

# REVIEW ARTICLE

## MANAGEMENT OF POST BURN SCAR CONTRACTURE OF NECK IN A DEVELOPING COUNTRY-AN EMERGING TREND IN INDIA

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**INTRODUCTION:** Burn Injuries are very common in developing countries due to various socio-economic reasons. Neck contractures and deformities as consequence of burn pose a great challenge to the plastic surgeons who undertake reconstruction. Face and neck are exposed to a variety of injuries such as scalds, Flame, Chemical and electrical splash injuries.

Altered mentosternal and cervicothoracic angles cause serious functional and esthetic problems. Scar contracture aided by gravity and weight of the head causes insufficient neck extension, incomplete oral occlusion, cicatricial ectropion and alter the tracheal position. Hence it results in difficult intubation and life threatening airway problems. Disfigurement of exposed areas like face and neck leads to depression which affects the quality of life of patients. Financial constraints, limited reconstructive facility centers and enormous volume of patients are the problems faced in developing countries. In recent times there is an increase in reconstruction with micro vascular free flaps in the management of post burn scar contracture neck...This Paper is mainly focused on the various surgical options available in a developing country like ours and analyzes emerging trends in reconstruction of neck contractures with free flaps.

**CLASSIFICATION OF NECK CONTRACTURES:** Neck contractures are divided into 3 anatomical subunits.

- 1) Lower lip / chin subunit.
- 2) Sub mental subunit.
- 3) Anterior neck subunit.

Achauer in 1991 classified the neck contractures as Mild, Moderate and severe contracture depending on what function of the anterior neck is involved. Onah in 2005 classified as major numeric categories of 1 to 4 based on the position, severity and likely problems. He described Subgroups based on the width of contracture. Tsai et al defined the Zones of scar contracture with the aim of reconstruction with free flaps.<sup>[1]</sup>



**Fig. 1: post burn scar contracture neck**

# REVIEW ARTICLE

**GRADE OF NECK EXTENSION DEFICIT:** The functional grading of neck extension was used for the evaluation of extension deficit severity. The Grades include:

- N – Normal With extension greater than 110 degrees
- E1 – Extension beyond the horizontal plane parallel to the ground 95-110 degrees.
- E2 – Extension and vision limited to the horizontal plane only 85 to 95 degrees
- E3 – Mentosternal synechia, Patient's visual range is below the horizontal Plane < 85 degrees

This grading system is useful to define the indication for Free flap and for reassessment of neck motion after reconstruction.

$$\text{Outcome of functional improvement (\%)} = \frac{\text{Post operative range-preoperative angle}}{\text{Ideal range-preoperative range}}$$

Ideal range for extension	= 120 Degrees
Ideal range for rotation	= 90 Degrees
Ideal range for lateral flexion	= 50 Degrees. [2,3]

## **SURGICAL STRATEGIES FOR DEALING WITH LATE SEQUELAE OF BURNS:**

### **The Reconstructive Ladder:**

- Primary closure.
- Split thickness skin graft.
- Full thickness skin graft.
- Local flaps.
- Distant flaps.
- Free flap.
- Tissue expansion.
- Tissue engineering.
- Biomolecular manipulation.

**DIFFICULT INTUBATION AND AIRWAY PROBLEMS:** Airway management in patients with orofacial and neck burns is often a challenge due to a combination of various factors. Pre-operative assessment by the anesthesiologist with regard to the following factors is important.

- Restricted mouth opening,
- Decreased oropharyngeal space,
- Limited atlanto-occipital joint extension,
- Reduced submandibular space compliance due to heavily fibrosed scars in the neck,
- Microsomia.

## REVIEW ARTICLE

Use of standard laryngoscope may not be possible due to functional and anatomical distortion because of limited mouth opening, the use of supraglottic devices are ruled out. Retrograde intubation may not be possible because of the neck contracture. Awake intubation with a backup plan of release of contracture under tumescent anesthesia is to be considered. Judicious preoperative airway and scar evaluation is mandatory with special reference to thyromental distance, the Mallampati score and the mouth opening (interdental) distance are important clinical assessments.

Fiber optic intubation is considered the safest and most effective method in known or suspected cases of difficult intubation. It permits direct visual control of the intubation procedures. Fiber optic bronchoscopy provides excellent visualization of glottis.

