



Mangled Hand Injuries and Management

Dr. Manashree Sankhe (Senior Resident)
Department of Plastic Surgery

- Reid defined “Mangled (from old French meaning cut to pieces) Hand” as a hand that has suffered a severe injury involving loss of substance and has been left lacking in prehension. These injuries have composite soft tissue loss & functional compromise needing early repair and rehabilitation, without which the hand would remain functionless.*
- Sugarcane juicing machine injuries frequently present as mangled hand and treatment demands an in-depth knowledge of hand anatomy and rehabilitative techniques from Plastic Surgeons so as to achieve a successful treatment outcome.
- Early operative management with aggressive post operative physiotherapy is essential for satisfactory recovery of hand function.

The Challenge

The variability of the tissues injured and lost, and the requirement for reconstruction to restore and salvage hand function, requires careful planning and meticulous execution of treatment.



Mechanism of Injury

- **Sugarcane juicing machines** which commonly used have two rollers with irregular surfaces opposed to each other.

Injuries often occur with

- A) Inadvertent switching on of the machine while cleaning
- B) hand/sleeves getting trapped between the rollers while working.



ROLLERS

SUGARCANE JUICING MACHINE



- The aim of is to sensitize surgeons regarding the requirement of complex surgical management and aggressive physiotherapy in these patients so as to rehabilitate them to early hand function.
- The ultimate aim is to restore sufficient function, so that the patient can perform their activities of daily living, and return to work.

Case presentation

We report 16 cases with crush injury of hand while using sugarcane machine, which presented to us within a period of 1 year, i.e. (February 2019-February 2020).

a)



Case 1: 44-year-old female presented to us within two hours of injury involving her right hand, which she sustained while cleaning the sugarcane machine.

b)



a) Pre-operative image of the injured hand
b) Post-operative image of the injured hand after suturing and Collagen dressing

Case presentation



Case 2: 35-year-old female with injury involving her right hand, which she sustained while grinding the sugarcane pulp in the machine.

a) Pre-operative image of the injured hand b) Pre op xrays of injured hand c) Post-operative image of the injured hand d) after K wiring]

Case presentation



- Case 3: 34 years old man, who presented with injury to the right hand, sustained while grinding the sugarcane pulp.

- Case 4: 30 years old man, who presented with injury to the right hand, sustained while grinding the sugarcane pulp.

Case Presentation



Case 5: 48-year-old male presented with injury involving his right hand, sustained while cleaning the sugarcane machine.

a) Pre-operative image of the injured hand b) Post-operative image of the healed hand after suturing at POD 60

RESULTS

A total of 16 patients presented to the Emergency Department of Dr D Y Patil Hospital, Pune, during the study period. with injuries sustained post sugarcane juicing machine accident.

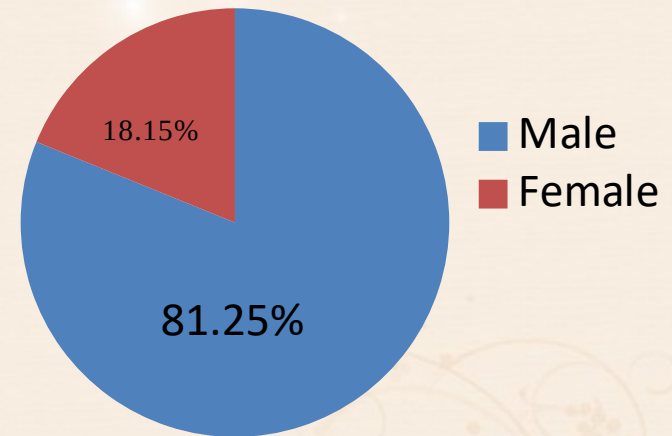
AGE - The mean age of presentation was 35.3 years.

