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CRUSH INJURY OF FINGERTIP AMONG VARIOUS AGE GROUP IN TERTIARY CARE CENTRE – A PROSPECTIVE STUDY

Plastic Surgery

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ABSTRACT

Background - A stable, mobile and sensate fingertip is important to the overall function of the hand. In addition, the face and hand are the most looked at parts of our body. When faced with a fingertip injury, clinicians will need to manage both functional and aesthetic considerations in their treatment plan. **Materials & Methods –** A prospective study of 50 patients were analysed and the results tabulated according to the various parameters. **Results –** Most od the patients were male with the involvement of the dominant hand and in the second decade of life. With treatment most of them regained normal function and aesthesis. **Conclusion –** Early and appropriate intervention of finger tip injuries can help the patient to return to work early with little or no morbidity.

KEYWORDS

INTRODUCTION

A fingertip injury is any soft tissue, nail or bony injury distal to the insertions of the long flexor and extensor tendons of a finger or thumb.[1] Fingertip injuries are commonly seen by family and emergency physicians. Many of these cases are simple to treat and do not need specialised treatment by a hand surgeon. However, there are certain conditions where early intervention by a hand surgeon is warranted for better functional and aesthetic outcomes. Common injuries include crush injuries to the fingertip (with resultant subungual haematoma, nail bed laceration, partial or complete amputation of the fingertips, pulp amputations and fractures of the distal phalanges), mallet finger, flexor digitorum profundus (FDP) avulsion, and distal interphalangeal joint dislocations

MATERIALS AND METHODS

The aim was to study the crush injury of fingers among various age groups in a tertiary care centre. The study was done for a period of 3 months between January to March 2023 in the Dept. of Plastic & Reconstructive Surgery, Saveetha Medical College & Hospital. A total of 50 patients with finger tip injuries were selected according to the inclusion and exclusion criteria and the proforma was filled. The various parameters were studies and assessed and the results were tabulated accordingly. This was a prospective analytical study with a consecutive sampling technique. The inclusion criteria were patients with zone 1 flexor injury and extensor injury. The **exclusion criteria were** other zones of flexor and extensor injury.

RESULTS

Table 1. Age Distribution

Age	No of patients	No of patients %
1-20	19	38%
21-40	26	52%
41-60	5	10%
Total	50	100%

Table 2. Gender Distribution

Gender	No. of patients	No. of patients %
Male	45	90 %
Female	5	10 %
Total	50	100 %

Table 3. Type Of Dressing

Type Of Dressing	No Of Patients	No Of Patients %
BUDDY STRAPPING	4	8%
COMPRESSION	35	70%
COMPRESSION, POP SLAB	2	4%
POP SLAB	6	12%
SPLINT	3	6%
TOTAL	50	100%

Table 4. Cause Of Injury

Cause Of Injury	No Of Patients	No Of Patients %
RTA	4	8%
WORK PLACE INJURY	46	92%
TOTAL	50	100%

Table 5. Injured Hand Of The Patient

Injured Hand	No Of Patients	Percentage%
RIGHT HAND	25	50%
LEFT HAND	25	50%
TOTAL	50	100%

Table 6. Dominant Hand

Dominant Hand	No Of Patients	Percentage
RIGHT HAND	48	96 %
LEFT HAND	2	4 %
TOTAL	50	100 %

Table 7. Anesthesia Given

Type Of Anesthesia	No Of Patients	Percentage%
LA	21	42%
REGIONAL	29	58%
TOTAL	50	100%

Table 8. Range Of Motion

Range Of Motion	No. Of Patients	Percentage %
NORMAL	42	84%
MILD RESTRICTION	6	12%
MODRATE RESTRICTION	1	2%
SEVERE RESTRICTION	1	2%
TOTAL	50	100%

