

Five Years Experience of Early Aesthetic Repair of Facial Trauma

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ABSTRACT

Injury to facial soft tissues is one of the most common calls from the emergency department to plastic surgeon. Facial trauma can result from a wide variety of blunt and penetrating injuries ranging from trivial to life-threatening. Causative agents of facial soft tissue injury vary among hospitals depending on proximity to busy highways, farmland, and urban violence.

In this study we represent our experience of five years, in management of 130 patients presented to trauma room with various facial injuries of different mechanisms. Management was carried out in accordance to the severity of injuries, utilizing different tools in plastic surgery for reconstruction. Most of the patients (115 out of 130) were discharged with highly satisfying results. Only 15 patients required refinement, revision and secondary reconstruction.

The aim of this paper is to describe, through case-based discussion, the current management sequences for soft tissue injuries of the face and the eventual outcomes that can be achieved.

INTRODUCTION

Physically, the face is the most prominent visible part of the body and provides a person's sense of identity. Functionally, it animates emotion, communication and intellect, and provides the essential access routes to the respiratory and gastrointestinal systems [1]. Cognitively the region is sole source of vision, hearing, taste and smell. Thus, facial disfigurement has the potential to cause multiple problems and psychosocial dysfunction [2].

Trauma remains a major health and social issue throughout the world. More than 125,000 laceration repairs were performed in the United States by plastic surgeon in 2006 and most of these were located in the face. For this reason it is imperative that plastic surgeons understand the pathophysiology of soft tissue injury, understand the delicate anatomy of facial structures that can be injured, and become adept in handling tissues and repairing soft tissue defects [3].

Soft tissue injuries with or without facial bone involvement are the most common presentation following maxillary facial trauma. These injuries may result from road traffic accidents, firearm, athletic activities and altercations. The cause of facial trauma is important to ascertain because it can influence tissue damage, infection rate, and aesthetic outcome of the repair [4].

Facial reconstructive surgeon aims to establish anatomic normality as closely as possible on an individualized basis to optimize functional and aesthetic outcome. The objective of this study is to look at the distribution pattern and the type of soft tissue injury in relation to etiology and to explore clinical effectiveness of repair of soft tissue trauma to the face by using plastic surgery techniques.

PATIENTS AND METHODS

A total of 130 patients treated for soft tissue injuries of the face between January 2006 and December 2011. Males were the majority of patients (86 cases) and females were (44 patients). Age ranged from 4 to 70 years. Road traffic accident was the main cause of soft tissue injuries (95 cases) and the remaining 35 cases were due to other causes (falls in 17 cases, assault in 10 cases and 8 cases were due to household injuries). Twenty cases had maxillofacial fractures, 10 mid face fractures, 7 upper face fractures, and 3 cases had mandibular fractures. Five cases had facial nerve injuries (buccal branch in 2 cases, frontal branch in 2 cases, and all branches in one case). Out of these five cases, 3 cases had associated parotid duct injuries. Seventeen cases had multisystem injuries (head, cervical spine, fractures of long bones, and liver lacerations).

Repair of soft tissue injuries of the face in 110 patients were carried out using the plastic surgery basic principles i.e. meticulous cleansing, minimal debridement, and repair according to the topogra-

phy and anatomical compositions of each region of the face. Twenty patients required immediate flap reconstruction (4 cases superficial temporal fascial flap, 2 cases advancement forehead flap, 5 cases cheek advancement flap, 2 cases submental artery flap, 3 cases nasolabial flap, 2 cases nasalis musculo-cutaneous island flap and 2 cases postauricular flap).

Out of 130 cases of repaired soft tissue injuries, 115 achieved satisfactory results and 15 cases need revision and secondary definitive reconstruction.

Initial assessment:

For any trauma, advanced trauma life support protocol (ATLS) should be followed initially and the patient should be treated as a whole, not as a facial injury. Careful examination of the entire body is important to reveal associated injuries such as cervical spine injury and long bone fractures.

