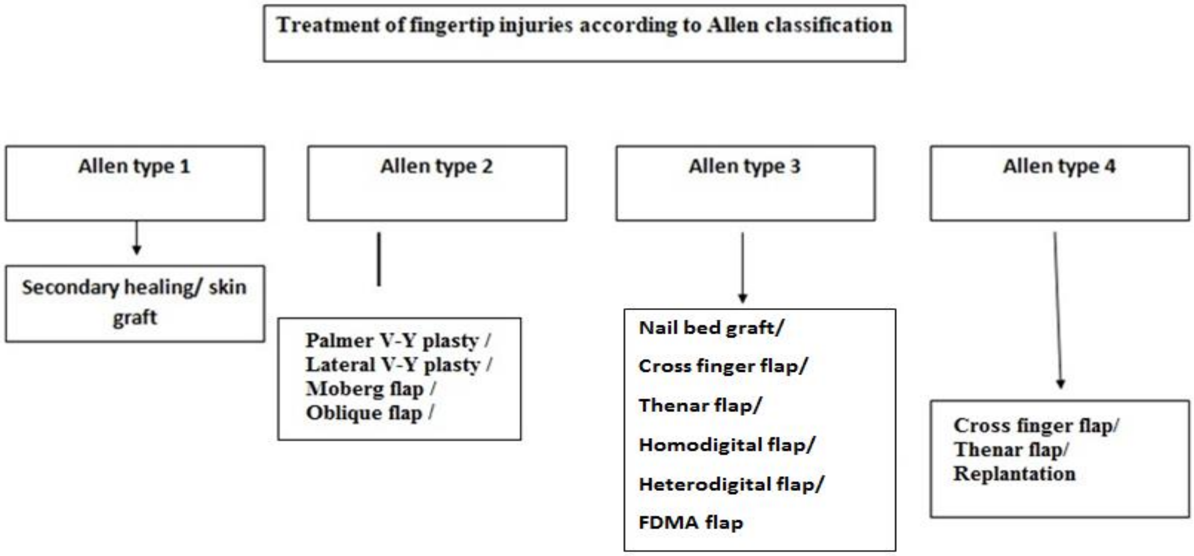

Figure (8): Algorithm of fingertip injuries treatment according to Allen classification (**17).**

Healing by Secondary Intention

Patients with finger amputation that have not exposed the bone or tendon and have less than 2-cm skin loss could be managed conservatively**.** As such, the wounds are left to heal without any operation being performed as the skin cannot be pulled to cover the wound **(7).**

Healing by secondary intention has been proven to offer full recovery, helping the patients to attain normal functionality. Secondary intention can be surprisingly effective; its results may be aesthetically superior to graft or flap reconstruction, without incurring donor site morbidity **(7).**

However, disfigurement and tenderness of finger amputations that affect a person's ability to work normally are some of the adverse treatment outcomes that may occur among individuals **(7).**

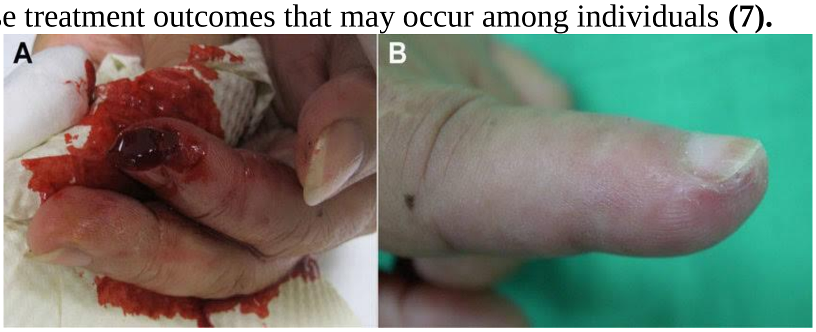

Figure (9): A secondary intention healing. (A) A 1.0 × 0.7 cm skin loss from a cut injury on the left index fingertip. (B) The wound was healed by secondary intention. The sensory recovery and cosmetic result were excellent **(18, 19).**