SEX – Male predominance seen with 13 cases out of 16. (81.25%)

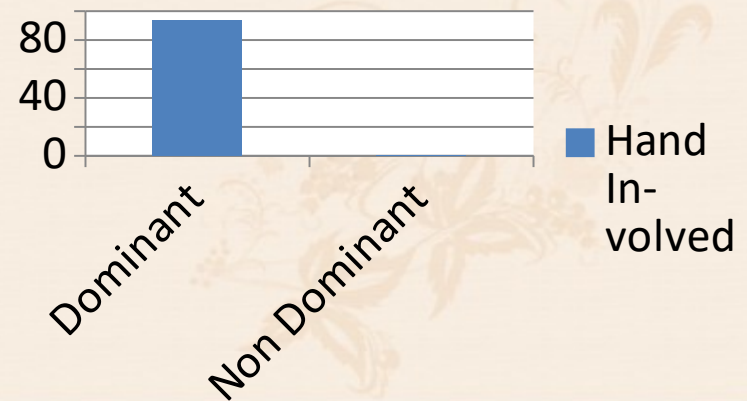
HAND INJURED – Dominant Hand was injured in all cases but one. (93.75%)

EXPERIENCE WITH WORKING ON MACHINE –The average experience of working with machine was 9.9 years

AGE PRESENTATION



Hand Involved



- **MECHANISM OF RETRIEVING CRUSHED HAND –**

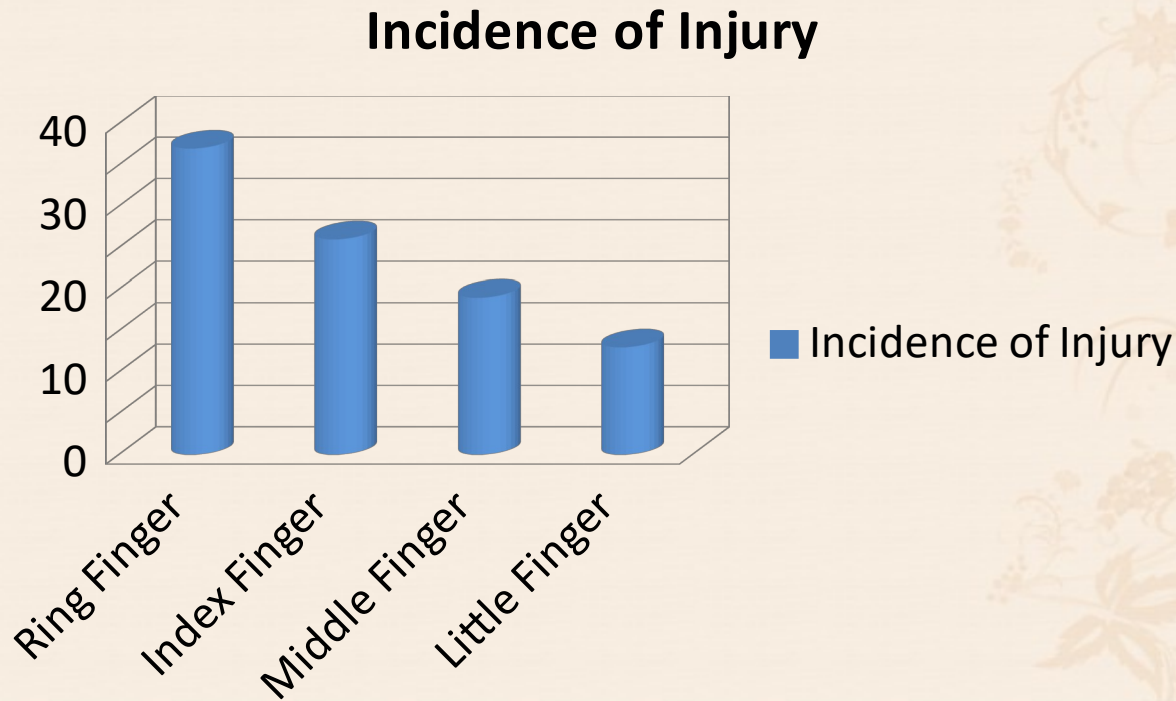
14 patients out of 16 (87.5%) reversed the roller blades to free the hand versus (12.5%) who gave history of pulling the hand away to get it out of the machine.

- **HISTORY OF PREVIOUS INJURY –**

2 patients (12.5%) patients gave history of having sustained prior injury by similar machine accident.