The brain and spinal cord are most susceptible to injury and a complete neurological examination is indicated in these patients. Forces sufficient to cause even minor damage to the maxillofacial complex can also harm the central nervous system. Patients with altered mental status and or neck pain should have head and cervical spine injuries ruled out by CT scan.

Once the patient is stabilized, a detailed head-to-toe physical examination or focused examination depending on the patient's chief complaint, mechanism of injury and initial assessment findings. A meticulous systemic examination of the head and neck should be performed. The entire scalp should be carefully inspected as well as both intranasal and intraoral examinations performed, documenting all injuries encountered. Specific attention must be paid to the patients' hemodynamics as facial and scalp lacerations can bleed profusely before emergency medical services reach the scene. Assessment of symmetry of facial structures comparing right to left may reveal flattening, asymmetry, depressions, misalignment of the jaw or nose to the midline or height of the eyes. Maxillofacial computed tomography scans are frequently obtained if an underlying bony injury is suspected.

Surgical principles:

Detailed soft tissue injuries should be documented and wounds must be thoroughly irrigated and cleansed of debris and bacterial contamination. Surgical scrub brushes are often necessary if the wound is potentially contaminated to avoid traumatic tattooing after repair.

After adequate cleansing, the wound can then be inspected. Bleeding vessels should never be blindly clamped as they often run with nerves that could be damaged by clamping. Instead, they should be carefully inspected and dissected prior to tying off. The depths of all wounds must be inspected to determine extent of damage and involvement of any special structures. Clearly devitalized tissue should be debrided sparingly.

In the operating room, wounds require careful exploration under magnification, surgical debridement, eliminating foreign body contamination, and irrigation with antibiotic containing solution. Conservative trimming of nonviable tissue margins and primary closure, keeping sutures below the skin surface if possible. Avulsed or widely undermined soft tissue flaps require proper suction drainage to prevent hematoma formation and pressure or support dressings to allow both arterial inflow and venous outflow. Frequent checks of the wound to confirm tissue viability are important. If there is concern over viability, steps should be taken to optimize tissue vascularity through suture removal, improved tissue support or enhancement of wound drainage. When loss of tissue is extensive, a staged approach to reconstruction is required. Serial wound debridement and numerous tissue dressing changes may be required in the first two weeks after injury.

Treatment aims to repair the natural bony architecture and to leave as little apparent trace of the injury as possible. Fractures may be fixed with metal plates and screws. They may also be wired into place. Bone grafting is another option to repair the bone's architecture, to fill out missing section, and to provide structural support.

Operative details and case presentation:

Each structure of the face has its own unique reconstructive principles that should be respected. These principles include the topography, anatomic composition and aesthetic subunits of the defect which are assessed and local flaps designed accordingly.

Lacerations are generally caused by sharp instruments such as broken glass or knives. These injuries tend to be clean and deep. Attention must be directed to deep structures such as nerves and arteries, which are more likely to be injured by the sharp instruments. Fortunately, little damage to the surrounding tissue occurs and the wound edges to be clean rather than irregular (Figs. 1,2).

Abrasions occur when the superficial layer of skin and soft tissue are damaged by a rough surface such as pavement. Loss of epidermis and superficial dermis requires only local wound care to provide a moist environment for reepithelialization. These injuries generally heal without scar. In the case of extensive full thickness abrasions, a plastic surgeon must decide whether to allow the wound to heal by secondary intention or to excise and close the abrasion with local flaps in an acute or delayed setting, so coverage can become an issue.

Avulsions are common on the face and generally occur from blunt trauma, such as motor vehicle accident and falls (Figs. 3,4,5). The initial tear through the skin and superficial tissue unroofs the underlying fascial planes of the face and creates rough flaps of skin and soft tissue. These flaps tend to have irregular edges with some devitalization of skin as well as damage to surrounding tissue. Moreover, the avulsion flap is at risk for ischemia due to the fact that it is usually only based on a single pedicle. It also has the tendency to swell or 'biscuit' after it has been repaired and healed.

