

Original Research

General Principles of Burn Reconstruction

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Submitted: 30 July 2021

Accepted: 11 August 2021

Published: 13 August 2021

ISSN: 2373-9363

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Abstract

Burns are serious traumatic injuries. Their management follows a well-established hierarchy of priorities. Lifesaving is the primary objective, then after securing survival of the burn victim, treatment aims at functional recovery, and finally aesthetic restoration, both essential for social rehabilitation and for a good quality of life. Deep burn wounds heal by scar formation that may become mostly hypertrophic or progress into frank keloids. Scars invariably retract causing serious deformities and contractions across joints. The following article summarizes the major sequelae observed in most burn survivors and outlines their management protocol.

INTRODUCTION

Burns, whatever their aetiology, (thermal, chemical or electrical) are always an extremely important traumatism; it is a dramatic event with not only a vital prognosis (through the surface) but also functional and aesthetic (through the deepness of the lesion).

The aims of burn reconstruction should be to preserve, restore, and maintain function and appearance so the patient can recover a social life.

Burn specialist target is triple: save life, but also save function and save aesthetic (very often associated)

Burn sequelae are still frequent:

- 1 -In spite of early treatment (early excision and grafting, orthosis, physiotherapy and hypertrophic scar prevention).
- 2 -The delayed early treatment because of the priority of the medical one (respiratory for example) explains some of them
- 3 -Spontaneous healing lead regularly to pathologic scars
- 4 -A high number of those is also due to a lack of knowledge in the physiopathology of burn injury and the treatment performed outside specialized burn centres lead to imperfect results which might have been avoided.
- 5 -Improvements in medical emergency treatment of heavy burns (shock, inhalation, infection, hyper metabolism) have saved many patients (over 80 %). So paradoxically, the consequence is an increase of the sequelae in burn survivors.

TREATMENT

There is a hierarchy of priorities in burn care: first life, than

function; and finally aesthetic; the surgeon should use the best technique to obtain a correct appearance and a good function, two elements of social rehabilitation. In children burn sequelae are increased by growth and demand a particular adaptation of medical and surgical treatment. Scars control is probably the biggest unsolved problem relating to morbidity associated with burn injury, and the burn sequelae treatment is a long way to go using medical and surgical process. It is difficult to set out a schema, because they are of various types, sometimes multiple and the surgical approach is not fixed. The major enemy of the plastic surgeon towards burn is the scarring tissue. Only superficial burns will heal without scarring, but deep ones involve the dermis and even deeper elements and will lead to important anaesthetic scars which may be at the origin of a functional handicap. The plastic surgeons try to reduce scar ransom, but it is difficult to completely rub out.

This treatment (medical and surgical) needs a close collaboration in between surgery and other members of the burn team. The surgical reconstruction is not therapeutically a secondary problem. It necessitates many surgical processes during months and years.

Psychiatric management of stressed, phobic and anxious patients is usually the first conditions calling for attention aiming at restoring the patient's moral. Treatment of depression and major psychiatric disorders are important. Family education and psychotherapy should also be considered.

The scope of burn treatment extend beyond the preservation of life and function and the ultimate goal is the return of burn survivors in the society (rehabilitation, physical and psychological re-integration), as soon and as well as possible.

Clinical Aspects

Burn patient is a « skin disabled » person (S. Baux). In most of the cases, sequelae only concern skin and underlying layers. It is more seldom, when they involve joints and tendons. It is therefore very deep burns or local infection. At least, if it is a carbonization injury, it leads with no doubt to distal amputation

a – Cutaneous sequelae

Through the inflammatory process, fibroblasts and angiogenesis produce some scarring tissue. Depending upon local or general context, and also upon performed treatment, this tissue will evolve towards hypertrophic sequelae, either keloïd or retractile ones. If there is no conflict, the evolution will be in favour of hypertrophy, in the other case it will go towards retraction.

Scar weakness: almost constant, ulceration because of minor trauma, even because of simple rubbing (difficulty to wear compressive clothes), phlyctena with redness tissue .