Skin Grafts

Moynihan reported that the "condemnation of the use of Thiersch graft (split skin graft) has almost been unanimous" and this paradigm has been preserved and inherited by contemporary surgeons. It is worth noting that Moynihan stressed that a thin graft over a bony prominence was the cause of tenderness and sensitivity rather than the use of split thickness graft **(9).**

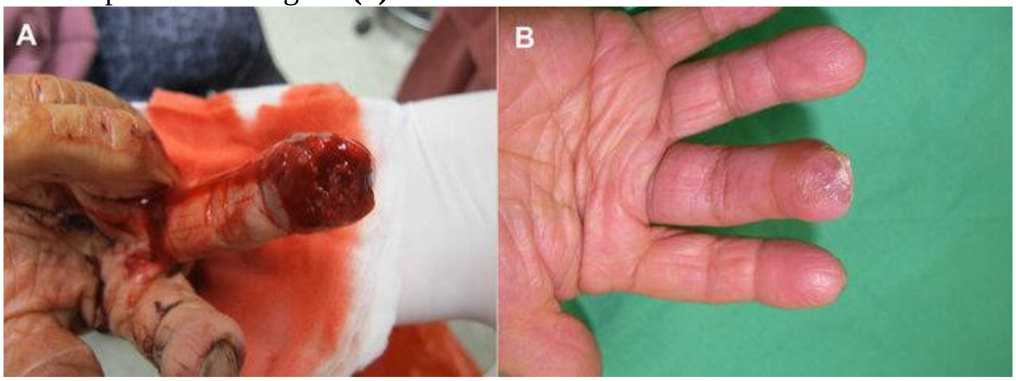

Figure (10): A skin graft. (A) A crush injury with a 1.5 ? 1.4 cm skin loss without bone exposure over the right long-finger pulp. (B) A full-thickness skin graft from his groin region covered the wound. The digital pulp was totally healed at a 3-week follow-up **(19).**

VY advancement flaps

The majority of fingertip losses are adequately treated with VY advancement and cross-finger flaps **(9).**

The first full thickness VY advancement flap was described by Tranquilli-Leali in 1935 for fingertip reconstruction**.** It was Kutler, in 1947 who first described bilateral VY advancement flap for reconstruction of fingertip amputation **(20).**

Other variations include the neurovascular Tranquilli-Leali flap in which the flap design extends proximal to the distal interphalangeal crease and the flap is vascularized by the digital artery proper. The flap design was described for fingertip amputations that were proximal to the mid nail level and that required a greater flap advancement for coverage **(21).**

DeJongh, (22) described a variation of advancement flap for fingertip defects in which the flap is designed as a rectangle and a transverse incision is made on the pulp about 6 mm parallel and proximal to the amputation. A crescent flap was also described for defects for use in situations in which the conventional VY flap would not be adequate for coverage and to preserve fingertip contour **(23).**

An alternative method for advancement was described by Snow, Furlow and Tezel in which the distal ends of the triangular flap are brought together to form a cup at the end of the flap. This flap provides better coverage with less advancement of the flap and, when the 2 ends of the triangle fold together, the dog ear that results adds bulk and gives better contour to the reconstructed fingertip **(21,22).**

This flap is simple to perform, reliable, and the donor site can be closed linearly. It also preserves good fingertip sensation with glabrous skin. It would be logical to assume that the Tranquilli-Leali technique would give a worse outcome in terms of sensibility because the branches of the digital nerves would be transected during the procedure. However, this has not been proved in the literature **(21-27).**

Venkataswami (Oblique) flap

Oblique triangular flap is a type of V-Y advancement flap described by Venkatswami in 1980 **(28).**