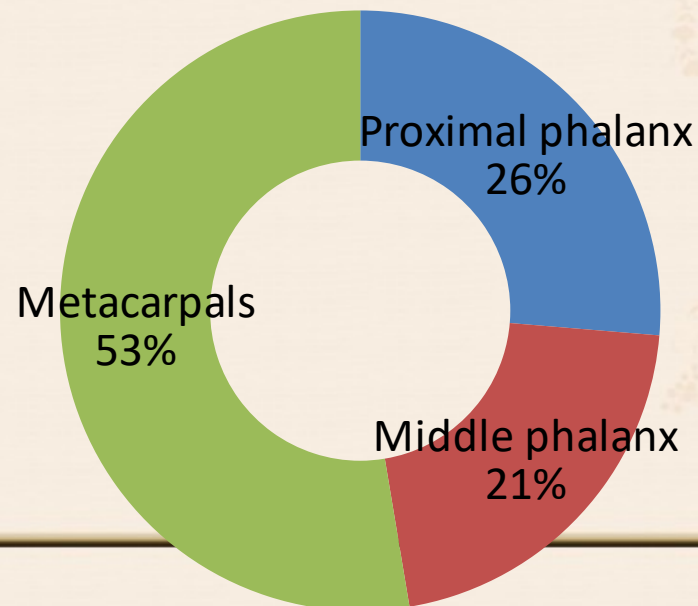
RESULTS

The fingers were very common to open hand injury. The ring finger (17%) was the most common site, followed by the index finger(16%), the middle finger (12%), and then the little finger (7%).



- Tendon injury was noted in (44.8%), and a laceration injury was seen in (55.3%)
- Majority of the study population had a fracture i.e. (85%) patients, while (15%) of the patients had no fractures.
- Among the patients who had fractures (60%), the proximal phalanx (48%) was among the most commonly involved bone followed by the middle phalanx (22%) and metacarpals (30%).

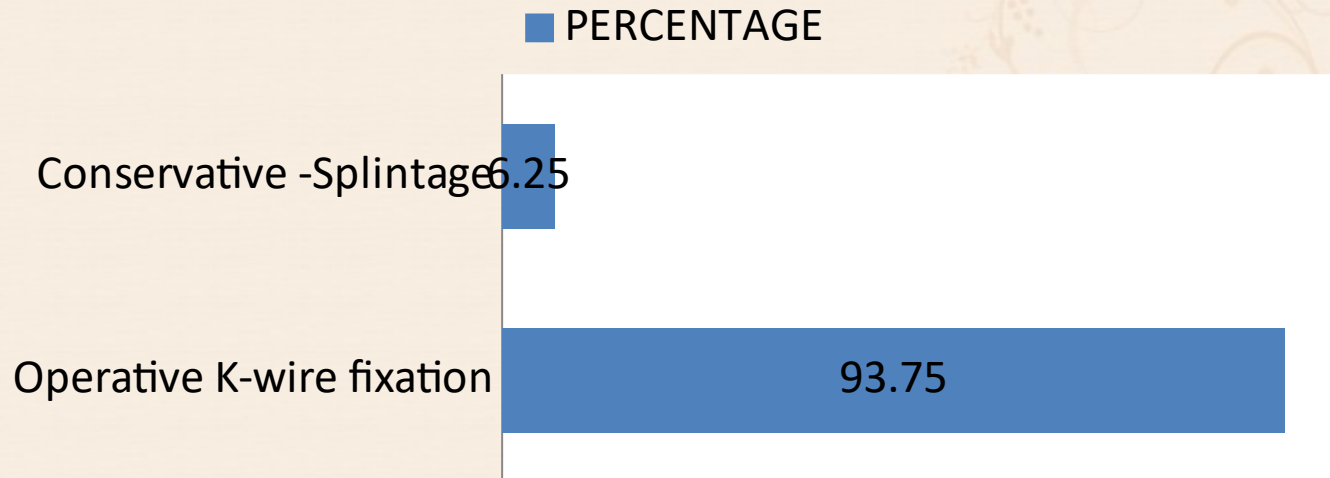
Bone Injured



TREATMENT FOR FRACTURES

Among the patients who had fractures (60%), K- wiring was done for fracture fixation in majority -93.75% of cases (15 cases) and splintage was done in on case with undisplaced fracture of middle phalanx

PERCENTAGE OF CASES



1) SKIN AND SOFT TISSUE

All 4 fingers had **longitudinal lacerations** both dorsally and volarly (more severe on the dorsal side) Thumb spared.