Typically, crush injuries occur as some component of an overall injury in concert with avulsion and laceration (Fig. 6). Within the zone of crush injury, the skin is often intact, but the underlying tissue has been micro-traumatized due to the pressure of the force. Injury to blood vessels and supporting fascia can also cause local tissue ischemia. This can affect the healing of nearby lacerations and avulsions. Special care should be taken in handling crush injury tissue to avoid iatrogenically worsening the situation.

Complex facial soft tissue injuries often include all types of injuries; lacerations, avulsion, and crushing, and it may include more than one of the anatomical subunits or different tissue components (Figs. 7-9). A plastic surgeon must address each injury pattern and approach its repair appropriately, multiple stages of reconstruction may be required to return the patient's form and function.

If injury of the facial nerve is suspected based on physical examination or wound location, the wound should be explored with loupe or microscope magnification. Sharply lacerated nerve ends should be repaired with minimal epineural sutures to allow axon growth (Fig. 10). Shredded or crushed nerve ends should be debrided to healthy tissue and coapted primarily or nerve grafted.

Injuries to parotid gland do not require suturing. To assess patency of parotid duct it should be

cannulated at Stensen's duct with a small catheter and approximately 5-10ml saline instilled. If saline pools in the wound, the duct is injured and should be repaired with fine suture over a catheter. The catheter is left in place for 10-14 days until edema has subsided.

Eyelid injuries, (Figs. 11,12,13), require careful repair to avoid not only deformity but also dry eyes and possible corneal ulceration. Through and through laceration of the eyelids require concomitant evaluation of the globe by an ophthalmologist to rule out laceration or retained foreign body within the globe. These injuries should be repaired early because they can result in tarsal thickening and fibrosis with lid notching. Generally a suture is placed through the tarsal plate, carefully reapproximating it, but it is not tied. The conjunctiva is then repaired taking care to bury the suture knots and tails. The tarsal stitch can then be tied and its tails trapped under the subsequent stitches through the lid skin. Injuries to the lower lid carry a risk of ectropion. The lid should be supported by adequate soft tissue suspension of the mid face especially in complex cases and facial fractures. An injured and grossly displaced nasolacrimal sac or duct requires repair with fine suture over stent. Partially injured ducts can be reapproximated without suturing and generally remain patent. Isolate injury to the upper canaliculus generally does not produce symptoms.

Injuries to the nose can involve the mucosa, cartilage and skin, these layers are closely reapproximated and repaired (Figs. 14,15). Mucosa is repaired with absorbable sutures. Lacerated lower or upper cartilages can be repaired with a small monofilament suture as 5/0 PDS or Nylon. The skin should be properly everted upon closure because it tends to be thick, sebaceous and prone to inversion. The nasal septum should always be inspected to rule out hematoma, which can cause septal perforation. Soft tissue loss of the nose may necessitate immediate reconstruction with local flaps, (nasolabial flap, Figs. 16,17, and cheek advancement flap Fig. 18).

Ear laceration and avulsions can be repaired satisfactorily depending on the amount of remaining tissue. Meticulous closure of postauricular skin, cartilage and preauricular skin provides excellent results if anatomic landmarks are properly aligned (Fig. 19).

Traumatic loss may require immediate reconstruction with local flaps to cover the exposed cartilage (Figs. 20,21). If the ear is completely

amputated, the cartilage can be banked and covered with postauricular skin for second stage reconstruction (Fig. 22).

After inspection and irrigation of lip lacerations, the landmarks of the lip should be marked prior to instilling local anaes-thetic. Landmarks that require careful repair include the philtrum, philtral columns, Cupid’s bow, mucosal wet-dry border, and white roll or vermillion border.

A helpful technique is to first provide a nerve block by injecting the infraorbital or mental neurovascular bundle. The lip can then be irrigated and inspected painlessly, without disturbing these

landmarks. Once identified, the landmarks should be tattooed with a 25-gauge needle and methylene blue. Direct injection into the laceration can then be performed if necessary for hemostasis, but often is unnecessary once an adequate nerve block is attained. The lip laceration can then be repaired in layers. The orbicularis oris muscle is repaired first with an absorbable suture such as vicryl. Intraoral mucosal injuries are then reapproximated with chromic catgut suture. The vermillion border is then reapproximated exactly with a buried dermal suture. The remainder of the lip repair should proceed with buried dermal sutures to realign the skin edges, then the use of nylon or fast absorbing plain catgut sutures to close the skin (Figs. 23,24).



