Acute and Reconstructive Burn Care of the Hand

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KEYWORDS

• Acute burns • Postburn • Hand • Contracture • Reconstruction • Pedicled flap

KEY POINTS

- Functional integration of a burn patient into the society depends upon the functionality of the hands.
- Accurate assessment of the depth of the burns and appropriate treatment will prevent post-burn deformities.
- Outcome of deformity correction depends on extent of deformity correction obtained by surgery and maintained till wound healing.
- All deformity correction patients need long-term supervised physiotherapy.

INTRODUCTION

The hand is commonly affected in thermal injuries. Hand burns account for 39% of all burns and they are involved in 34% of instances when the total body surface area (TBSA) of a burn exceeds 15%.[1,2] Inadequate or inappropriate treatment could result in significant morbidity. The ultimate integration of a burn patient into the society largely depends on the functionality of the hands. Hence, it is important to reduce complications by providing good care during the acute stage. If deformities occur, reconstructive surgery followed up with good physiotherapy can help restore function but could be demanding both on the surgeon and patient.

Anatomical Considerations

Function of the hand depends upon stability of the skeleton, gliding motion of the tendons, and intact sensate skin cover. Though burns often affect only the skin, the response to the injury and the anatomic derangements that take place in the acute and healing phase has the potential to cause severe disability. On the hand, the dorsal skin is much thinner than the palmar skin. For the hand to function fully, the dorsal skin must be non-adherent and elastic, allowing hand closure and the palmar skin must be thick enough to withstand forces arising from daily use. Dorsal hand burns are most often flame or explosion injuries; palmar burns occur more frequently from chemicals, friction, or high-voltage contacts.

The thick palmar skin is tightly held to the skeleton by fibrous septa while the dorsal skin is thin and loosely attached to the underlying structures.

Edema occurring in the acute post-burn period preferentially accumulates on the dorsum causing wrist flexion, extension of the metacarpophalangeal joints, and flexion of the interphalangeal joints (IP) joints causing a claw deformity (**Fig. 1**). That is also the position of comfort. We need to remember a burn treatment adage: The position of comfort is the position of deformity.[3] If left uncorrected, the contracted collateral ligaments of the metacarpophalangeal (MCP) joints and the shortened volar plate of the IP joints pose a challenge in correction.

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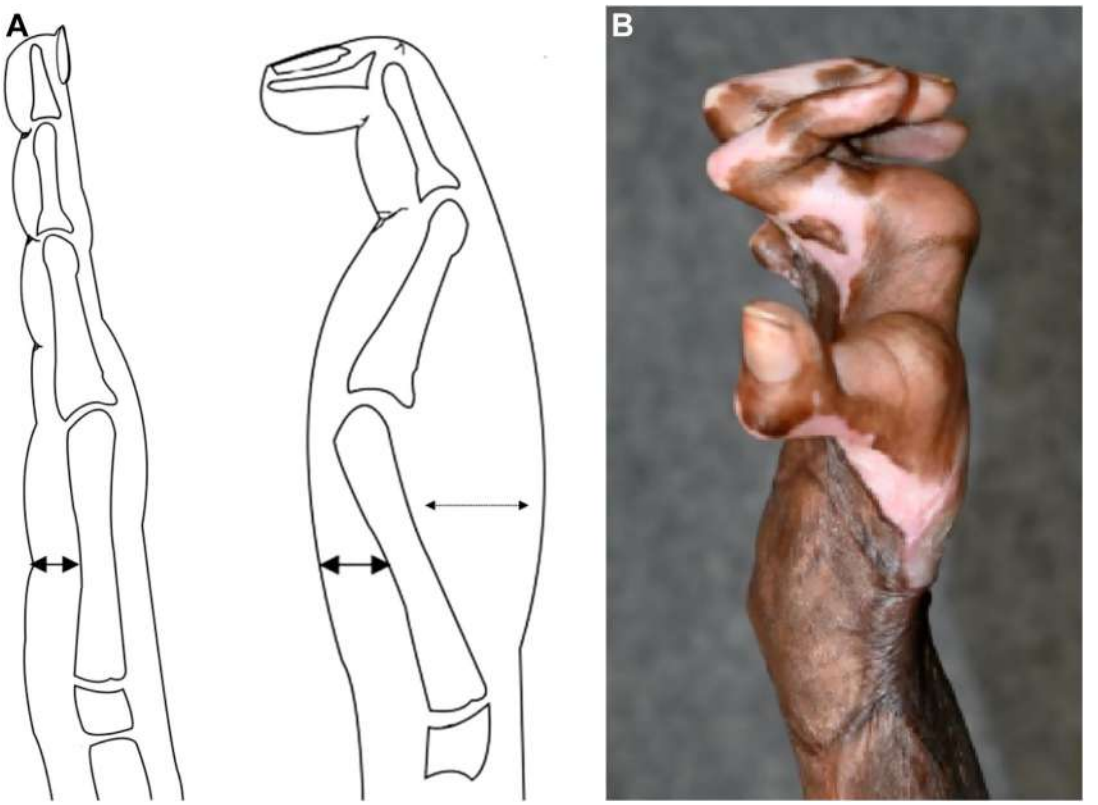

Fig. 1. Pathogenesis of burn claw deformity. (*A*) The volar skin is tightly bound and the edema preferentially collects on the dorsum causing hyperextension deformity at the metacarpophalangeal (MCP) joint. The adjacent joints take up the opposite position, (*B*) a fully formed deformity with flexion at the wrist, hyperextension at the MCP joints, and flexion at the proximal interphalangeal joint (PIP) joint.