Another major advantage of the fiber optic technique under video guide is that the dynamics of endotracheal tube insertion can be continuously viewed on the screen until intubation is accomplished. If the endotracheal tube fails to enter the trachea directly, it may be manipulated under visual control. The extubation strategy of the difficult airway should be adjusted to the type of surgery and the medical condition of the patient. Preparedness for the possibility of extubation failure and safe extubation strategy are equally important.

**SURGICAL OPTIONS AVAILABLE FOR POST BURN NECK CONTRACTURES:** Primary closure of the defects can be accomplished when the burn areas are small enough for suturing. Incorporation of Z-plasties helps to reduce the recurrence of contracture. Neck contracture release and surfacing with Split thickness skin graft is the time honored procedure. This procedure needs long periods of splinting and the chances of recurrence of contracture are common.<sup>[4,5]</sup>



**Fig. 2: Neck contracture release and split thickness Skin graft**

The use of Full thickness skin graft reduces the chances of recurrence of contracture and also reduces the need for prolonged splinting. But the main disadvantage of the procedure is "take" of the graft. Partial graft loss results when the dimensions of the graft are large.

## REVIEW ARTICLE



**Fig. 3: Neck contracture release and Full thickness skin grafting.  
Note the partial loss of graft in the post-operative period**

Flaps will be better in maintaining release and reducing the need for further surgery. The use of local flaps are done depending on the size of the defects. Flaps may be raised locally with or without prior expansion. Pedicled flaps, particularly the latissimus dorsi myocutaneous flap, can create permanent and effective release. The use of Supraclavicular perforator artery-based flap with sensory supply from the middle supraclavicular nerve was also reported. Good results are obtained with Supraclavicular artery island flap reconstruction. Free flaps can provide excellent functional and aesthetic results that are long lasting. Free flap has been used in both primary and secondary reconstruction of burn patients.[6,7,8] Recently Jabir S. et al published a review of free tissue transfer in burns. Free anterolateral thigh flap with cervicoplasty was reported at Chang Gung Memorial Hospital in 2001. The results were satisfactory since suprafascial dissection technique was used to yield a thin flap.

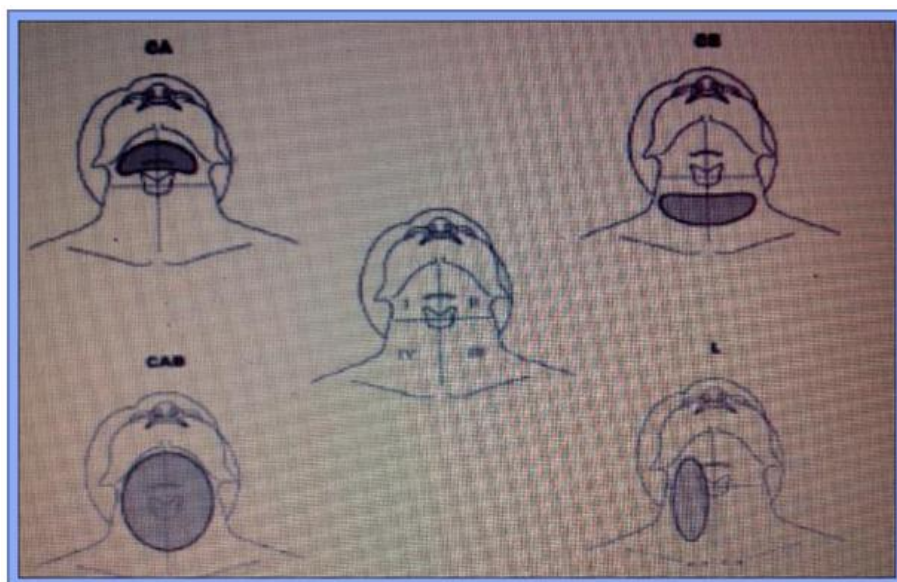
**INTEGRA:** Integra is a synthetic product of biological components. It is a bilayer structure composed of a defined matrix of type I bovine collagen and chondroitin sulfate derived from shark cartilage. This matrix is covered with a layer of silicone. The material is placed onto a full thickness defect and secured with sutures or staples. Macrophages invade the collagenous matrix and begin to biodegrade it. They recruit fibroblasts and endothelial cells, which follow the macrophages into the matrix. The fibroblasts replace the degraded matrix with autologous collagen, and the endothelial cells begin the process of angiogenesis. The pore and fiber sizes of the Integra matrix permit an element of control in the neomatrix formation, and after 3 to 4 weeks the Integra matrix is replaced with a new autocollagenous "dermal" matrix exhibiting organization and morphology that distinguish it from scar tissue. At this stage the silicone is removed, and an ultrathin "epidermal" autograft is placed on the newly formed dermis. This is an extremely expensive procedure and requires a specialized unit. This requires two stages namely, application of integra and removal of silicon layer and application of thin skin graft.