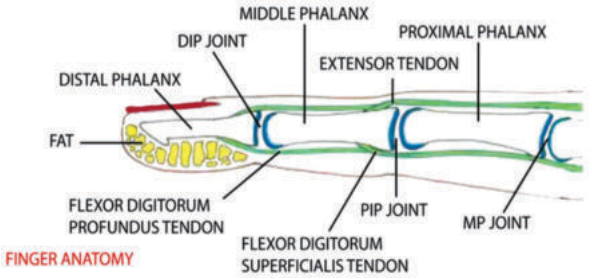
DISCUSSION

Hand and finger injuries can be crippling and affect all ages, none more so than the working-class adults and children. In adults, injuries are commonly due to occupational activities with lacerations being the major type of injury, followed by crush and avulsion injuries. Most injuries tend to be singular and of minor severity, and can be treated as an outpatient. However, powered machines and non-powered hand tools are more likely to result in multiple types of injuries.[2] The National Institute for Occupational Safety and Health in the United States conducted a survey across multiple emergency departments in 1982, and estimated occupational finger injuries to account for 25.7%

of its workload. 1.6% had amputations of one or more fingers.[3] With regard to children, the Royal Hospital for Sick Children's (Glasgow) Accident and Emergency Department sees fingertip injuries which account for 1.8% of its workload. Injuries in children limit their daily activities like eating, playing and schoolwork. Parents worry about immediate problems as well as long-term functional and aesthetic outcomes/disabilities. In isolated finger injuries,[4] the incidence is highest in younger children and boys. Most injuries arise at home and are due to "jamming/crushing", usually by doors, either by their parents or siblings.[5]

Fingertip injuries can affect the bones at the ends of the fingers (distal phalanges), the fingernails or the soft pads of the fingers. Crush injuries are the most common causes of injury to the tip of the finger, but cuts and dislocations can also occur. Some injuries can affect the sensory nerves in the fingertips, which is why it's essential to get the right treatment for fingertip injuries. Types of fingertip injuries include distal phalangeal avulsion fracture or dislocation of DIP joint, fingertip laceration, jersey finger, mallet finger, nail root avulsion and subungual hematoma. The most common causes of fingertip injuries include crush injuries, lacerations from sharp objects and sports injuries. Symptoms of a fingertip injury will depend on the cause of the injury, but may include bleeding or bruising beneath the nail bed, deformity of the fingertip if the bone has been shoved out of alignment, fingertip numbness if nerves are damaged, fingertip pain and swelling and lacerations of the nail or nailbed. When the fingertip or nail bed sustains an injury, common treatments include: closed reduction where the fractured or dislocated bone is non surgically realigned, hematoma decompression where tiny pin holes in the nail bed drain blood and relieve pressure, splinting causing stabilizing the fingertip and joint, nailbed repair to prevent future nail deformity and surgery which is reserved for cases of complex fractures, tendon tears or fingertip amputations. Certain risk factors can increase your chances of sustaining a fingertip injury, including contact sports or occupational hazards. It is impossible to prevent accidents that can cause fingertip injuries, but taking certain precautions may reduce your risk by keeping nails trimmed to avoid nail plate avulsions, refraining from high-risk activities like rock climbing or contact sports and wearing protective gloves when handling heavy machinery or sharp objects. The fingernail and the underlying nail bed are the most commonly injured part of the hand. If a fingernail is injured by a direct blow, the underlying bone may also be broken. Each finger (except the thumb) has three bones, or phalanges: the proximal phalanx, the middle phalanx, and the distal phalanx. A fracture of a phalanx may be an isolated injury, but it is often associated with injury to tendons, ligaments, fingernails, or other soft tissue. A dislocation is an injury to a joint that causes a bone to move out of its normal alignment with another bone. Finger dislocations commonly happen due to a direct blow to the finger (like while playing ball sports). Usually, a dislocation causes damage to the surrounding ligaments, which are stretched and remain damaged even after the dislocation is reduced. Ligaments are the tough tissues that hold two bones together and stabilize a joint. A ligament may be torn by a forceful stretch or blow, leaving the joint unstable and prone to further injury. Tendons are the fibrous bands that attach muscles to bones and allow the flexible, precise movements of the joints. Tendons lie just under the skin of the fingers and are covered by a protective sheath. Both the tendon and its sheath can be damaged by a laceration (cut) or a crush injury. A tendon can also be torn away from its bony attachment, which is called an avulsion fracture. Sensation to the finger is supplied by four nerves, two (dorsal and volar digital nerves) running along each side of the finger. Damaging the nerve can cause numbness on the side of the finger supplied by the nerve.