Fig. (1A,B): A 16 year old boy sustained periorbital laceration and satisfactory result postoperatively.



Fig. (2A,B): A 55 year old man, sustained facial laceration with satisfactory post operative result.

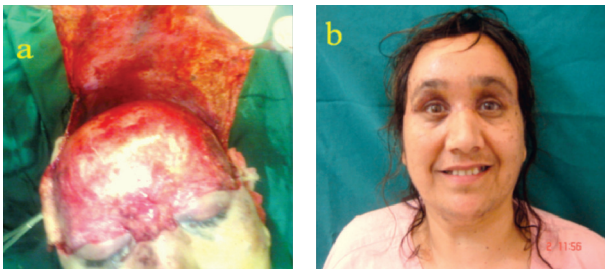


Fig. (3A,B): A 35 year old female with avulsion injury of the forehead, eyebrows and root of the nose. Irrigation, minimal debridement, anatomical repair of the gale apponerosus, muscles and anchoring of the eyebrow were done with good appearance and symmetry of the eyebrows.



Fig. (4A,B): Avulsion injury of the forehead, left eye brow, left upper eye lid, and root of the nose, in a twelve years old boy. Debridement, meticulous anatomical repair with good appearance, symmetry of the eyebrows, and function of the upper eye lid.

Fig. (5A,B): A 6 year old girl sustained avulsion injury of the forehead, eyebrow, left eye lid. Anatomical repair with good appearance and symmetry of the eyebrows.

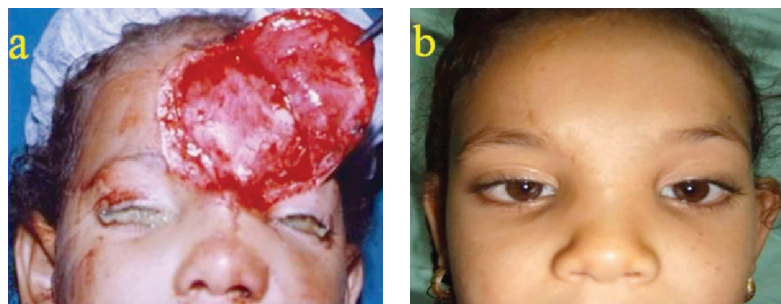




Fig. (6A,B,C): A 33 year old male, with crush injury left cheek and upper third left ear, anatomical repair was done with satisfactory result.



Fig. (7A,B,C,D,E): A 57 year old man, RTA, with soft tissue injury and skin loss of the forehead, and fracture of the frontal sinus. Debridement, removal of foreign bodies, eradication of frontal sinus mucosa, and titanium mesh reconstruction of frontal bone done by maxillofacial surgeon. Advancement forehead flap used to cover the exposed bone and mesh, with good postoperative result.

Fig. (8A,B,C,D): Female patient, 42 years, victim of RTA, got zygomatico-orbital fracture with sever soft tissue injury of the Lt. cheek, eyelid and periorbital area. Fixation of the fracture with plate and screws, cheek advancement, soft tissue anchoring of the mid face done by maxillofacial and plastic surgery team with fair function and aesthetic result.





Fig. (9A,B,C,D): An eleven year old boy, RTA, sustained severe facial injury and full thickness soft tissue loss on the fronto-parietal area. Immediate reconstruction with temporo-parietal fascial flap and full thickness skin graft from supraclavicular area was done after debridement and cleansing.