## REVIEW ARTICLE

**ADVANTAGES:** It is an off-the-shelf tissue substitute. If an initial application fails or needs to be revised, no irreplaceable native tissue is lost. Contour restoration after extensive tissue loss is good. Patients fared well with pain control and rehabilitation. The Quality of scar after 1 year is more acceptable than other procedures and the scars appear pliable, flexible, and smooth. More rapid restoration of function and return to gainful employment in these patients is appreciated.

**BIOMOLECULAR MANIPULATION:** Biomolecular engineering is the application of engineering principles and practices to the purposeful manipulation of molecules of biological origin.

**INDICATIONS FOR FREE FLAP RECONSTRUCTION:** The indication for free flap reconstruction is limited range of neck motion (equal or more severe than E2) for at least 6 months after an aggressive rehabilitation program with or without surgical release, skin grafting, local flaps or Z-plasties. Based on Tsai et al classification of the reconstructive territories of the neck, free flap surgeries are planned according to the following guidelines.



**Fig. 3: Tsai et al Classification system: the zones of anterior cervical scar involvement (zones I– IV) and the reconstructive territories of the neck (CA, CB, CAB and L reconstructive territories)**

### PRINCIPLES OF FEE FLAP RECONSTRUCTION:

- Total Scar contracture release and replacement with good tissue cover is the goal.
- Single staged procedure with the possibility of primary closure of the donor site, when possible.
- Reconstruction of CAB region when all four zones are involved. In case of limited donor sites priority is for reconstruction of CA region.



# REVIEW ARTICLE

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- Flaps are used in CB area for scars limited to Zones 111 and IV. This is not the first option if the scar advances to Zone 1 and 11.
- Flap inset into the lateral Zones where the scars extends to lateral Zones.
- Z-plasties can be incorporated at the flap margins.
- Grade E3 extension deficit requires extensive resurfacing with larger flaps.

## **The free flaps can be used in one of the following patterns:**

- Free split perforator flap.
- Double free flaps.
- Pre-expanded free flap.

## **The Ideal donor site is the thigh for the following reasons:**

- Availability of multiple flaps in one region.
- More constant anatomical relationships.
- Perforator flaps can be harvested without sacrificing major vessels.
- Large size flaps can be harvested and the donor site can be closed primarily.

## **Disadvantage of Thigh as donor site:**

- The color is different from that of the neck skin.

**DISCUSSION:** There is an increase in the utilization of free flaps in both primary and secondary reconstructive surgery following burn injuries. Advantages of Primary reconstruction are reduced stages in reconstruction, limb salvage coverage of exposed vital structures and reduced length of hospital stay.<sup>[9]</sup> In secondary reconstructive procedures, achieve sufficient contracture release, closure of chronic wounds and treatment of unstable scars. Success rate following free flap surgery for secondary reconstruction is better since the patients are physiologically stable.

Free fascial flaps provide thin, pliable and mobile reconstructive substrate with a reliable vascularity and potential for sensibility.<sup>[10]</sup> They are particularly useful for hand, neck and scalp defects. Commonly used flaps are tensor fascia latae, radial forearm, temporoparietal flap and lateral arm flap.<sup>[11]</sup> Disadvantages of fascial flaps are the limited size and need for skin graft over the flaps.

Free fasciocutaneous flaps have been used extensively to resurface the defects following burn scar contracture release in neck Advantages are they are thin and pliable, easy to raise, can be thinned with micro-dissection and large flaps can be raised with less donor site morbidity.<sup>[12]</sup> Disadvantage being more susceptible to infection than muscle flaps. This study showed an increase trend towards free flap reconstruction for post burn scar contracture of the neck.

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# REVIEW ARTICLE

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