Understanding the fingertip anatomy provides the basis for optimum care of these specialised structures after injury. The nail is the most prominent feature of the finger. It fulfils both an aesthetic and functional role, allowing increased sensory perception in the pad of the finger, and the accurate picking up of objects. The parts include the eponychium, paronychium, hyponychium, lunula, nail matrix and dorsal nail fold. The eponychium is the soft tissue on the dorsal surface superior of the nail, extending from the dorsal finger skin. The paronychium are the folds on each lateral aspect of the nail that curve into the fingertip. The hyponychium is a plug of keratinous material situated beneath the distal edge of the nail (i.e). where the nail bed meets the skin). The nail fold consists of the dorsal and ventral floors. The dorsal nail fold is responsible for the shine of the nail. The nail bed consists of the sterile and germinal matrix. The germinal matrix is responsible for 90% of the nail growth, and the sterile matrix is where the nail adheres to the nail bed. The white arc on the nail is called the lunula, and it demarcates the sterile from the germinal matrix underneath. The nail itself is composed of onchyn, which is a keratinous material that is produced by the death of the germinal cells as they are pressed upwards. The pulp consists of multiple fibrous trabeculations arising from the periosteum to the epidermis that divides the pulp into a latticework of separate septal compartments containing fat. The core of the fingertip contains the distal phalangeal bone. It is of close proximity to the nail bed. The extensor tendon attaches onto the base of the distal phalanx, and lies about 2 mm from the proximal end of the germinal matrix. The flexor digitorum profundus tendon attaches on the volar aspect of the distal phalanx. Each of the two digital nerves splits just proximal to the base of the nail fold, giving one branch into the pulp and another to the nail bed. There are multiple variations to the nerve supply at the fingertip.[6] In the fingertip are unique structures called glomus bodies. They are intertwined balls of fine nerves and vessels that regulate blood flow to the fingertip. Each digital artery dives into the pulp at the level of the distal phalanx, and gives off a branch parallel to the paronychium. This then becomes multiple small, fine branches going into the nail bed as the vessel traverses distally.[7] The small veins of the fingertip do not follow the artery as vena concomitants but progress proximally in a random fashion.[8]



FINGER ANATOMY

Common Injuries

Nail & Nail Bed Injuries

These injuries include simple lacerations, complex stellate lacerations, avulsion injuries, amputations or associated paronychial injuries. Subungual haematomas are usually the result of a crushing injury. A plain radiograph of the affected finger should be taken to rule out an associated fracture. Painless subungual haematomas can be treated conservatively if the nail plate is still adherent to the bed and not displaced out of the nail folds. This is regardless of the size of the haematoma.[9] For cases of subungual haematomas with an underlying fracture, the nail should be avulsed and the nail bed debrided and repaired.[10] Depending on the configuration of the underlying fracture, the fracture might need to be reduced and fixed.

Subungual haematomas with no underlying fractures can generally be left alone, unless it causes pain for the patient. Trephination of the nail can be carried out as an outpatient procedure to relief the pain, usually instantaneously. A digital block is performed, followed by trephination using a heated (red hot) paperclip **(Fig.1)**

Simple lacerations through the sterile matrix can be sutured in the outpatient setting with 6/0 absorbable sutures. Nonabsorbable sutures are avoided. Digital tourniquets applied after the digital block is given will help ease the repair by creating a bloodless field. Lacerations through the nail fold, germinal matrix or dorsal roof should also be repaired accurately. Back cuts at the two corners of the proximal nail fold can allow one to visualise the germinal matrix and dorsal roof for this purpose. Nail plates removed are usually sutured back to act as a splint, keeping the dorsal roof and germinal matrix from being adherent to each other. Artificial nails, or the silver foil from the suture package cut into shape are used as splints when the patient's own nail is missing, too damaged or too dirty to be utilised. The splints are to prevent the dorsal roof from adhering to the nail bed before the new nail grows. A nonadherent dressing is used to protect the repair. The risk of permanent nail deformity is higher if the germinal matrix is involved in the injury.