A combination of deep dermal or deep burns and edema causes thinning or ulceration of the skin over the dorsum of the IP joints. Over the proximal interphalangeal (PIP) joints, it can cause attenuation or rupture of the central slip causing boutonniere deformity.

Edema fluid occurring on the palmar side is masked by the tight fibrous septa but nevertheless can cause significant problems. In deep circumferential burns of the hands or fingers, the unyielding leathery skin causes arterial insufficiency. It could also cause nerve compression in the carpal tunnel and Guyon canal and compartment syndrome. A combination of contracted intrinsics and contraction of the burn scars on the dorsum of the finger can result in swan neck deformity. The focus in acute care is to reduce edema in the acute phase and achieve healing as early as possible without resorting to secondary healing.

First Aid and Assessment of a Hand Burn

The aim is to douse the fire and reduce the effects of the thermal injury. Both are achieved by keeping the hand in flowing water until the patient feels comfortable. Tap water at room temperature is acceptable. This needs to be done for at least 20 minutes. Water rapidly reduces the subdermal temperature and prevents the burn injury from becoming deeper. Constricting items like rings and jewellery are to be removed immediately. If it is part of a major injury, all patients must be examined as per the Advanced Trauma Life Support (ATLS) protocol in order not to miss any associated injuries. Though the hand accounts for only 2% of TBSA, according to the American Burn Association, a burn of any depth to the hand is classified as a major injury and requires treatment at a specialized burn center.[4]

Extent and the depth of burns are the 2 important things that have to be decided upon during initial assessment. Depth assessment is important because other than superficial burns which could be left to heal spontaneously, hand burns deep dermal and deep burns have to be operated early to prevent inevitable contracture.

Redness, skin blanching under pressure, and area painful to air and temperature indicate

superficial burn. Blisters when unroofed, revealing skin which is wet or waxy, dry with variable contour and skin which does not blanch on pressure denote deep dermal burn and in addition, if the area is waxy white or leathery gray, charred, dry, and inelastic with no blanching to pressure and if thrombosed veins are visible, then it is a deep burn.

At first assessment, the areas are marked on a diagram and photographs done before applying any ointment which may later make the assessment of depth difficult. In addition, the circulation of fingertips as assessed by blanching on pressure, sensation at the fingertip, and pain on passive extension of the fingers are noted for signs of compartment syndrome. These are important in case of electrical burns and circumferential burn injuries.

Acute Care in Special Type of Burns

Chemical Burns: The crucial difference between a chemical burn and a thermal burn is that the damage continues until the chemical is removed or neutralized.[5] Loose dry agents must be dusted off and clothing must be removed. Immediate high-volume water lavage is the treatment of choice, and it should last for at least 20 minutes and in cases of concentrated alkali can last for several hours. Use of neutralizing compounds or alternative lavage substances is generally discouraged. There are certain exceptions to the use of water. Phenol is insoluable in water, so polyethylene glycol may be used initially to increase its solubility in water. Elemental metals like sodium, potassium, and lithium combust when exposed to water; hence, burns from these metals should be immersed in mineral oil and the metal with the mineral oil is then removed. Dry lime becomes caustic only on contact with water and so it is dusted off.

The damage could be more severe than simple thermal burns. Good history and knowledge of the chemical involved and the concentration and duration of contact will be crucial. It is advisable to consult a specialist center and follow the protocols of management.

Electrical burns: Electrical injuries have been classified as high-voltage and low-voltage injuries (more and <1000 V respectively). Low-voltage injuries occur in the domestic environment while high-voltage injuries occur in the workplace. Both may be lethal.

In survivors, low-voltage injuries would need debridement and reconstruction of the local area, whereas high-voltage injuries need massive resuscitation efforts and intensive care in the acute phase.[6] Cardiac assessment for myocardial involvement, occurence of arrythmia and maintaining high-volume urine output are important.

Electrical burns cause severe edema and most will require fasciotomies and carpal tunnel decompression on arrival. Though there are techniques to measure compartment pressures, decision to decompress is clinical. Blood creatinine phosphokinase levels give an idea of the extent of muscle damage, but are also not a determinant of the need for fasciotomy.[7] If there is severe swelling of the forearm, and it feels tense, the patient will benefit from fasciotomy. The illustration of lines of incision are marked in the diagram (**Fig. 2**).[8] Later, they would need serial wound debridement and major reconstructive procedures.