High sensitivity to contact, cold and heat.

Itching, from light sensation to insomnia, often transitory with progressive improvement (local corticotherapy, creams, and massages).

Pigmentation disorders: hypochromia on pigmented people, hyperchromia on Caucasian skin, deep redness mainly on legs which exaggerates with orthostatism positions. It improves with time.

Hypertrophic scar and keloïd: it is usual to say that it takes 6 months for normal scarring, 2 years for hypertrophic evolution and life time for keloïds. It is better today to talk about mature scar or not. It is a well-known physiological process. The immature scar looks like granulation tissue including fibroblasts, many mastocysts and myofibroblasts, collagen is of type III. In the fundamental substance, the chondroitines sulphates are important. Hyper vascularisation is constant. On the contrary, the mature scar is almost like normal skin without myofibroblasts and extreme diminution of fibroblasts, type III collagen is replaced by type I. This is why we must talk about a true keloïd disease and not only about keloïd scars. "Vitropressure test" "with a qualitative and quantitative aspect (assessment of decolouration and of recolouring time). separates « warm » scars if positive and cold ones if negative (no scar bleaching). During that maturation period, surgery must not be performed under the risk of recurrences or worsening. Only medical cares must be performed.

Retractions are due to superficial fibrosis of skin, subcutaneous layer and sometimes the skin superficial muscles. It is a cutaneous defect, proportional to the importance of the retraction and always more important than expected. It explains why it is enough to incise (and not to excise) to create a large defect. Retractions are mainly represented by three types of bridles or bands: linear ones attracting the normal skin on both sides, huge burns on half size leaving partial intact skin on half of the area, and scar all over the retracted area without any normal skin around. We must insist on bridles located on the flexion side of a joint without real retraction as joint movements are normal,

but creating skin ulcers proving the lack of elasticity in the area. Treatment must absolutely be performed otherwise it may lead to local skin cancer (Marjolin). Those degenerative lesions may appear after a long time (10/20 years). It is most often due to squamous cells carcinomas which easily spread through lymphatic vessels. So, the ulceration of a scar which appears without trauma absolutely needs a systematic treatment.

b – Tendinous sequelae

It mostly happens in case of dorsal hand and foot burns. It often consists in fibrous tissue around but sometimes it is also due to deep burns involving directly those elements. Infections may also occur locally during the scarring process.

c – Joint sequelae

1 – Either after a long immobilization, sometimes on hand and fingers.

2 – After an open wound of the joint (secondary infection with septic arthritis).

3 – Ossifications around the joint

d - Amputation

Most of the time, we observe distal ones in case of thermal burn and following carbonization. Electrical burns may need often amputation and create peripheral paralysis by nerve destruction.

Chronology Treatment (Time for Secondary Reconstruction)

The question is: when should plastic reconstruction surgery should start? Patient himself often asks: « *when can you operate to remove those ugly scars so that I can go back to normal life?* ». But reconstruction must only start when the patient's condition is stabilized and only when the scar process is mature (merits of the vitropressure test), which means at least 9 months or even more. Till then priority must be given to conservative treatment with creams or oily products, massages, clothes-compression and physiotherapy. However, it is sometimes necessary to start earlier if important deformation occurs going obviously towards a functional problem such as a severe ectropion of lower eyelid for example, unstable scars, and severe microstomia. On the face, it may not be necessary to wait if the scarring tissues increase the deformation.

Scar Management

A-Prevention

What is the best type of reconstruction? It is the prevention of excessive hypertrophic process and scarring retraction. Hypertrophic scars should be prevented or at least minimized as follow:

1 – Use of early compressive procedure on healed or grafted areas with special clothes specially made and adapted (25 to 30 mm de Mercury pression during 22h out of 24). In children it is necessary to verify the normal growth and to adapt the cloth little by little.

2 – Use of silicone sheet.

3 - Use of corticoid injections or corticoid dressing.