In cases with partial or complete nail bed loss, reconstruction of the nail and nail bed might be required. Children with nail bed injuries should be referred as they usually require general anaesthesia for any repair or debridement to be carried out, because they are unable to cooperate with treatment under local anaesthesia.

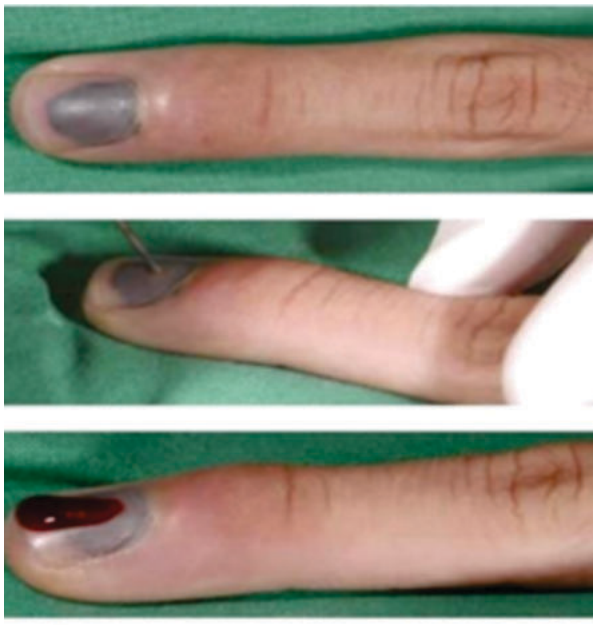


Fig. 1 Subungual haematoma and treatment photographs show (a) subungual haematoma affecting 80% of the nail, associated with pain, (b) trephination with a red hot needle after a digital block was given and (c) release of haematoma and relief of pressure.

Fingertip & Pulp Amputations

Allen's classification is commonly used to describe the level of amputation **(Fig .2)** [11] for fingertip amputations. Type 1 injuries are those involving the pulp only. Type 2 injuries consist of injury to the pulp and nail bed. Type 3 injuries include distal phalangeal fracture with associated pulp and nail loss. Type 4 injuries involve the lunula, distal phalanx, pulp and nail loss. Additional information that is useful to the hand surgeon when receiving a referral is whether the amputation is volar neutral, volar favourable or volar unfavourable.

Fig. 2 - Allen's Classification

Fig. 3 - VY advancement flap for Allen volar neutral fingertip amputation (b) the design of VY advancement flap (c) post operative photograph

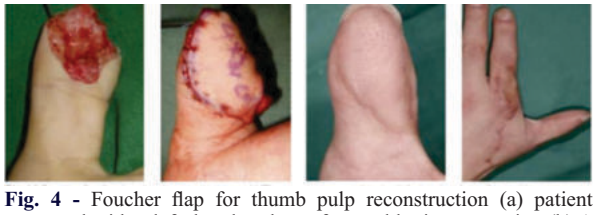


Fig. 4 - Foucher flap for thumb pulp reconstruction (a) patient presented with a left thumb volar unfavourable tip amputation (b) A Foucher flap was used to cover the defect (c) The appearance of the flap six month post-operative (d) the appearance of the donor site six moth post operative

Diagnosis is usually straightforward, based on the clinical history and examination, as well as the plain radiographs of the affected digit. Treatment options targeted toward the exact kind of defect or pathology the patient presents with include secondary intention healing, skin grafting, flaps (VY advancement **(Fig. 3)**, cross finger flap, neurovascular island flap, reverse vascular island flap, foucher flap **(Fig. 4)** , toe pulp transfer), terminalisation or revision amputation, and distal replantation **(Fig. 5).**

Fig. 5 - Distal replantation photographs and accompanying radiograph images shows (a) a complete amputation through the distal phalanx and (b) the replanted finger one month post operation ,where the distal interphalangeal joint is fused.(c) the final result 6 month post operation.