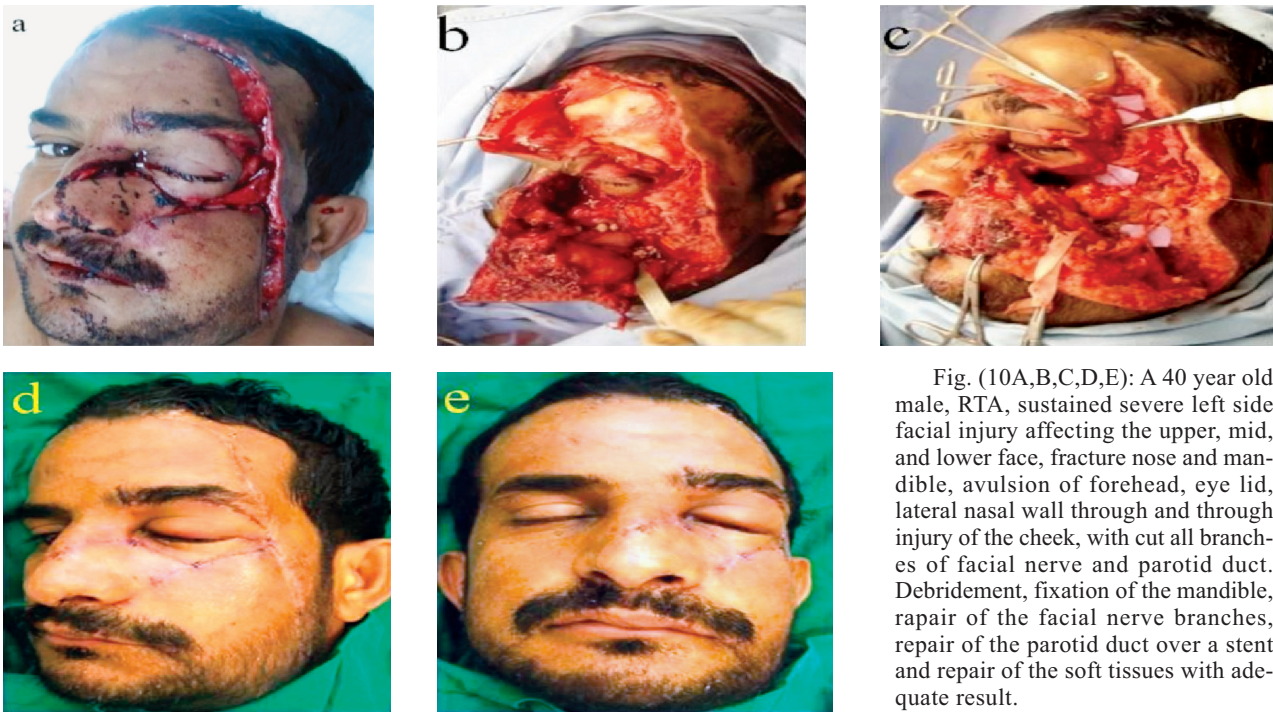


Fig. (10A,B,C,D,E): A 40 year old male, RTA, sustained severe left side facial injury affecting the upper, mid, and lower face, fracture nose and mandible, avulsion of forehead, eye lid, lateral nasal wall through and through injury of the cheek, with cut all branches of facial nerve and parotid duct. Debridement, fixation of the mandible, rapair of the facial nerve branches, repair of the parotid duct over a stent and repair of the soft tissues with adequate result.

Fig. (11A,B): A 38 year old gentleman, with left lower eye lid crush injury extending onto the left cheek, lateral cantholysis, meticulous repair, with fine result.



Fig. (12A,B,C): Left lower eye lid and cheek injury, 6 years old girl, meticulous repair and a satisfactory functional and cosmetic repair.

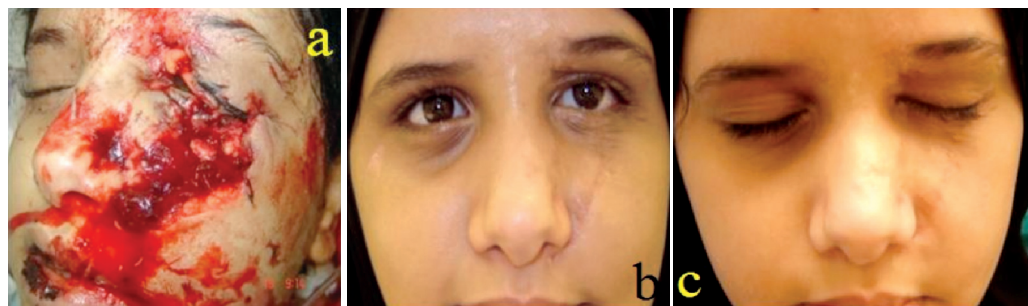




Fig. (13A,B,C): An eighteen year old boy, with crush injury left upper eye lid and eyebrow, anchoring of the eyebrow with meticulous repair of the eyelid is the key of the final satisfactory result.