It is an axial pattern flap based on known digital artery. The main indications of Venkataswami (Oblique) flap are volar and dorsal oblique fingertip amputations and transverse defects and oblique defects in the lateral aspect at zone I or II. It provide a well-padded glabrous sensate skin and have the advantage of avoiding midline scar formation in the fingertip. However it not suitable for Large defects >2 cm and contraindicated in case of prior injury of the digital vessels or previous history of angiopathy affecting the vessels of the hand, such as vasospasm, vasculitis, peripheral vascular disease, or embolism. The flap is outlined beginning at the mid-lateral line and is extended proximally 2.5 times the diameter of the wound. The flap design is oblique triangular V-shaped. The base of the triangle lies adjacent to the wound. The apex of the triangle is marked

at the PIP joint. Vertical (dorsal) limb is lying in the mid-lateral line. Oblique (volar) limb is pointed from the downward margin of the base to join the apex **(29).**
Evans and Martin modified this technique. They created a step pattern along the medial incision instead of the traditional straight line. The advantage of this modification is that, it minimizes the risk of scar contracture and retraction of skin paddle **(29).**

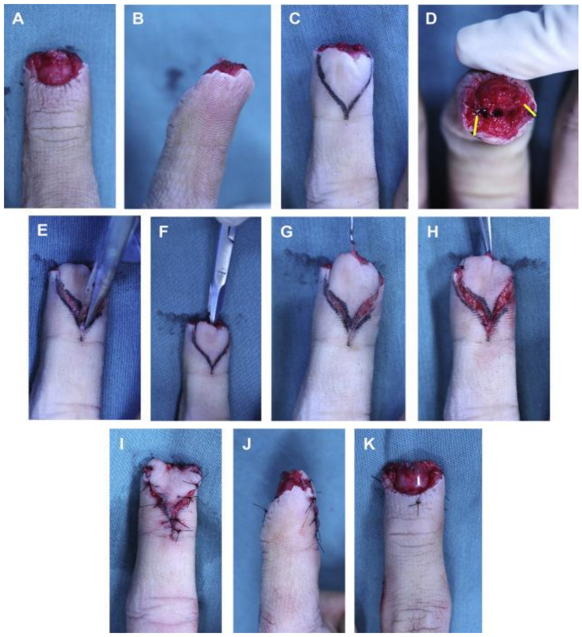

Figure (11): Steps of raising a VY advancement flap. (A, B) Volar neutral fingertip amputation. (C) VY flap design. (D) Yellow lines represent the lateral limits of the flap, which should be same as the width of the nail bed. (E) Division of fibrous tissue at the apex of the flap. (F) Separation of the deep margin of the flap from the periosteum and the flexor tendon sheath. (G) Using a skin hook for traction at the flap base, fibrous tissue that is limiting advancement is identified and divided. (H) The flap is then advanced and sutured to the nail bed. (I–K) After flap inset is complete **(21).**

Figure (12): Oblique amputation reconstructed with an osteocutaneous VY flap to reconstitute the nail complex contour (bone outline in dashed line). Satisfactory nail contour and normal looking fingertip after remodeling **(9)**

Bone loss

To minimize loss of bone support and fingertip length, a vascularized bone graft can be obtained as part of a VY flap to reconstruct the fingertip while preserving length **(24).**

The Moberg Flap

The Moberg flap is a bipedicled (radial and ulnar digital arteries of the thumb) axial advancement flap that is used specifically in reconstruction of distal thumb volar defects. This flap was first described in 1964 by Moberg for soft tissue reconstruction of the volar thumb injuries with exposed bone and tendon **(25).**

Moberg flap is a good choice providing sensate glabrous tissue for volar oblique defects measuring up to 2 cm over the distal third of the thumb **(25).**

The shortcoming of Moberg flap is the development of a stiff thumb (IPJ contracture). To overcome this problem, the original Moberg flap was later modified with the addition of a V-Y advancement to extend the range of the flap and provide for a tension-free closure of the defect **(26).**

It needs to be noted that the Moberg flap can safely be utilized in thumb reconstruction due to the unique anatomic vascular supply of the thumb: since both neurovascular bundles are harvested with the flap, the blood supply to the thumb is preserved via the reliable dorsal blood supply of the princeps pollicis artery, preventing dorsal skin necrosis. Prior to harvesting the flap, the wound needs to be adequately debrided and the wound margins freshened **(25).**