Secondary intention healing is ideal for superficial clean wounds that are smaller than 1cm2 in adults, with no exposed bone.[12] Recovery usually takes up to six weeks, with regular wound dressings at the clinics. Skin grafting is considered when the defect is larger but with no exposed bone, or if the patient does not wish to go through the long healing process of allowing healing by secondary intention. However, skin grafting will leave a wound from the donor site. Long-term results from secondary healing and skin grafting are generally good. Complications can include beaking of the nail, the loss of pulp contour and hypo- or hyperaesthesia. With fingertip injuries where the bone is exposed or there is a sizeable amount of tissue loss, a local or free flap is required to cover the defect. The site the flap is taken from depends on the size and site of the defect, the experience of the surgeon, and to a certain extent, the patient's choice. The flap can range from a simple VY advancement flap to a free toe pulp transfer for thumb pulp defects. In children, surgical treatment is more conservative in nature, with the aim of preservation of the digit length. Children below the age of five do well with "cap-plasty", where the amputated tip is sutured back primarily as a composite graft **(Fig. 6)** after a thorough debridement with minimal defatting.

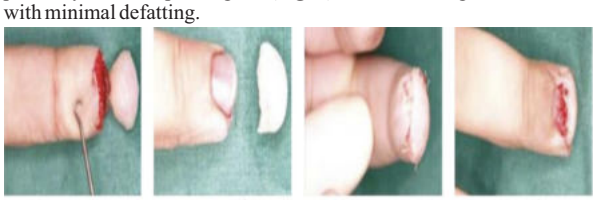


Fig. 6 - Composite grafting works well for children under five years of age with finger tip amputation (a,b) a child with fingertip amputation and salvaged amputate (c,d) the wound were cleaned thoroughly and the amputate was sutured back as a composite graft

Distal replantation is defined as the replantation of the fingertip at the level of or distal to the distal interphalangeal joint (DIPJ).[13] Replantation is attempted when the amputate is present with the normal architecture. This allows the preservation of finger length and the irreplaceable nail bed. The functional and cosmetic outcomes are usually good, even if the DIPJ is fused for the replant.[14] Replantation should be attempted in children as they have better cosmetic and functional outcomes compared to adults, although it is technically more challenging to the surgeon due to the smaller vessels. Common complaints from patients following a fingertip amputation include cosmesis, stiffness, cold intolerance, and hyper- or hyposensitivity to the affected digit. This can be regardless of the type of treatment administered.

Distal Phalangeal Fractures

No fixation is usually required for tuft fractures. Patients should be given analgesia and a protective splint for a few weeks until the pain

resolves. They should also be counselled that pulp pain on pressure can persist for up to two to three months as the bone is healing. If there is an associated nail bed or pulp laceration, then meticulous toileting of the wound with repair of the lacerations should be carried out. Open fractures with significant pulp or nail bed defects, unstable or significantly displaced fractures, and fractures in children should be referred to the hand surgeon for further management.

Mallet Fingers

Mallet fingers are most commonly the result of a sudden flexion of an extended DIPJ along the long axis of the finger.[15] This is the commonest closed tendon injury in the hand. The extensor tendon can be stretched, partially torn, ruptured or avulsed with a bony fragment from the base of the distal phalanx. The loss of active extension of the DIPJ is the hallmark sign of a mallet finger. The loss of passive extension with "swan-necking" due to proximal interphalangeal joint hyperextension suggests chronicity of the injury. The diagnosis is mainly a clinical one, with the aid of plain radiographs to rule out or confirm an associated fracture and subluxation of the joint. Most mallet fingers can be treated effectively with continuous splinting of the DIPJ in extension for a total of six weeks before interval mobilisation, with a further two weeks of night splintage. A Cochrane review has shown that all available splints give similar end results.[16] Surgery is indicated for patients who have failed conservative treatment, have open mallet injuries, are unable to work with the splint in position, and who have a fracture involving greater than one-third of the articular surface or subluxation of the DIPJ. There are many methods of fixation for bony mallets. Whether surgically or conservatively treated, the patient will likely be left with a residual extension lag of 10º–20º of the DIPJ (15).