Dressings for Hand Burns

After a decision is made on the depth of burns, if there are no indications for immediate surgery, dressings are done. The burnt area is dressed with topical agents. There are many topical agents available ranging from simple occlusive moist dressing to some with antibacterial properties. The authors prefer non adherent paraffin-soaked gauze. There are dressings with antibacterial properties and there is not much to choose from one another except the ease and frequency of application and cost. It is beyond the scope of this article to discuss all the available materials and the reader is referred to many articles which deal with this in detail[9,10]

The main aim of the dressing is to position the hand to reduce the edema, keep the fingertips visible for inspection, and facilitate movement. This is achieved by putting a conforming and comfortable dressing and putting a plaster slab on the initial day keeping the wrist in about 20° of extension, the

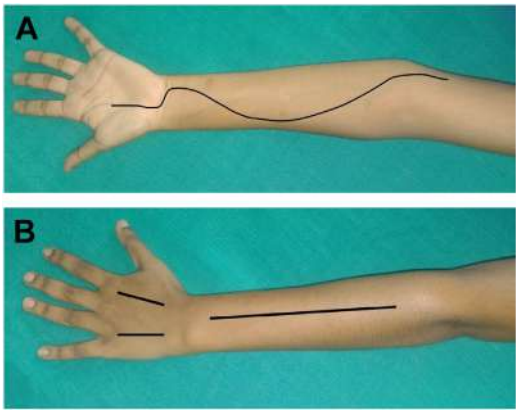

Fig. 2. Line of fasciotomy incisions: (*A*) Volar side. Staring with carpal tunnel decompression, the incision is extended proximally. The design is to prevent exposure of the median nerve. (*B*) Incisions on the dorsum to decompress extensors and the interossei in the hand. The mobile wad is to be decompressed through either of the incisions.

MCP joints in about 60 to 80° of flexion, and the IP joints in as much of extension as possible. Though a 90-degree position of the MCP joint and neutral position of the IP joints is preferrable, seldom is it possible to achieve it on day 1. In addition, the authors position the forearm in supination since it will help in rehabilitation. A forearm stiff in pronation, with the wrist stiff in flexion is severely nonfunctional and difficult to correct. The patient is encouraged to move the fingers. Elevation and movement are the two factors which reduce edema.

After a few days, special orthotic splints are made, with the wrist in 20° of dorsiflexion, MCP joints in 90° flexion, and the IP joints in extension. This is used whenever the patient is not moving the fingers and retained till healing of the wound. Dressing changes are made as per the topical agent used and before the application, the hand is washed with soap and water. Simple washing with soap and water reduces the bacterial colony count significantly.

Immediate Surgery in Hand Burns

In circumferential full thickness burns and deep partial thickness burns, edema can cause circulatory compromise. Ultrasound recordings, pulse oximetry, photoelectric plethysmography have been tried but escharotomy has to be done on clinical grounds. If the fingers or hand starts feeling cold and palmar arch pulse disappears on Doppler, it is better to decompress. Significant increase in survival of the fingers has been found following lateral digital escharotomy compared with those not decompressed.[11] Escharotomy is done on the ulnar side of the index, middle, ring, and little finger along the mid lateral line and carried proximally to hypothenar eminence. On the thumb, it is done on the radial side first.

If there is compartment syndrome, the fingers could take the posture of swan neck deformity with difficulty in flexing the PIP joint. The Finochietto test—difficulty to flex the proximal interphalangeal joint (PIP) joint with the MCP joint placed in hyperextension—will be positive. The thenar, hypothenar, and interossei muscles have to be decompressed. If the sensation is reduced and clawing is present, it is a sign of nerve compression and warrants carpal tunnel and Guyon canal decompression. This is common in electrical burns of the hand and the authors have found that even after decompression, it might take a few weeks for clawing to disappear (**Fig. 3**).

Early Surgery for Hand Burns

Early surgery in hand burns is done in deep dermal, full thickness, and fourth-degree burns.

Tangential Excision for deep dermal burns: Early tangential excision and immediate cover of burns was initiated by Zora Janžekovič.[12] It involves shaving of the burnt superficial part of the skin leaving back the unburnt dermis behind and covering it with thin split skin graft. It was based on her observation that many deep dermal burns did not end up with good outcomes on conservative management. In such cases, she found that the burnt superficial dermis got infected, and infection destroyed the uninvolved dermis converting the deep dermal to a full thickness burns. This is prevented by early tangential excision. In this process, the deep dermal burn is sequentially shaved in thin layers up to the level of viable dermis and covered with thin skin graft and they are known to give excellent functional outcomes (**Fig. 4**). Since some dermis is left behind, and the sweat glands and hair follicles are present, thin graft provides better results. Retention cysts which develop can just be brushed away. Thick grafts and widely meshed grafts give poor results after tangential excision of burns.

Burn wound excision: In full thickness burns, the burn wound is excised and depending upon the bed, skin graft or flap cover is provided. The excision could be only the skin or in deeper burns, sometimes it is done to the level of the fascia. While graft take is better with excision to fascia, it leaves behind an contour defect. While thin grafts are applied after tangential excision of deep dermal burns, after full thickness excision, moderately thick split thickness graft is applied. Thicker the graft the less are the chances of contraction.

Early reconstruction: Localized electrical burns are mostly deep burns and they require early excision and flap cover. Local or regional flaps can be used if the area is limited (**Fig. 5**). Though it can be done immediately, the authors usually do it by around the fifth day, when the local edema has settled and the extent of damage is also well delineated. The authors do not hesitate to use distant pedicled flaps or free flaps when the defects are large, or involve multiple fingers.

Physiotherapy Following Early Surgery

Edema control, early movement, massage with moisturising creams, and compression of the scar and grafted areas are the key elements of physiotherapy protocol following acute burn management.

Burns which heal within 14 days are superficial and the skin is almost restored to normal function. Contractures do not develop, and scarring is minimal. These patients need to apply moisturizing cream and do all normal work.