B – Surgical secondary treatment and process:

Reconstruction principles are the same whatever the anatomical localization:

- To bring healthy skin,
- To preserve the cutaneous capital and the areas where to take off the grafts,
- To respect the aesthetic units.

Different methods of reconstruction may be classified as follows:

1-Urgent procedures as for example exposed eye or bone or cartilage.

2-Essential procedures, to give back the local function, such as joint movements, neck flexibility, or mouth continence: don't wait scar maturation!

3-Desirable procedures, to bring back some aesthetic appearance (nose reconstruction, alopecia, scar improving) but eight or more months after burns.

Techniques:

1 –Hypertrophic scarring:

Remove by:

- Simple scar resection,
- Scar abrasion
- Tangential excision together with over grafting.
- Scar resection with graft
- Scar resection using skin expander

2 – Retractions:

They priority occur in functional areas because of movements and skin tension. It may happen one or two month only after the injury, will look as a reddish and inflammatory string. Then it will decrease and the scar becomes fibrous and sclerous. It may enlarge or get thicker, looking as a real retractile patch.

Possibilities of treatment:

- Grafts

Simple incision of the bridge and graft of the created skin loss either with split or total skin graft: split thickness skin grafts (STSG) isolated or full thickness skin graft (FTSG) with better aesthetic result; but the graft should be meticulously defatted:

Skin substitutes: artificial dermis (Integra, Matriderm) useful to minimize the scarring and improve the cosmetic qualities of the graft

- Flap procedures: Exchange, Simple Z plasty, Multiple Z, Trident

Others local flaps:

. IC flap, Rotation, translation, transposition, diamond-shaped flaps

. Distant flaps, ie

- Free flaps: but more complicated (venous drainage), lake of donor site: new technologies like negative pressure treatment and skin substitutes have decreased the indication of free flaps

-Tissue expansion: turning point in the repair of burn sequelae by allowing replace of the original tissue with a coating of the same quality or a large full thickness skin graft

-Fat transfer: lipofilling for volume and also for sliding plane.

Anatomically Based Reconstruction

Burned scalp: Burn injury to the scalp is a common problem, particularly in children; scalp alopecia lead to a significant functional, aesthetic and psychological disturbance. Secondary reconstruction included hair transplantation, staged excision, local flap and very often tissue expansion, for extensive defects free tissue transfer (scapular, para scapular, latissimus dorsi) are used. Clearly, restoration of the scalp should be delayed until the patient is stable and rehabilitated as much as possible.

Forehead and brow: Although a perfect appearance may never be achieved, it is necessary to keep in mind several goals: - Normal aesthetic subunit should be respected, - Scars should be hidden along the boundaries of the aesthetic subunit. - Symmetry and normal eyebrow position should be achieved - Dynamic function of the face should be preserved: so prefer grafts than flaps.

Periorbital region: The priority of periorbital burn management is the prevention of corneal injury; the patients remain at risk until the scar tissue has fully matured. Full skin grafting or flaps (nasal- labial flap, island flap). Masquerade technique (Converse and Smith) in complete lid loss (conjunctival approximation and skin grafting). Specific deformations: ectropion, tissue loss, blepharostenosis, entropion, canthal deformities.

Burned lip, mouth and nose:

A – Lip

Commonly seen with extensive facial burns.

Timing of surgical correction is controversial (early or late)

Correction is best performing following scar maturation.

Variety of methods to obtain a satisfactory static as well as dynamic result.

Use local tissue whenever possible, replace vermillion by vermillion, skin for skin and avoid additional scar.

Tongue flap in case where there is significant tissue loss from one or both lip

B – Nasal reconstruction

Use skin graft, median forehead flap, composite grafts.

Ectropion repair: skin graft, after horse shoe stapled incision.

Burget has described sophisticated techniques.