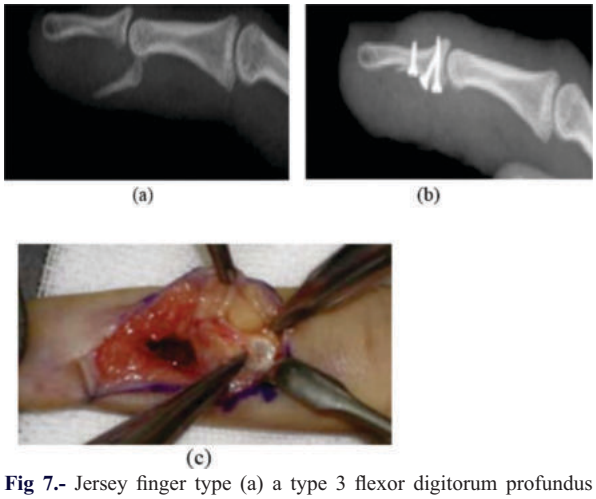


Fig 7.- Jersey finger type (a) a type 3 flexor digitorum profundus avulsion fracture and (b) screws used for definitive fixation of the fracture (c) operative view of the avulsion fracture site Jersey Finger (Flexor Digitorum Profundus Avulsion)

This injury is a result of forced extension with the DIPJ in active flexion. The ring finger accounts for up to 75% of jersey finger injuries.[17] The end of the avulsed tendon retracts proximally along the finger or to the palm. **(Fig. 7)** Diagnosis is based on history, examination and plain radiographs. The patient will be unable to actively flex the DIPJ after the injury. There will be a loss of the normal finger cascade at rest. Patients will sometimes feel a palpable lump over the proximal interphalangeal joint or in the palm. This is the retracted end of the flexor digitorum profundus tendon. The treatment of jersey fingers requires surgical intervention, which can include fracture fixation, primary tendon repair for early cases and tendon transfers for late diagnosis. The prognosis of jersey finger injuries usually worsens with delay of treatment. The functional outcome of the affected finger is also usually worse with a more proximal retraction of the flexor digitorum profundus tendon.

In this study 50 patients were involved in which 38% patients fall under the age group of 1-20,52% patients fall under the age group of 21- 40 and 10% patients fall under the age group of 41-50. The gender distribution says 90% were men and 10% were female. Type of dressing for the injury were budding strapping was 8%, compression 70%, compression with POP slab was 4%, POP slab was 12% and splint was 6% .The anesthesia given was local anesthesia 42% and regional anesthesia 58%. In this the patient with RTA injury were 8% and work place injury was 92%. In this study, out of a total of 50 patients, 25 were of the right hand and 25 were of the left hand. The patients had right hand dominance were 48 and patients with left hand dominance were 2 which accounts for 96% and 4% respectively. The treatment done include Debridement, primary skin suturing, nail plate repositioning, nail bed repair, K-wire fixation, eponychial flap, V-Y advancement flap, shortening and closure, figure of 8 fixation, cross finger flap and reverse homodigital artery flap. After the treatment of finger injury, the range of motion has improved except for one percent patients who had moderate to severe range of motion.

CONCLUSION

In this study it showed that people in the age group of 21 to 40 were affected in which male gender population had significant injury than women, this population are mostly working men whose etiology was injury in their work place due to lack of the knowledge and use of PPE (personal protective equipment). Hence, these working men have to be treated to improve the range of motion so that they can start their work within a couple of days after treatment to manage their family financial status. Crush injury of finger should not be taken lightly as they can result in significant morbidity if poorly treated functional as well as aesthetic considerations have to be taken into account when treating finger crush injuries. Most fingertip injuries can be treated by the family or emergency physician, but there are some conditions that require referral to plastic surgeons for optimal management.

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