Figure (13): Multiple finger amputation. Moberg flap for the thumb, Kutler flap for the index finger, V–Y advancement flap for middle finger and skin graft for the ring finger **(27).**

Nail bed grafting

Split-thickness sterile matrix grafting

A split-thickness sterile matrix (STSM) graft is used to repair simple sterile matrix defects**.** The STSM graft may be harvested from either the injured finger or the great toe if sufficient tissue is not available locally. The graft should be approximately 1–2 mm larger than the defect and thin enough to prevent full-thickness removal. One trick is to keep the scalpel edge visible during the procedure to obtain a thin slice that is 0.25–0.5 mm thick. STSM grafts have no directional orientation, and the graft can be positioned according to the defect. Compared with full-thickness grafts, the STSM grafts avoid donor deformities **(30).**

Figure (14): STSM grafting after resection of a superficial acral fibromyxoma. (A) The partially deficient sterile matrix. (B) A STSM graft taken from the adjacent sterile matrix. (C) The defect covered by the STSM graft. (D) After grafting, reset and fix the nail plate. STSM, split-thickness sterile matrix **(30).**

For full-thickness sterile matrix avulsion with significant exposure of the distal phalanx, a fascial flap combined with sterile matrix graft works better**.** Although this is a multistep surgery, it significantly improves the appearance of the nail **(31).**

Sterile matrix particle grafting

Skin particle grafting has been widely used for large skin defects to address the insufficient supply area. The sterile matrix is a derivative of the skin and has similar biological characteristics. Based on this, only a small amount of sterile matrix tissue is required to treat sterile matrix defects **(30).**

A pressure dressing is applied to the grafting areas for 2 weeks. This technique not only produces auto amplification of the sterile matrix tissue, but it is also convenient to perform. However, due to minimal contact with the base and poor blood supply, it has a higher risk of graft necrosis **(30).**

Germinal matrix grafting

Germinal matrix grafting is used to repair defects that cannot be closed directly or with matrix flaps. Studies suggest that the split-thickness germinal matrix graft does not produce nail due to the lack of a basal layer in the germinal structure; therefore, the effect of split-thickness germinal matrix grafting is unsatisfactory **(32).**

A relatively common germinal matrix graft combines free, full-thickness germinal matrix with sterile matrix, usually from the toe to the finger. The matrix scar is excised, and the defect is covered by a free graft taken from the intact matrix of the toe. The germinal matrix is strictly directional and must be correctly placed. The appearance of the regenerated nail plate is nearly normal, leaving a donor deformity **(30).**

Full-thickness skin grafting

Full-thickness skin grafts are most commonly used to repair entire nail unit loss. It works well, even on the distal phalanx. Grafts harvested from the lower abdomen, groin, or flexor side of the non-dominant arm are fixed in place. This simple method can effectively close the defect, and the wound can achieve good primary healing **(33).**

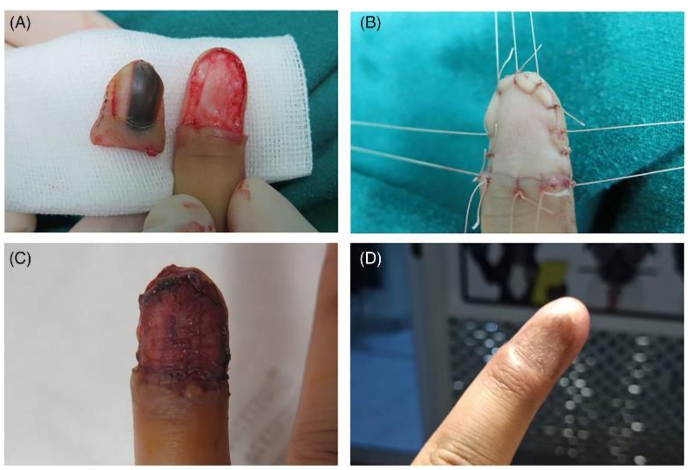

Figure (15): Full-thickness skin grafting. (A) Total resection of the nail unit. (B) The flap sutured on the defect. (C) 10 days postoperatively. (D) 3 months postoperatively **(30).**