Fig. (14A,B): Sharp truma to the nasal tip, columella and caudal end of the nasal septum in 7 years old girl, anatomical repair of the mucosa, cartilages, and skin, with fine result.



Fig. (15A,B,C): A 31 year old male sustained severe sharp traumatic avulsion of the nose with fracture of the nasal septum and upper lateral cartilages attached by a narrow pedicle. Meticulous repair of the mucosa, cartilages and skin with adequate result.

Fig. (16A,B): Severe laceration of the right side of the nose, with full thickness loss of the right ala and the caudal part of the upper lateral cartilage, in 48 years male. Immediate repair with nasolabial fold flap in staged procedure, with accepted result.



Fig. (17A,B,C): Severe laceration with full thickness loss of the nasal tip and columella, in 52 years male. Immediate repair with nasolabial fold flap in staged procedure, with accepted result.

Fig. (18A,B): A 33 old male patient sustained crush injury right side and dorsum of the nose with soft tissue loss and extensive laceration to the upper lateral cartilage. Immediate repair with cheek advancement flap was done after debridement and irrigation of the wound with highly satisfactory result.



Fig. (19A,B,C,D): Avulsion injury of the upper two thirds right auricle, in a 23 year old male. Irrigation, debridement, meticulous repair of the cartilage, pre, and post-auricular skin with adequate result.



Fig. (20A,B,C): A 23 year old male, sustained traumatic loss of the middle third left helix, immediate reconstruction using superiorly-based post auricular flap regained adequate contour.



Fig. (21A,B,C): A 48 year old man, with lost lower third right auricle. Reconstruction with inferiorly-based post auricular flap was done, with adequate immediate post operative result.

Fig. (22A,B,C): Avulsion injury with complete amputation of the left auricle, in a 34 old male patient. The cartilage was stripped off the amputated part and banked under the mastoid skin for secondary definitive reconstruction.

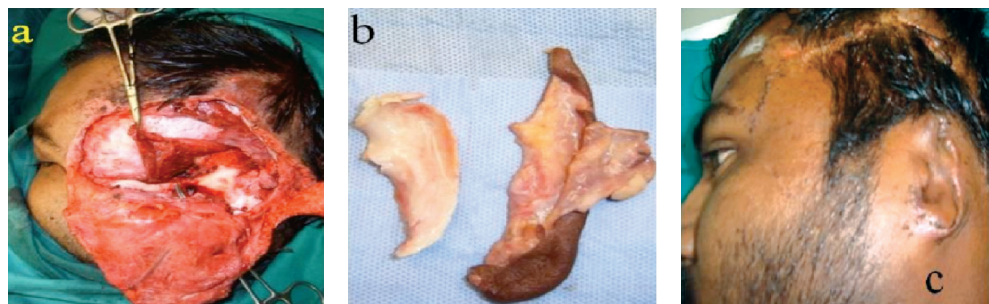
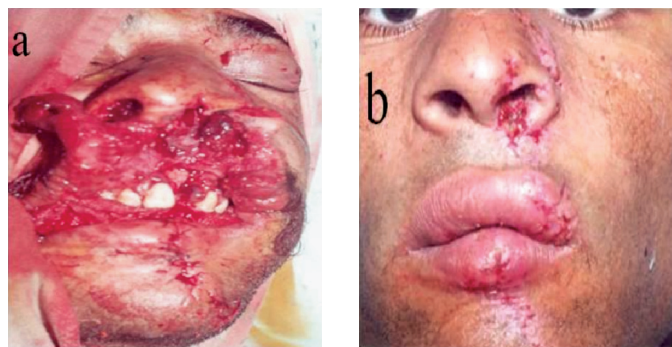




Fig. (23A,B,C): 14 years old boy, sustained through-and-through injury to lower lip. Irrigation, minimal debridement, meticulous repair of the muscle, mucosa, and skin with preservation of the landmarks resulted in adequate result.