Fig. 3. (*A*) Electrical burns at presentation. The patient had reduced sensation at the fingertips and tendency to clawing is seen, (*B*) carpal and Guyon canal decompression done, (*C*, *D*) the hand at 3 weeks showing a full-blown total claw hand, (*E*) fully recovered at 3 months.

Patients whose burns have taken longer to heal or have undergone surgery or grafting will need scar management. The goal of scar management is to modulate scars as much as possible to achieve a flat, smooth, supple, and aesthetically acceptable scar, with no functional limitations. This is achieved by the effective use of compression dressings, silicone products, and massage[13–15]

Management of Post Burn Contractures

Though it is ideal to prevent the post burn contractures, inadequate primary care either due to logistic reasons or when hand burns form part of a major burn predisposes to deformities. It can affect any joint and could seriously limit function. Many classifications exist to describe the extent of the contractures in individual joints.[16–19] In the authors' experience, the authors have found that barring minor contractures, burn deformities affect multiple joints to different extents and it becomes difficult to classify them. Though it is good to classify, a good descriptive and photographic documentation has been found to be more useful. With that the authors use scores like Disabilities of the Arm, Shoulder and Hand (DASH) and Mental Health Quotient (MHQ) to assess pre-functional and post-functional status.

At Ganga Hospital, the authors apply the following principles when they manage post burn contractures of the hand[20]

1. While reconstructing a burnt hand, the burn surgeon must concentrate on restoring function

Fig. 4. (*A*) Deep dermal burns on the dorsum of hand, fingers, and forearm, (*B*, *C*) Outcome of tangential excision done with application of thin skin graft.

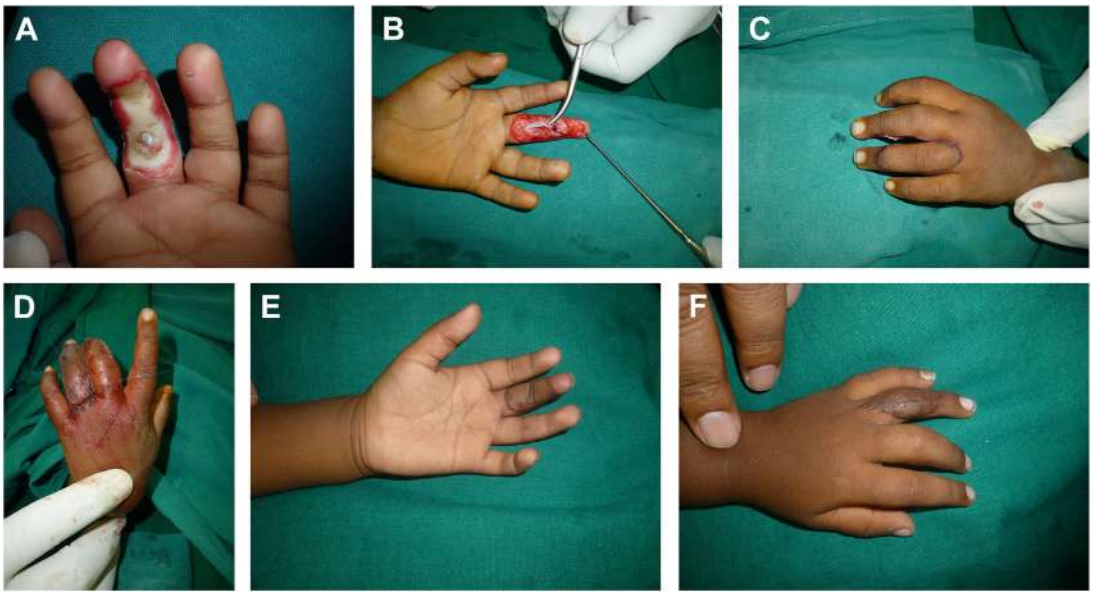

Fig. 5. (*A*) Low-voltage electrical burns of the finger with exposure of the tendon, (*B*) early debridement done, showing the extent of skin loss, (*C*) a large cross-finger flap marked on the dorsum of the ring finger, (*D*) flap inset and the donor area covered with skin graft, (*E*, *F*) long-term outcome. The patient had good flexion and extension. Over time, the flap develops crease at the level of the PIP joint due to good flexion.

than on increasing the range of movement of individual joints.

Surgery on the burnt hand must restore pinch, the ability to grasp large objects, and the power grip. This is obtained when the thumb pulp meets the pulp of other fingers, the hand has adequate first web space, and the musculotendinous units function to provide adequate power. Surgical procedures must be chosen to achieve these, rather than aiming for an increase in the range of movement in each individual joint. For example, it might be an advantage to have a PIP joint arthrodesed in good functional position than to perform complicated procedures to restore movement in a bad boutonniere deformity.

2. When a hand is severely involved, choose the first set of procedures that will bring the maximum benefit to the patient.

It is usual for a severe burn contracture to undergo a series of procedures to obtain the ultimate functional result, but the first procedure must produce a perceivable improvement in function. Early restoration of independence in the use of the hand will boost the morale and encourage the patient to adhere to postoperative protocols and take up subsequent procedures.

When contractures occur at multiple joints, correction usually starts from proximal to distal unless the proximal deformities are minor.