Reversed dermal grafting or artificial dermis grafting

An alternative to full-thickness skin grafting is the reversed dermal grafting. In this surgery, a dermal graft is obtained from an area with a thick dermis. A very thin split-thickness graft is raised with its connection to the donor uncut, and a piece of the exposed dermis is then excised. This dermal graft is placed upside down on the defect because the abundant fine vessels of the superficial dermis are beneficial for wound revascularization **(30)** when fine granulation tissue appears in the wound, re-epidermization from the surrounding tissue takes place **(34).**

This graft provides mechanically resistant skin with sufficient connective tissue but relatively few cells, for which it can be applied successfully even in areas with poor blood supply. Practically, it is also feasible to use an artificial dermis to cover the wound for secondary healing. The main disadvantage of reversed dermis grafting is the prolonged recovery time. Relatively, the combination of an acellular dermal matrix graft and a subsequent skin graft can provide more satisfactory aesthetic outcomes with minimal functional deficits **(30).**

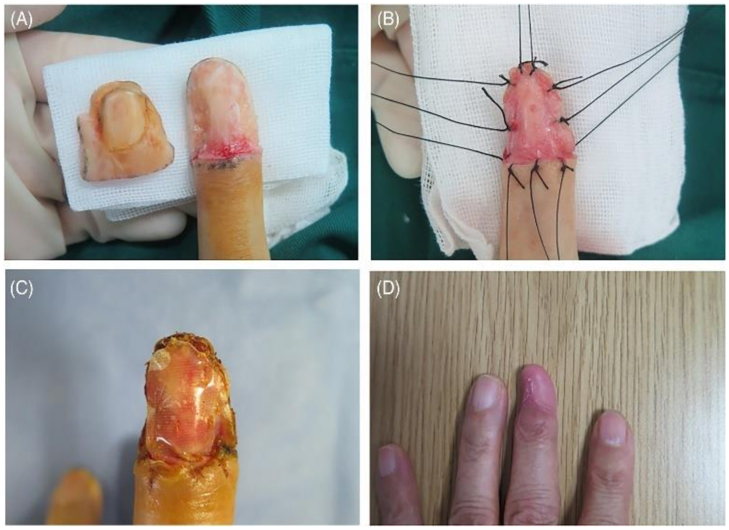

Figure (16): Artificial dermis grafting. (A) Total resection of the nail unit. (B) The artificial dermis sutured on the defect. (C) 1 month postoperatively. (D) 5 months postoperatively **(30).**

Cross-finger flaps

The cross-finger flap is a 2-staged procedure first published by Gurdin and Pangman in 1950 but was used by Cronin 1951 as an original procedure. the flap is taken from the dorsum of an adjacent digit, usually at the level of the middle phalanx, and is used to resurface a volar unfavorable pulp amputation. This flap does not require the patient to place the arm in an awkward position, and is also easier to perform and less time consuming than raising an island flap **(21).**

The innervated cross-finger flap was first published by **Adamson et al. (35).** The flap was harvested from the index finger along with branches of the superficial radial nerve to cover the thumb pulp. This technique was described with the aim of providing sensation to the thumb. A dual-innervated flap was also described **(36).**

The dual innervation originates from branches of the superficial radial nerve as well as the dorsal branch of the digital nerve proper. The dorsal branch of the proper radial digital nerve is cut and then neurotized to the thumb ulnar digital nerve to provide a dual source of innervation **(21).** The cross-finger flap is reliable and has the ability to cover extensive loss of the pulp of the fingers and the thumb **(36).**

It can also cover defects at any level of the digit, unlike the thenar flap, which can only resurface defects at the fingertip. It is limited only by the amount of available skin from the donor digit; the width is limited by the mid-lateral line of the digit, and the maximum length extends from the level of the distal interphalangeal joint to the level of the palmar digital crease **(21).**