II) TENDONS

The flexor tendons are found in continuity with extensive damage to the flexor tendon sheath in the region of the volar laceration.

The extensor expansion had vertical slits running along its length till the metacarpo-phalangeal joints and the flexor tendons were usually in continuity.

III) BONES AND JOINT

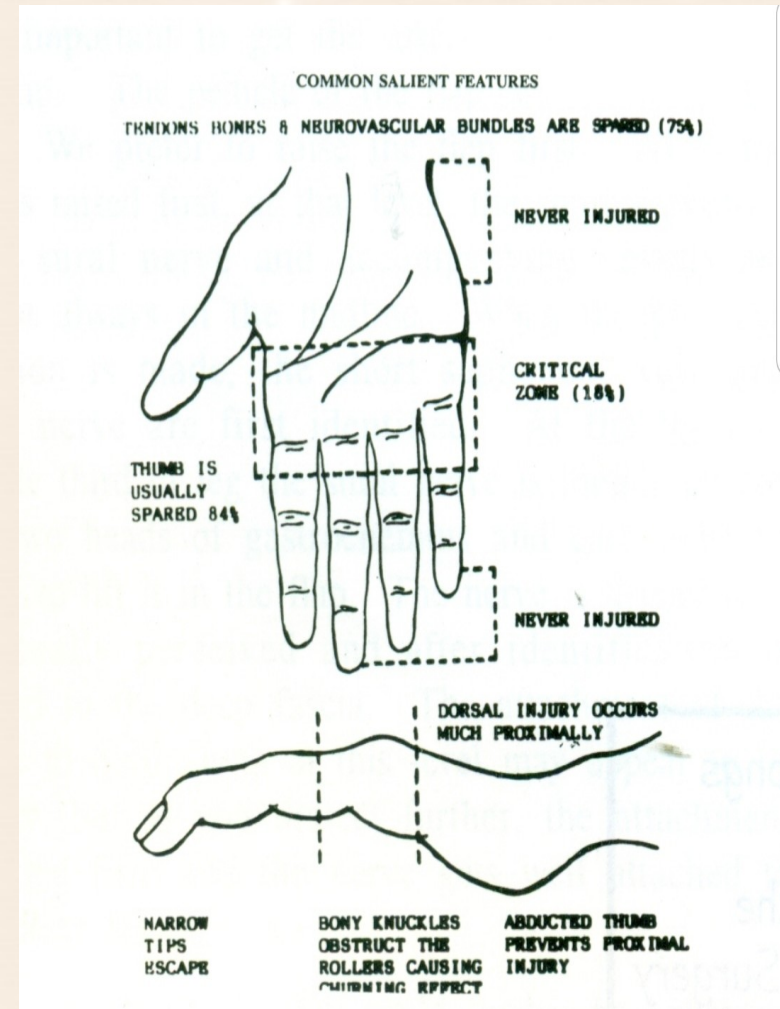
Bony injury presenting a from periosteal stripping to unicortical fracture, to transverse, oblique, spiral or comminuted fracture, to segmental fracture and segmental bone loss. Proximal interphalangeal joints were exposed with the avulsion of the central slips and loss of continuity of the covering capsules.

IV) MUSCLE INJURY - In the mid-palmar space, which is a relatively confined region holding soft tissues contained by a thick fascia.