3. Assess the deformity in each tissue component to make the treatment plan.

Burn deformities occur secondary to skin loss. But deformity correction involves not only correcting the skin loss but also the secondary changes that have occurred in the musculotendinous units and joints. They usually are the limiting factors for deformity correction. Evaluate the deformity in each of the components of skin, tendons, joints, and bones while making the treatment plan.

4. Success in deformity correction depends on the excision of the scar tissue and correcting the deforming forces than on the type of skin cover provided.

Most deformity correction would need skin replacement. Mere replacement of the burn scar with skin graft or a flap will not correct the burn deformity. The deformity must first be corrected to achieve thumb-finger opposition, wide first web space, and flexion at the MCP joints and then the defect be planned for soft tissue cover. The correction achieved on the table is the maximum that could be achieved. Therapists have to work hard to maintain the gains of surgery and cannot be expected to provide more correction than what was achieved on the table.

5. Timing of surgery is crucial to get a good outcome in deformity correction. It is better to perform the surgery when there is tissue

equilibrium, as shown by a reduction of the induration and the scars becoming pale.

While this principle holds good for most instances, the authors prefer early correction of deformities in children. Scars in young children can deform bones and cause dislocation of joints. Articular cartilages retain their vitality only when they are in contact with another smooth articular surface and enclosed in a joint capsule and bathed by synovial fluid. When the joints remain dislocated for long, the surface loses its sheen and vitality and restitution of congruous joint surfaces still may not restore good function.

6. Function is very important, but a burn surgeon must also constantly think of the aesthetic aspect of reconstruction of a burned hand.

   The hand is a part that is always exposed and constantly reminds the patient that he is different. An aesthetically acceptable reconstruction helps him or her to easily integrate back into the society. The statement that "hand surgery is also aesthetic surgery" has never been truer than in the treatment of burned hands.
7. Physiotherapy, splinting, and scar control measures are important to achieve good outcome. Supervised physiotherapy at least for 8 weeks after reconstruction is essential after any major reconstruction.

All these principles will apply to the correction of any burn deformity in some way or the other.

Technical Note on Specific Deformities

Burn Syndactyly: Burns to the dorsum of the fingers usually also affect the sides of the fingers. If allowed to heal secondarily or if the grafts do not take fully, syndactyly results. It affects lateral pinch when the index is involved and reduces the span of holding an object. Conventionally, it is advised that during correction, we need to plan a flap of normal skin in the web. In burns, most often it will not be possible. Good outcome is achieved by painstakingly suturing the grafts ensuring full take of the graft. Post healing, the authors use silicone sheets taped to the web (**Fig. 6**) and maintained for about 6 months. Silicone must not be applied to raw areas or unstable scar. Moderate thick split skin graft is to be used.

First web contracture: The first web is a specialized anatomic entity, triangular in outline with the apex between the bases of the first and second metacarpals and a thin base distally. Only band contracture of the skin at the free edge is amenable to correction by various forms of Z-plasty.[21] In most instances, there is always a shortage of skin and there must be no hesitation in adding up skin to replace the lost skin.

Fig. 6. Technique of compression of the graft after web reconstruction with skin graft. A small strip of silicone sheet is placed and secured with plaster tapes.

With long-standing severe contractures, the first dorsal interossei and the adductor pollicis undergo adaptive shortening. To release the web, the first dorsal interossei must be released from its origin from the first metacarpal and the adductor pollicis must be released from the third metacarpal. In this way, they retain their innervation, form a new attachment, and continue to have adequate function.

Circumduction movement at the carpometacarpal (CMC) joint of the thumb is important for pulp pinch and opposition.[22] This is achieved by releasing the tight skin on the dorsum of the CMC joint by a transverse incision. The transverse incision could be continued volar across the wrist.

The released thumb is stabilized in full abduction in line with the outer border of the index finger by a K-wire passing as a spacer between the first and second metacarpal. The wire is retained for about 3 weeks till the wound healing is complete and the patient is ready to start physiotherapy. The tendency to stabilize the thumb in extension must be resisted. Thumb in an extended position would lead to inadequate skin replacement. If release needs more than skin release, flap would be needed. In isolated hand burns, posterior interosseous flap is a good choice. Otherwise, the authors usually prefer a groin flap or a free lateral arm flap (**Fig. 7**).

Dorsal contracture release

Dorsal hand contractures are sometimes associated with volar contractures of the wrist and IP

Fig. 7. (*A*) Severe contracture of the first web space in an electrical burn, (*B*) picture at the completion of web release, (*C*) the release obtained is maintained by a transverse K-wire passed between the first and second metacarpals. (*D*) Marking of the groin flap, (*E*) inset of the flap, (*F, G*) long-term pictures showing preservation of the web space.

joints and first web contractures. If present, they have to be released first or along with dorsal contracture release. The goal of dorsal contracture release is to obtain flexion at the MCP joints. A transverse incision is made a few centimeters proximal to the MCP joint line. This is to make allowance for migration of the skin after release so that it will cover the MCP joint after capsulotomy. The scar is excised, tenolysis of the extensors are done and if necessary, tendons lengthened.

The MCP joint can be approached for capsulotomy underneath the flap. The extensor expansion is split in the midline and the joint released. But the authors found that in long-standing contractures on attempting flexion post-surgery, it causes opening up of the sutures. Hence, the authors prefer to approach the joint by going beneath the sagittal bands and with the use of the curved tenotomy scissors divide the capsule and the contracted collateral ligaments. Post release, the joint is pinned till wound healing.