The main criticism of the cross-finger flap is that it is a 2-staged procedure, uses an uninjured digit**,** and may result in stiffness of the donor finger. In addition, it does not provide glabrous skin for coverage. Although the flap is not an innervated flap, it has been shown that this flap can achieve good sensory recovery and good results with younger patients with no reduced range of motion of the donor digit **(21).**

Figure (17): Cross-finger flap. (A–C) Volar unfavorable fingertip defect. (D) Excess skin is needed to recreate the pulp contour. (E) The proximal and distal extent of the flap is incised first and dissection is carried down to the paratenon of the extensor tendon. (F) The flap is then separated from the paratenon with blunt dissection. (G) To get good fingertip contour, anchor the sides of the flap at the lateral aspect of the distal-most region of the defect first and leave about 5 mm of excess flap hanging out distally. After the proximal part of the flap inset is done, the tip is turned down and then sutured to the sterile matrix. (H) A full-thickness skin graft is then harvested and used to cover the flap donor defect and the exposed skin bridge. (I, J) Flap inset is complete **(21).**

Thenar flaps

The earliest description of the thenar flap was by Gatewood in 1926. He described an ulnarly based pedicled flap over the thenar eminence that was used to cover a 2 × 2.5-cm defect over the index fingertip. The donor defect was closed linearly and the flap was divided at 12 days after the initial surgery. Since then, flaps that are distally based, proximally based, and H shaped have been described **(21).**

Disadvantages includes stiffness of the digit, injury to digital nerve to the thumb, and donor site scar contracture and sensitivity. In general, all reported series of the thenar flap have good aesthetic outcomes, good sensory recovery, with absent to minimal finger stiffness and donor site problems. **(21).**

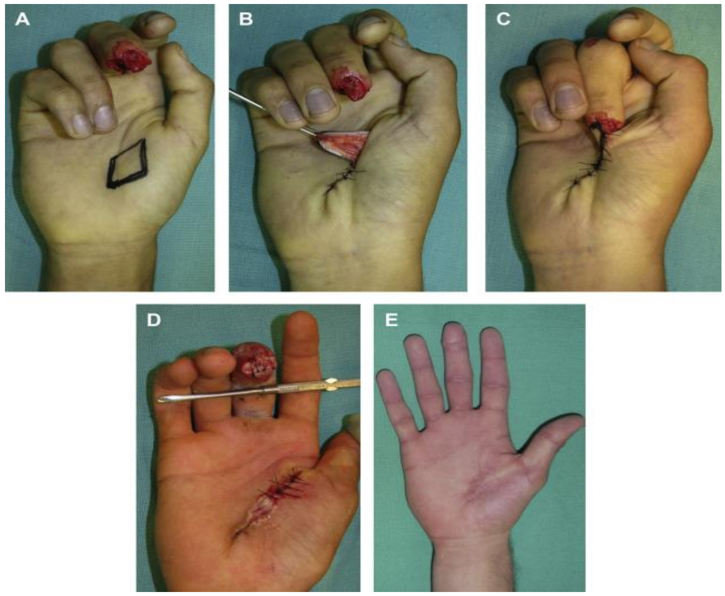

Figure (18): Thenar flap. (A) Flap design: rhomboid-shaped flap is outlined at the proximal thenar eminence. (B) Flap is raised distally based with linear closure of donor site. (C) Flap inset. (D) Flap division. (E) Results at 4 months after surgery **(21).**

Homodigital island flap

The homodigital island flap is a sensate flap from the same finger with glabrous tissue to reconstruct the fingertip. Yet many studies report some extent of proximal interphalangeal (PIP) joint flexion contracture due to bending of the finger for an optimal insertion of the flap **(37).**

Some authors advocate to include z-plasties or step ladder designs or to implement a mandatory splinting regime to minimize PIP joint contracture **(29).**

The homodigital island flap may be local antegrade homodigital neurovascular island flaps (AHIFs) or regional reverse homodigital island flaps (RHIPs) **(38).**