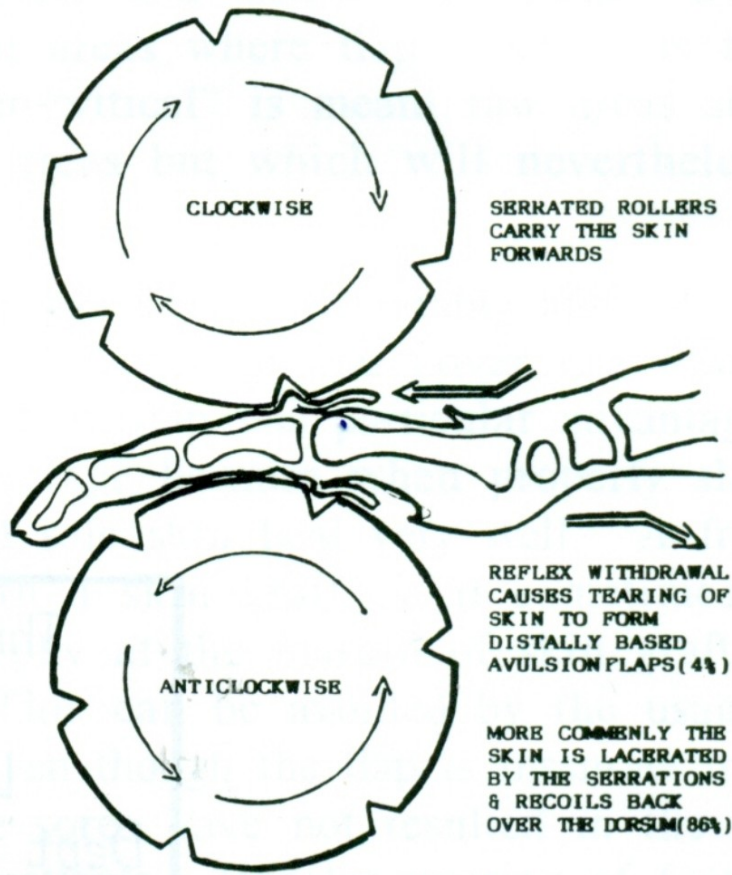
V) NERVES AND VESSELS - The digital nerves and vessels usually escape injury, likely due to the longitudinal nature of lacerations.

Characteristic Features Of Injuries

- Area proximal to the level of the thumb is never injured.
- The injury occurs only distal to the level of the thumb. This is because the thumb is abducted while feeding the sugarcane into the rollers.
- The thumb is rarely injured even when injured it has only skin lacerations or cuts.



MECHANISM OF DISTALLY BASED AVULSION FLAPS



- The finger tips are RARELY injured. (pulp is easily compressed and passes),
- pulp or the nail bed may only be contused.
- There is a critical zone of maximum injury where damage to neurovascular bundle occurs is between the distal palmer crease and the proximal interphalangeal joint crease.

Relation Between Violent Pulling Free Of The Hand From Machine And Skin Viability.

- 2 patients gave history of pulling the hand free from machine as against reversing the blades of the machine in 14 other patients. There was Palmar skin loss in both the cases with one patient requiring Groin flap for Soft tissue coverage.
- **Degloving** of palmar skin occurs from the dynamic force of the hand pulling away and the resultant shearing off of blood vessels in the subcutaneous plane may lead to secondary thrombosis of the blood vessels resulting in fat necrosis and delayed necrosis of overlying skin

- The mutilating injuries of hand have a **seasonal incidence**; being more common during the spring and summer months, during which the harvest of sugarcane is reaped throughout India.
- In our experience, the bony injuries were less severe compared to the soft tissue injuries which may be due to the rollers of the sugarcane machine having gaps between them, thus leaving some space and avoiding severe bone damage.
- Early Debridement and removal of sugarcane fibers along with intravenous antibiotics should be undertaken and if the tissue are mutilated beyond salvage, amputation with reconstruction of the hand should be undertaken.

CAUSES FOR JOINT STIFFNESS

- a) injury to both the flexor tendon sheath and extensor tendons leading to stiffness on both sides of the fingers
- b) extensive lacerations with thin skin bridge and loss of skin over dorsum of hand
- c) high risk of infection (contamination by sugarcane fibres)
- d) late feature - Boutennier's deformity (injury to the central extensor slip)
- e) k wiring for fractures causes delay in early active and passive mobilization.

Factors in favor of Recovery

- **METHOD OF RETRIEVAL OF CRUSHED HAND** : Reversing the roller blades is less traumatic compared to violent pulling of the hand free from the blades and creating additional degloving injury of skin.
- Relatively **SMALLER DURATION of Crush injury** – the phenomenon of crush Syndrome is avoided since there is no history of prolonged compression of tissues.
- Crush injuries to the hand distal to the wrist have less systemic manifestations primarily due to a **SMALLER MUSCLE BULK.**

Fundamentals Of Treatment

- Wound care and splinting must be carefully provided to ensure a good outcome.
- Early fracture fixation and satisfactory bony approximation with adequate soft tissue cover.
- **AGGRESSIVE** active and passive physiotherapy for Joint mobilization after healing of fractures.