C - Ear reconstruction

In major facial burn, the shrinkage of an ear is easily seen and its reconstruction in many burn patients can offer an improvement to their self-image and recovery. It is a complex problem because delicate structure. The use of temporo-parietal fascial flap (TPF) combined with either an autologous cartilage framework can recreated many elements of the ear in a single stage (Brent, Firmin). But different stages are often necessary. The ear reconstruction requires experience in even available method of tissue reconstruction: skin grafting, local skin, fascial flap, tissue expansion, cartilage harvesting, and frame work fabrication (team well trained). Reconstruction of one or both ear is often the last step in a rehabilitation process after burns. In case of complete destruction of the ear in adult, the use of osteo integrated implants provide a secure method of prosthetic ear reconstruction.

Burned face:

Our window to the world and it reflect our self image.

It is a surgical challenge.

Early treatment is preferable.

Late facial reconstruction is difficult.

Goals: - Facial balance and symmetry

- Distinct aesthetic units fused by inconspicuous scars

- Skin texture approximative

- Dynamic facial expression

Most patient will need several operation and corrective make up is frequently use: skin grafts, flaps, synthetic coverage after scar excision, expansion.

Burned neck: Neck contracture are often seen in areas where burns where allowed to heal by primary intention, but also even after early treatment (early excision, grafting, post operative splint). It is a functional and aesthetic problem. Use quality skin as close as possible to original skin. (Flexibility, texture, thickness, colour). Recreate chin neck angle. Techniques proposed: grafts (FTSG) after excision and utilisation of skin substitute, Z plasty, flaps: fascio cutaneous supra clavicular artery island flap; tunnelled supra clavicular island flap (N. Pallua) Merits of previous expansion not only for local flaps but also for grafts donor site. The free tissue transfer is now rarely used in neck reconstruction. Importance of post-operative physiotherapy.

Burned breast and abdomen: Burns to the breast, in adult female, can cause such disfigurement and distortion that it can lead to psychological problem: sequelae are aesthetic, rarely functional. In adolescence the constrictive effect of burn scars can compress the developing breast inhibiting its proper growth. Adequate releasing of scar contracture, excision of all the scarred skin and graft with STSG, or coverage with Integra, Alloderm and thin STSG (buttock first choice as donor site).

Local flaps Z, VY, rotation can be used for smaller burns. Reduction mammoplasty in some hypertrophy breast to correct asymmetry.

Abdominal burn: Severe contraction can be released or excised, and closed with further STSG or preferably by FTSG.

Alternatively local flaps, serial excision or tissue expansion can be used.

Burned axilla: Despite preventive measures (abduction splinting, positioning, pressure garment, physiotherapy), some patients will still develop significant axillary contracture. Since a burns scar contracture has developed, early surgical correction should be performed to prevent further involvement of the underlying tissues and structure.

Techniques proposed :

Z, VY, Trident, IC. Fascio cutaneous flap.

Latissimus dorsi flap, para scapular flap in very severe cases.

Burned hand: Palmar and dorsal skins are very different. The main deformities are: claw deformity, palmar contracture, web space deformity, burn syndactily, contracture bands, nail bed deformity are the major sequelae of burn hand. Reconstructive surgery is an immense chapter (hand surgery).

Lower extremity: Most burns of the lower extremity will be treated by STSG. Fascio cutaneous flaps are very suitable for severe burn deformity: lateral anterior thigh flap, muscle flap, free flap.

CONCLUSIONS

Reconstructive surgery represents a « step » to rehabilitate a deep burned patient.

It is an important part of burn care, beginning at the arrival of the patient on the burn unit and continuing throughout the burn's survivor life. It can't be performed without taking all the rest into account. It takes place amongst a therapeutic procedure where medical treatments must also be performed: physiotherapy, compressive clothes, and thermal care. The deep burnt patient must be considered as the central work of a whole team including surgeons, psychiatrists, psychologists, physiotherapists and occupational therapist. Chronology of the different steps must be planned and discussed with the patient. Psychological problems must always be prevented and avoided as far as possible. So if multidisciplinary approach is mandatory, the place of plastic surgeon, however, is fundamental all along the process.

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Cite this article

Costagliola M, Atiyeh B (2021) General Principles of Burn Reconstruction. *J Subst Abuse Alcohol* 8(2): 1094.