Fig. (24A,B): Severe soft tissue injury of the upper and lower lips, irrigation, minimal debridement, meticulous repair of the muscle, mucosa, and skin with preservation of the landmarks, with satisfactory result in a 24 year old boy.



DISCUSSION

The facial trauma has become an inevitable subject for the medical community for its frequency has been increasing, mainly in the past four decades, and it correlates to the high number of automobile accidents and urban violence.

Maxillofacial injuries are commonly encountered in the practice of emergency medicine. More than 50% of patients with these injuries have multisystem trauma requiring coordinated management between emergency physicians and surgical specialists in otolaryngology, trauma surgery, plastic surgery, ophthalmology and oral and maxillofacial surgery [5].

As many as 50-70% of people who survive traffic accident has facial trauma. There was a bimodal distribution of injuries according to age, with peaks presentation in the first four years of age group and 15-19 years age group. Males presented more frequently than females in every age group except for those more than 65 years [6].

The nature of injury varies across age group, with a higher proportion of injuries in children resulting in superficial injuries and a higher proportion in adults resulting in facial fractures [7].

Facial fracture is distributed with a peak incidence occurring between ages 20 and 40 years

[8,9]. Fortunately, facial trauma comprises relatively small proportion of pediatric injuries; between 1% and 15% of facial fractures occur in children [10]. There was great frequency of trauma to the nose in age group of 11-40 years. In both sexes there was no statistical difference between the female and male in relation to nasal trauma.

Brain injury occurs in 15-48% of people with maxillofacial trauma [11]. Cervical injury may be associated with facial fractures [12,13], but less commonly in children than in adults [14].

To some degree, all injuries involve laceration, avulsion, abrasion, crush injury, puncture or complex injuries. Each of these injuries requires specific attention from plastic surgeon. Ideally the injury should be repaired as soon as possible after injury to avoid bacterial contamination of the open wound. However with strict adherence to the principles of copious irrigation and adequate debridement, wounds can be safely closed up to 24 hours after injury. In fact, closure after this time may be possible with the understanding that the elevated risk of infection may require reopening of the closed wound for drainage. When loss of tissue is extensive, a staged approach to reconstruction is required [15,16].

Special wounds, such as those involving nasal and ear cartilage, require thorough cleaning and

removal of any foreign bodies, then meticulous approximation of the cartilage and skin. Cartilage needs complete soft tissue coverage and support or bolster dressing to eliminate hematoma and seroma formation. Cartilaginous disruption, particularly of the nasoseptal cartilaginous skeleton, is susceptible to growth disturbances [17].

For ear injuries, it is important to attain closure primarily because even the best secondary reconstruction falls short of adequate primary repair. Fortunately, the ear is with an abundant blood supply, even a near total avulsion will often survive. If the ear is completely amputated, then a diligent search for replantable vessels should be undertaken to provide the best result. Alternatively, the cartilage can be banked and/or covered with a temporal parietal fascial flap. Unfortunately, these options give inferior results and can compromise other choices for secondary rib cartilage reconstruction [16,17].

Lip laceration is common due to prominence of the mouth and proximity to the underlying sharp teeth. Intraoral examination is required with lip laceration to rule out a through-and-through injury from the underlying teeth. The landmarks of the lip should be marked prior to instilling local anaesthetic. It is important to realign the orbicularis oris muscle to avoid persistent indentation or a whistle deformity with animation [16].

Injuries to the eyelids require an initial ophthalmologic assessment and possibly dilation and slit lamp examination to rule out globe injury. The eyelids are composed of anatomical layers called lamellae (anterior, middle and posterior), and each lamella must be repaired or supported to ensure proper eyelid function. Placement of silicone intubation tubes through the severed tear ducts will preserve the canalicular and lacrimal system [17].