In long-standing extension contractures, the MCP joints may be subluxated or dislocated. During reduction, a volar pocket has to be made for the articular surface of the proximal phalanx to slide over the head of the metacarpal.[23] If it is not achieved, the joint surfaces go back and recurrence of contracture is inevitable (**Fig. 8**).

A component of the dorsal extension contracture of the MCP joints is flattening of the transverse arch of the palm. Longitudinal skin release incisions are made in the web which will spread out to regain the cupping of the palm.

Post release, the choice of skin cover is made on the basis of the nature of the defect. If the defect would accept a graft, the authors prefer a medium thickness graft. Small areas of exposure of the tendons can be managed with the application of dermal substitutes and later skin grafting. If bare tendons or joints are exposed, the authors opt for a flap. Pedicled groin or lower abdominal flaps or free flaps can be used to cover the defect (**Fig. 9**).

Palmar Contracture: Contracture of the palm occurs less often than dorsum and is more common in chemical, electrical, and in certain religious practices. The skin of the palm is thicker and most often heals without skin graft. But if there is skin loss, it has to be taken care of since contractures are more difficult to correct. Dorsal contractures even if they are long standing, do not have the risk of shortened vessels and nerves. On the other hand, contracture of the palm and flexion contracture of the fingers have the serious risk of stretching of the nerves and vessels compromising their integrity during release.

While releasing palm contracture, attention is also drawn to the adduction contracture of the thumb. Skin grafts are the preferred option so that the cupping of the palm is maintained, and good grip is possible (**Fig. 10**). If a flap cover must be given, a thin flap has to be chosen. A bulky flap makes prehension difficult and has to be thinned early.

Finger Contractures: Flexion contractures of the fingers are common and frequently accompany extension contracture of the MCP joints (**Fig. 11**).

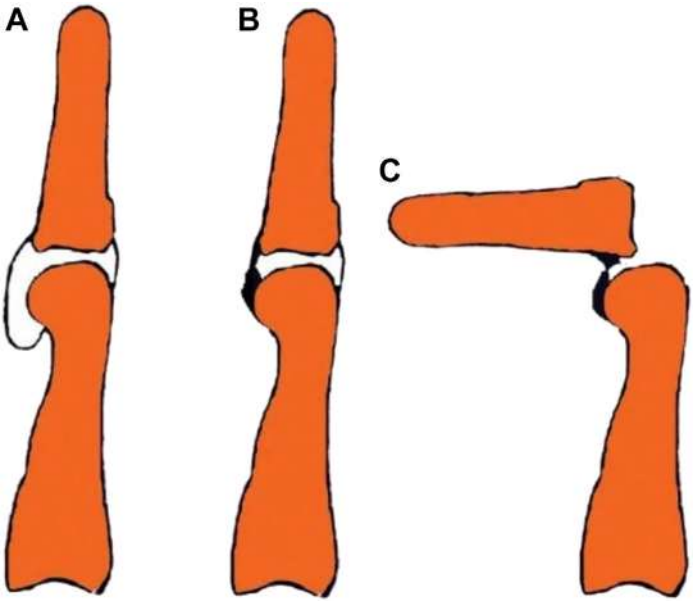

Fig. 8. (*A*) Normal MCP joint, which has a synovial laxity for the gliding of the base of the proximal phalanx over the head of the metacarpal. (*B*) In extension burn contracture, the volar capsule is contracted and scarred preventing gliding of the proximal phalanx over the head of the metacarpal. (*C*) If the pouch is not recreated during release, the proximal phalanx buckles up and it will cause sure recurrence of the deformity.

Finger flexion contractures need to be released first since early extension contracture release of the MCP joints will make the fingertips bury into the palm. Minor band contractures are released by Z- plasty. In fingers, it is good to keep the flaps of the Z big and the tip a bit broad so that good release is obtained, the flaps are viable, and suturing is easy.

Correction of severe contractures would need skin replacement. Contractures are released by cutting across the contractures. Critical structures like vessels, tendons, and nerves have a tendency to get exposed at the level of the joint. In contractures of moderate severity, release is done by incisions on either side of the joint line leaving a small bipedicle flap in between over the joint and grafting on either side. This yields better results than a flap. If the tendon gets exposed in a small area, the bipedicle flap can be used to cover as a transposition flap by dividing one end and the raw area grafted.

If the contractures are very severe, full release and full thickness graft or a flap is needed. Single fingers can be managed by cross finger flaps and other local flaps. If multiple fingers are