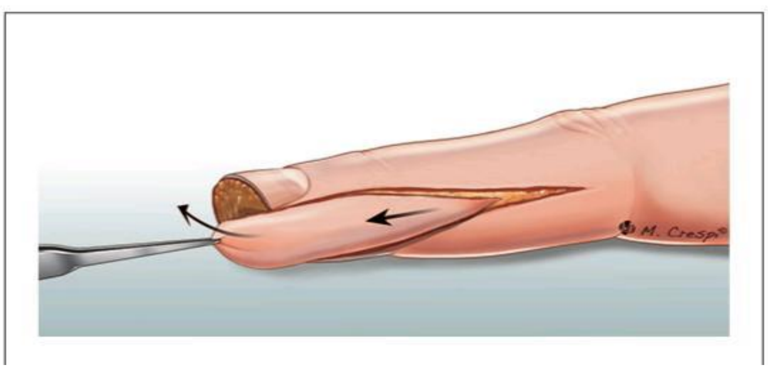

Figure (19): Antegrade homodigital neurovascular island flap dissection **(39).**

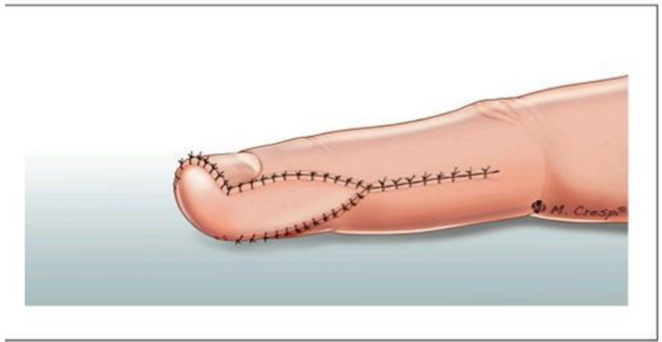

Figure (20): Antegrade homodigital neurovascular island flap insertion **(39).**

Both types (AHIFs and RHIFs) allow single-stage reconstruction, with a quicker recovery and shorter period of immobilization when compared with other multistage procedures such as cross-finger or reverse cross-finger flaps **(38).**

The flap is also durable and typically has a similar color and thickness to the surrounding area. Nevertheless, RHIFs can be complicated by postoperative venous congestion, flap necrosis, flexion contractures, and cold intolerance **(39).**

Heterodigital flap

A heterodigital vascularized island flap can functionally restore large soft tissue defects to the injured fingertip in a single stage. It is optimally used for digits of unequal length so that the donor fingertip is not violated, and the skin island is best taken from the less dominant side of the donor finger **(40).**

Because it is a transposition flap with a proximal axis of rotation, its transposition arc can also reach the dorsum of an adjacent digit. It preserves the donor finger digital nerve and distal pulp, thus reducing donor site morbidity **(40).**The disadvantage of the heterodigital flap is that it requires morbidity to another digit, and there have been problems with cross-localization of sensation to the donor digit, cold intolerance, and hyperesthesia or paresthesia of the donor digit **(40).**

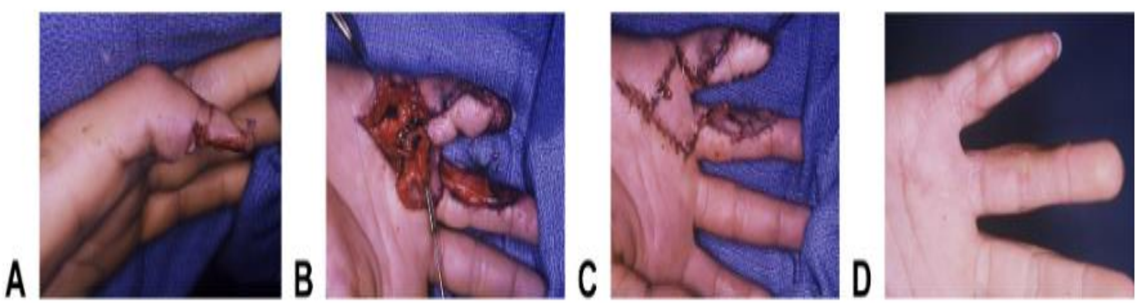

Figure (21): A: Loss of distal pulp after an avulsion injury of the little finger. B: Digital artery is dissected proximally to the common digital artery bifurcation, and the digital nerve is dissected away from the flap. C: Final flap inset and skin graft after transposition. D: Long-term outcome with fully sensate volar fingertip **(40).**