Repaired facial laceration and abrasions should be treated with antibiotic ointment to provide moist environment for optimal reepithelialization [18]. Antibiotics provided only for contaminated wounds [19]. Permanent sutures should be removed within 5 to 7 days [20]. Traumatic suture removal in an uncooperative, young patient or leaving sutures in for a prolonged time in a noncompliant patient who is lost to follow-up can cause more harm than good. In these patients, rapidly absorbing plain catgut suture may be a better choice for skin closure. Regardless of the material chosen, the closure must be tension-free to provide an optimal final scar outcome [21].

All nerve and ductal injuries require micro-repair with permanent sutures. Lateral to the mid pupillary line, the facial nerve branches are prone to injury from deep laceration and require exploration and repair, medial to this line, the facial nerve has branched into deep and superficial planes so that injuries in this zone typically do not produce deformity due to cross innervation and therefore do not require repair [22,23].

The Parotid duct courses from the parotid gland to Stensen's duct which exits intra-orally opposite the maxillary second molar. The duct generally follows a line from the tragus to the oral commissure. Deep laceration along this line should alert a plastic surgeon to duct injuries. Failure to restore duct patency can result in a fistula or gland atrophy. Severed ducts should be stented for at least two weeks or until epithelial tissue continuity has been restored in the lumen [22]. When ducts are stented, the patient should be prescribed antibiotics for 7-10 days, as the gland may become somewhat static and prone to obstructive sialadenitis [17].

To date, no consensus has been reached regarding the treatment of nonhypertrophic, nonkeloid, non-burn scars. However, evidence from research in these fields points to the efficacy of topical silicone and pressure in a scar that is beginning to become hypertrophic. Silicone sheeting or tape is applied in attempt to prevent keloid scarring before it occurs [24].

Generally, surgical revision of traumatic scars is not considered until the scar had matured, which may take 1-2 years. The type of revision depends on the specific deformity created by the scar. Irregular scars can often be improved with surgical excision and careful, layered, tension-free closure.

Scars that cross relaxed skin tension lines can be re-oriented with Z plasty or W plasty techniques to better camouflage them within facial creases. Scars that have caused depressions or dimples can be treated with micro-fat injections to improve the facial contour. One of the most difficult deformities to correct is the biscuited, U-shaped avulsion flap. Simple re-elevating and debulking the flap is useless because doing so creates more fibrosis beneath the skin and does not address the lymphatic drainage of this area. Small Z-plasties at the curved edges of the flap provide moderate improvement. Sometimes, the entire flap must be excised and closed with a local flap or serial excisions to provide a better aesthetic result [25].

Recently, a number of studies have objectively looked at cosmetic outcomes of wounds that have

been closed by traditional suturing techniques compared with a relatively new tissue adhesive, octylcyanoacrylate [26-28]. They found no clinically important cosmetic difference in facial wounds that were closed by nylon suture, octylcyanoacrylate, or rapidly absorbing gut suture.

This represents the clinical experiences with management of soft tissue injuries of the face in 130 patients using the basic plastic and reconstructive techniques for repair and flap covering of soft tissue defects [29-36]. The results were comparable with many authors dealing with this subject [37-42].

Conclusion:

Soft tissue injuries of the face present a challenge to plastic surgeons. However, careful evaluation, fastidious cleansing, and meticulous repair can provide gratifying results and grateful patients. The face is unique. It is how we present ourselves to the world and a large component of our self-image. The ability to repair even the most complex soft tissue injuries separates plastic surgeons from other specialists who treat patients with traumatic injuries.

Repair of facial soft tissue wounds is a high priority, identifying and maintaining tissue viability is paramount, as is early diagnosis and repair of nerve and ductal integrity. Wound support and daily cleansing, as well as measures to decrease tension, help to decrease scar formation.

Early aesthetic repair of facial trauma could prevent the secondary treatment. However, in complex facial trauma, flap coverage might be required preserving the topography and anatomical composition of the affected area and maintaining the aesthetic subunits of the face.

The main experiences include early careful debridement, excellent wound closure technique, fine instruments and sutures and post surgery scar prevention treatment are crucial to satisfactory results.

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