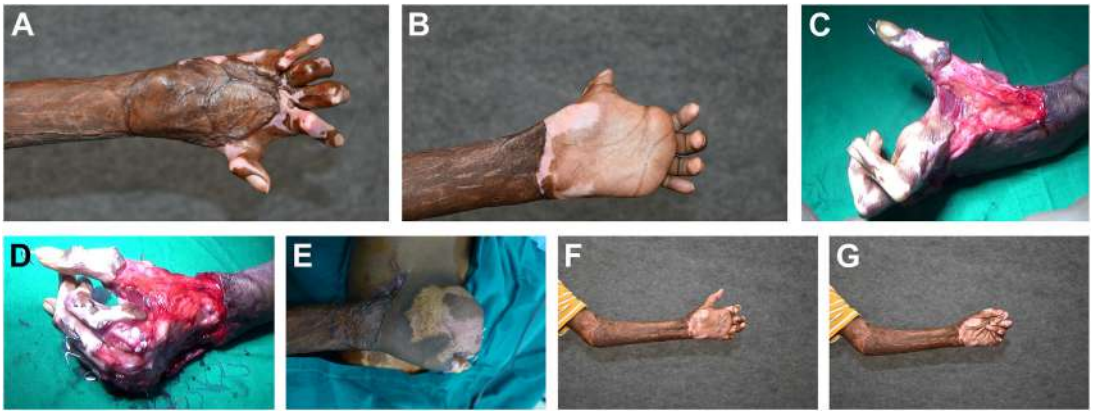

Fig. 9. (*A*, *B*) Severe extension contracture of the MCP joints with flexion contracture of the interphalangeal joint (IP) joints and swan neck deformity of the thumb with total loss of function. (*C*) The extent of release of the thumb and positioning for flap cover, (*D*) position after release of the MCP joints. Note that the boutonniere deformity in the index and middle is not corrected, (*E*) the raw area is covered with a combined groin and hypogastric pedicled flap, (*F, G*) showing the thumb meeting the fingers and appreciable function in a single step.

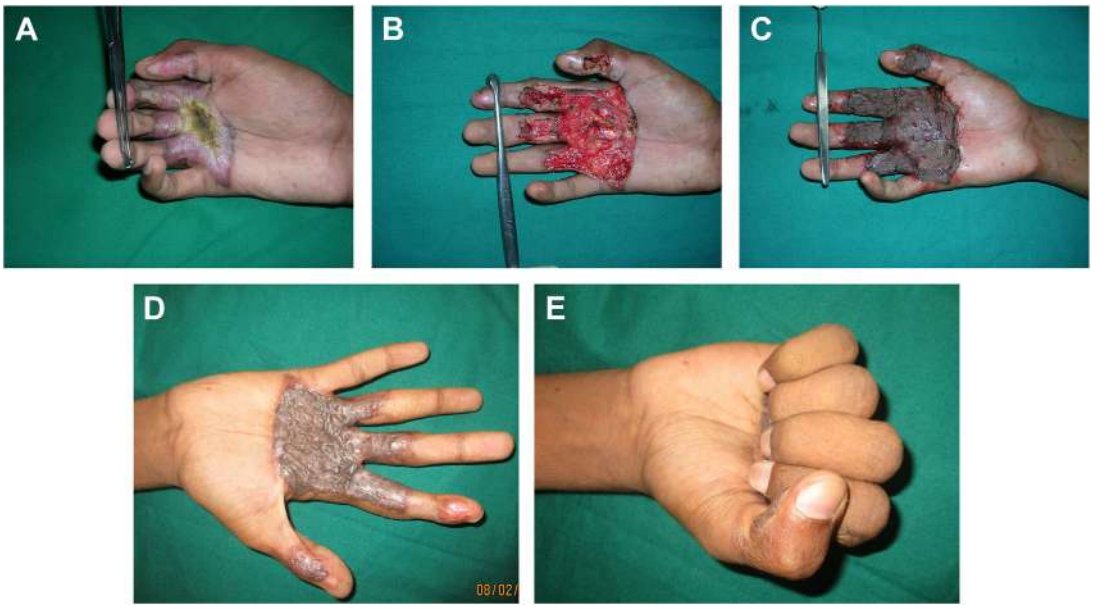

Fig. 10. (*A*) Contracture of the palm and base of the fingers, (*B*) post release showing the extent of the raw area, (*C*) coverage of the raw area with moderate thickness split skin graft, (*D*, *E*) long-term result showing excellent function.

Fig. 11. (*A*, *B*) Severe combined dorsal and volar contracture in the hand. (*C*) The extent of release required to get the thumb to functional position. The arrow shows the area that has to be released to get protonation and opposition movement (circumduction) at the carpometacarpal joint of the thumb. (*D*) These patients almost always need release on the volar aspect of the wrist, which is the continuation of the incision at the base of the thumb. (*E*) All raw areas are covered with split skin graft, (*F–I*) pictures' of the functional outcome after 1 procedure.