First dorsal metacarpal artery (FDMA) flap

The first dorsal metacarpal artery flap is currently the first choice for the treatment of thumb pulp defect. It was introduced by Foucher and Braun in 1979 for coverage of thumb with partial tissue loss. The FDMA is a type of island flap that has an average pedicle length of around 7 cm, making it an ideal flap for reconstruction of the thumb due to its wide arc of rotation **(25).**

It is based on ulnar branch of FDMA. FDMA arises from the radial artery just distal to the extensor pollicis longus tendon, before the artery dives between the two heads of the first dorsal interosseous muscle **(41).**

Patients with injury to the radial artery at the anatomic snuffbox are not candidates for this flap. The flap may be a sensate flap if the branch of the superficial branch of the radial nerve (SBRN) is harvested with the flap, something that can increase the functionality of the reconstruction **(25).**

It can be used for volar and dorsal defects. Various modifications have been suggested for various types of defects such as extended FDMA, reversed FDMA and bilobed FDMA **(42).**

Figure (22): Intraoperative photographs showing raised racquet-shaped first dorsal metacarpal artery flap (FDMA) flapin(A) (B) In setting of FDMA flap over thumb dorsum and split skin graft (SSG) from volar wrist over flap donor site as shown in(C). Cross-finger flap was raised from index finger for middle finger as shown in (D) **(41).**

Microsurgery replantation

Microsurgical replantation may play an important part in the treatment of distal fingertip amputations, in some cases salvaging the tip, resulting in superior functional and aesthetic outcomes**.** Arterial or venous anastomoses, however, are impossible at very distal levels especially in the pediatric population where vessels are smaller, and in some crush and avulsion amputations **(43).**

The decision to replant depends not only on the survival predictors described, but also on the expected long-term function. Some studies have found patients prefer revision amputation (vs replantation) once informed of post-replant expectations**.** Thus, functional and aesthetic benefits are also considered, as well as the patient's motivation to undergo complicated procedures with lengthy rehabilitation**.** Microsurgery requires the appropriate equipment (microscope and set), post-operative monitoring and set-up, motivated patients and most importantly a highly skilled and trained hand microsurgeon. It is associated with high operation costs, prolonged operative time and inpatient stay **(43).**

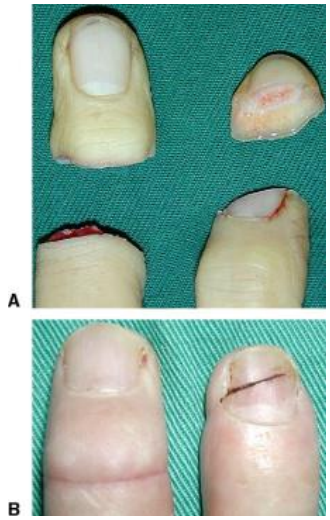

Figure (23): Fingertip replantation **(44).**

Conclusion

Fingertip injuries are the most common injuries that occur to the hand. Various treatment options have been described including healing by secondary intention, skin graft, homodigital, heterodigital and regional flaps as well as free flap. Small defects with limited exposure of the bone can be treated conservatively with healing by secondary nature. Good results can be achieved with standard dressings or a semi-occlusive dressing. With larger defects, surgical treatment is needed. Without prompt and precise treatment, finger injuries can interfere with the complex function of the hand and may result in permanent deformity and disability. The fingertip is a crucial part of the hand, So, an interprofessional approach to fingertip injuries is essential to limit morbidity. The choice of the most suitable management option depends on a triad of surgeon factors (experience & skills), Patient factors (age, sex & occupation) and defect analysis (injured finger, type of injury and bone exposure). The precise treatment strategy based on Allen Classification, whether conservative or operative, primarily depends on the extent of the injury and must be determined on a case-by-case basis.

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