Management

Emergency Department : wound **lavage** -> sterile dressing and splintage -> limb elevation & prophylactic Antibiotics.

Radiographs for assessing the **Fractured Bones** (Antero-Posterior, Oblique Lateral view).

All routine investigations and prepare for Emergency OT.

Plan : Early operative intervention – Debridement, Repair of fractures, reconstitution of soft tissues, tendon repair and skin suturing of the multiple lacerations with SSG/Flap cover if required.

Surgical Goals

Stable skeletal scaffold

- ❖ Bony repair before soft tissue reconstruction.
- ❖ Fixation must be *strong enough to provide a stable scaffold for further soft tissue repair and post operative rehabilitation.*

Good soft tissue repair and reconstruction

- ❖ Adequate skin resurfacing & **soft tissue cover** allow early rehabilitation and mobilization to restore function.
- ❖ Adequate **debridement without tourniquet** ,Minimal diathermy, if tissues are damaged beyond repair, amputation. Suturing **without tension**

Fracture Fixation-> K-wires (0.9 to 1.0 mm).



Neurovascular bundles usually spared (due to vertical lacerations)



Tendons -> Vertical midline lacerations of the extensor expansion were sutured. Flexor tendons usually found uninjured. Flexor tendon sheath is repaired.



Multiple Vertical lacerations over Dorsal skin -> Suturing with Ethilon 4.0

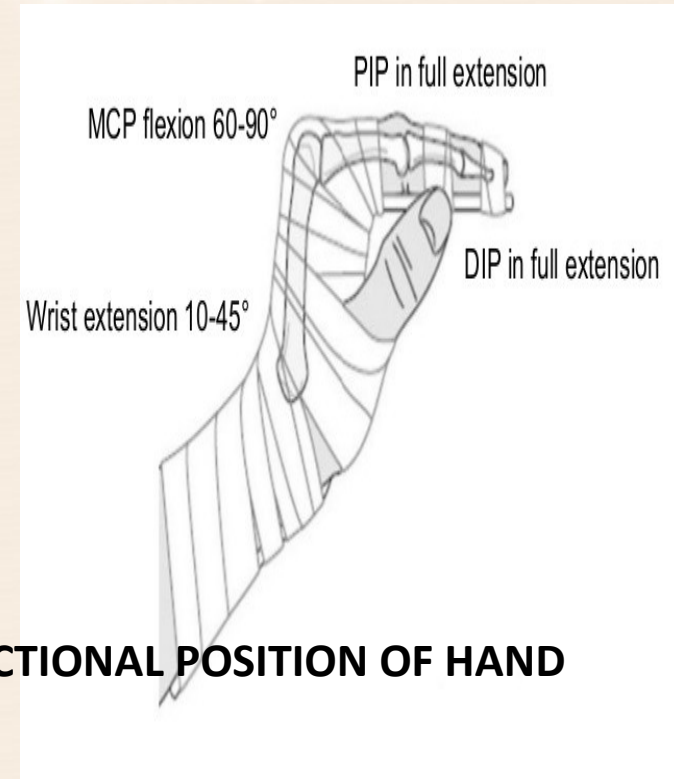


Palmar skin flap with degloved skin at the level of distal Palmar Crease-> Suturing with Ethilon 3.0



Skin Resurfacing by -> Split thickness Graft/flap cover

- Immobilized in functional position.
- Limb elevation to decrease soft tissue edema.
- K- wire removal at three weeks.
- Rehabilitation - Aggressive Physiotherapy (passive, active-assisted and active)



Preventive Strategies



Protective gloves



Safer Juicing machines without roller blades

There are various preventive strategies introduced in view of the high incidence of accidents like-

- safer designs for the machines(without roller blades) ,
- training on proper handling techniques,
- use of specialized protective gloves and
- enforcement of safety regulations and guidelines.

- Mangled hand injuries must be treated aggressively and efficiently which is essential to achieve good functional results. Any delay in effective management may lead to stiffness and very poor functional results.
- Timely surgical intervention and aggressive post operative physiotherapy are important for satisfactory recovery of hand function.