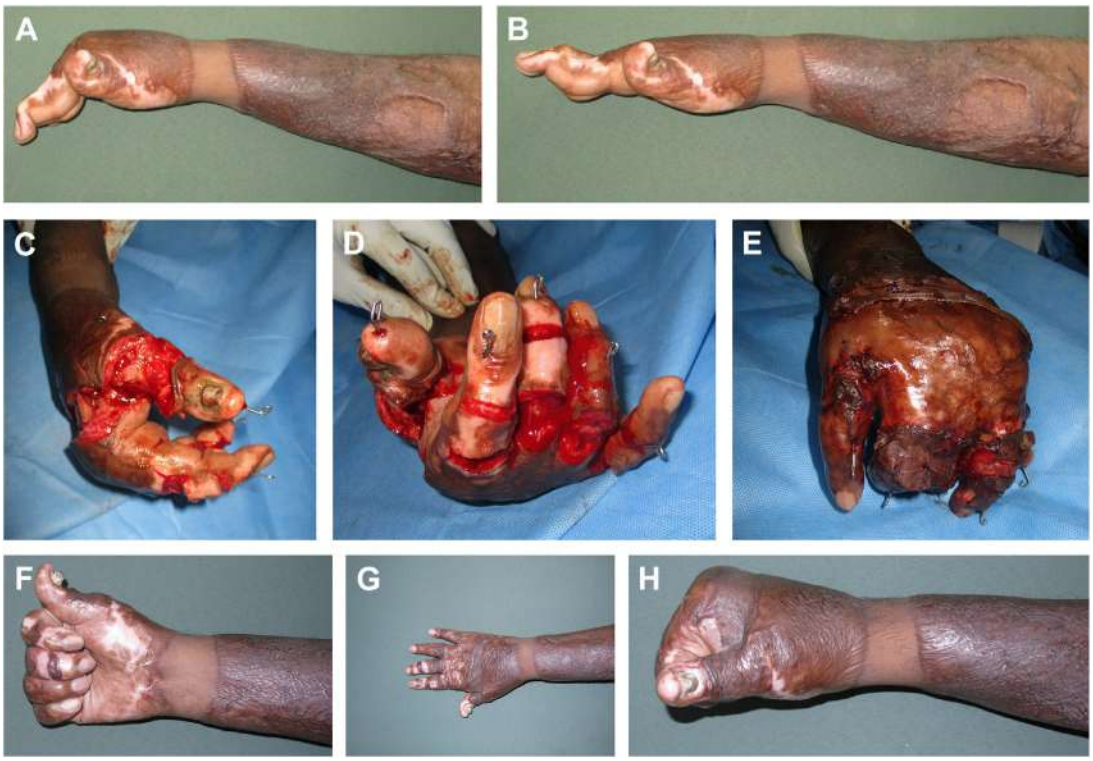

Fig. 12. (*A, B*) Stiff Swan neck deformity of the index, middle, and ring fingers and the thumb with severe functional compromise. (*C, D*) Multiple dorsal skin release done and (*E*) raw area covered with split skin graft. (*F–H*) Long-term functional result.

involved, temporary surgical syndactyly is made, and a flap cover is given.

Vascular compromise is a real risk while releasing flexion contractures of the fingers. Caution is to be exercised while stretching the joints during release. Normally, the released IP joints are stabilized with K-wires. Tourniquet is let down and vascularity confirmed before taking on the next step. If there is any doubt, as shown by the finger remaining pale or taking a long time to perfuse, the wire is removed, the joint gently flexed to the point where the circulation picks up, and the joint is stabilized at that level.

Boutonniere Deformity: Boutonniere deformity occurs due to dorsal burns causing severe edema at the level of the PIP joint. Poor positioning of the wrist and the MCP joints may result in flexed position of the IP joints for a long time. This causes stretching of the joint capsule and the attachment of the central slip leading to its attenuation and rupture. Further direct involvement of the overlying skin again could be a cause.

Pinning of the PIP joint in neutral position during the acute stage can be done to prevent boutonniere deformity. Position is maintained till wound healing occurs.

Once the deformity occurs, if the deformity is passively correctable, the PIP joint is splinted in extension and flexion at the distal interphalangeal (DIP) joint is encouraged. Later, if there is good dorsal skin, the joint is explored and correction surgeries are done.[24] This is only rarely possible in burns since the dorsal skin is scarred and thinned out and the patients present in a state of stiff joints.

Burn patients with stiff boutonniere deformity surprisingly retain good function since pinch is possible, if there is good MCP joint function. So the decision to correct is taken after assessing overall function. It may be prudent to arthrodese the PIP joint in functional position than suggesting complex deformity correction procedures.

Swan neck deformity: Unlike boutonniere deformity, swan neck deformity compromises function and correction is usually recommended. The commonest cause is contraction and hypertrophy of the dorsal skin over the fingers causing hyperextension deformity at the PIP joint and flexion at the DIP joint. Correction is done by incising the scarred skin on the dorsum on either side of the PIP joints, mobilizing the joints, stabilizing the PIP joint in flexed functional position, and grafting the raw areas.

The grafts contract and as they contract, they stretch the intervening skin bridge (**Fig. 12**).

The other cause of swan neck deformity is secondary to contracture of the intrinsic muscles as part of the compartment syndrome in the acute stage. Finochito's intrinsic contracture test (resistance and tightness to flex the PIP joint with the MCP joint in hyperextension and easy flexion with the MCP joints in a flexed position) will be positive. Division of the tight lateral bands is a good option to correct the deformity.

A good clinical assessment and judgment is needed to manage swan neck and boutonniere deformities.

SUMMARY

Burns to the hand irrespective of the size and depth need specialized care. Skin cover and early wound healing are important to prevent deformity. Deep dermal and full thickness burns need early surgery.

When contractures occur, attention to detail while planning and executing the procedure could be life changing to the individual.

CLINICS CARE POINTS

- All hand burns need to be seen by a specialist unit.
- Accurate assessment of the depth of hand burns and appropriate management will prevent deformity.
- During correction of post burn deformity, concentrate on gaining function than on range of movement of individual joints
- The extent of correction obtained at the end of surgery will be the maximum correction obtained and so go for full extent.
- Deformity correction must be undertaken early in children since secondary deformities are severe in children.
- All patients need long-term physiotherapy for scar control and maintaining the gains of surgery

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