Maxillofacial Injuries in Counter Proxy War Posture of the Armed Forces

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Abstract

Background : Various maxillofacial injuries, sustained in counter insurgency operations in the counter proxy war posture (CPWP) of the Armed Forces in the Kashmir valley are being treated at various maxillofacial surgical centres.

Method: Proper triage, documentation of injuries and mode of injuries along with various clinical, radiological and other investigations were carried out before operating these individuals for primary reconstruction of skeletal tissue and facial soft tissue.

Result: A total of 324 persons with various types of maxillofacial injuries were treated within the period ranging from 01 January 2000 to 30 June 2002 successfully in this centre as a part of the advanced trauma life support (ATLS) system of Combat Medical Support.

Conclusion: Proper primary reconstruction (soft tissue and skeletal tissue) of the facial region goes a long way in reducing subsequent disfigurement and morbidity. Improving the structural design of the combat head gear for safety and comfort will go a long way in preventing majority of maxillofacial injuries or can at least reduce the severity of these injuries.

MJAFI 2004; 60 : 357-362

Key Words : Battle accident; Battle casualties; Counter proxy war posture; Maxillofacial injuries

Introduction

The nature of CPWP of the Armed Forces within the country tests the efficacy of the Combat Medical Support (CMS) system of medical services. In the scenario of 'no war no peace', the role of a maxillofacial surgeon has increased as a part of the CMS. Battle casualties and battle accident cases present with maxillofacial injuries associated with/without injuries to other parts of body. Various maxillofacial injuries due to gunshot wound (GSW), high velocity missile injury, improvised explosive device (IED) blast injury, splinter and shrapnel injury from enemy small arm firing / artillery shelling across the Line of Control (LOC), roadtraffic accidents (RTA) in mountainous terrain and other modes of injuries were treated in this centre as a part of the ATLS system of CMS successfully. Various modalities of treatment, ranging from repairing of lacerated wounds, open reduction and internal fixation (ORIF) to bone grafting of blown - off facial bones followed by prosthetic rehabilitation, were carried out successfully from January 2000 to June 2002. The medical services of the Armed Forces assure medical presence with the soldier on the front, while at the same time providing state-of-the-art CMS. Maxillofacial surgeons of future have to maintain a high standard of competency, professional skill and

dedication to keep pace with the changing nature of conflict and unconventional injuries inflicted to the maxillofacial region.

Material and Methods

A total of 324 patients were treated for maxillofacial injuries covering a period of 30 months from 01 January 2000 to 30 Jun 2002. These injuries were sustained in counter insurgency operations, firing across the LOC, RTA and other modes of injury (Table 4). The rank wise distribution is as per Table 1. The cases injured due to blasts (IED / grenade / arty shelling) were often associated with multiple injuries including head injuries, ophthalmic injuries (penetrative type) and neck injuries.

Table 1
Distribution of rank

Category	Number of cases (%)
Officers	15 (4.62%)
JCO	22 (6.79%)
OR	209 (64.50%)
Paramilitary	76 (23.45%)
Civilians	02 (0.61%)
Total	324*

*251 patients had multiple findings

Standard resuscitation protocols were followed along with

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Received : 30.12.2002; Accepted : 10.11.2003

Table 2**Arms/Org of patients**

Arms/Org	Number of cases (%)
Army	243 (75%)
Air Force	01 (0.30%)
Navy	02 (0.61%)
CRPF	25 (7.71%)
BSF	34 (10.49%)
ITBP	17 (5.24%)
Civilians	02 (0.61%)
Total	324*

*251 patients had multiple findings

Table 3**Site of injury**

Region wise distribution	Number of cases (%)
Mandible	137 (23.33%)
Maxilla	86 (14.65%)
Zygomaticomaxillary complex	98 (16.69%)
Orbit	52 (8.85%)
Naso - ethmoidal complex	19 (3.23%)
Pan facial injury	26 (4.42%)
Splinter removal	67 (11.41%)
Facial soft tissue injuries only	102 (17.37%)
Total	587*

*251 patients (77.46%) had multiple findings

prioritisation of treatment [1,2]. For those cases, which were associated with polytrauma, a multispeciality trauma team performed the surgical intervention. Injury distribution in the maxillofacial region covered all facial bones, either in isolation or in various combinations (Table-3) along with mild to severe facial soft tissue lacerations. Latest techniques of investigations including CT scan along with 3D representation (Fig 1), which facilitated reconstruction of the facial skeleton and use of state of art reconstruction systems were used for these cases. All cases underwent debridement of facial tissues, removal of foreign bodies in the form of splinters/bullets, ORIF of fractured facial bones with or without bone grafting, primary closure of soft tissues (except in 2 cases) followed subsequently by active physiotherapy after a lag period of 2-3 weeks to enhance facial and jaw movements and rehabilitation of the damaged or lost dental and facial structures by fixed partial dentures, removable partial dentures, crowns and eye prosthesis (Fig 2). Cases of IED blast injuries showed the maximum amount of contamination and damage (Fig 3), both in the facial soft tissues and the skeletal tissues with impregnation of splinters whose size ranged from 1 mm - 15 mm (Fig 4). The reconstruction of these cases was done with titanium bone reconstruction systems along with extensive use of local vascular flaps for soft tissue repair in majority of the cases. One soldier sustained an anti-aircraft bullet injury and was treated successfully (Fig 5). One case of IED blast injury and one case of GSW naso-labial region had to be sent to Reconstructive surgical centre subsequently for secondary reconstruction.

Fig. 1: Three dimensional CT representation of various maxillofacial injuries

Individuals with fractures of the orbital bone (Fig 6) (lateral wall / superior wall / inferior wall / medial wall) and naso-ethmoidal complex were treated with micro reconstruction system to restore the skeletal configuration. Fractures of the zygomatico - maxillary complex were treated by ORIF in the fronto-zygomatic (lateral orbital) and the zygomatic buttress region.

Isolated maxillary fractures (14.65%) and Le Fort fractures were comparatively uncommon and were treated by ORIF. Maxillary fractures were always associated with involvement of the maxillary sinus and adequate care was taken for repair of the sinus and alienation from oral cavity to prevent oro-antral fistula. 3 (3.48%) cases presented with traumatic cleft palate and repair of the same was done as a secondary procedure with good results reflecting on the phonation and comfortable deglutition without the aid of palatal obturator subsequently.

Results

A total of 324 persons with various types of maxillofacial injuries were treated within the period ranging from 01 January 2000 to 30 June 2002. The mean age of the patients was 32.6 years (range 20-47 years). All the patients were male. Maximum injury was sustained due to blast effects (32.71%) (Table 4). These patients were of various arms/organisations (Table 2) with the maximum casualties sustained by the personnel of Army (75%). The cases who were injured in IED blasts, took longer time to recover optimally from their injuries, both functionally and aesthetically, compared to the other modes of injury. In majority of the cases, the facial bones were comminuted and reconstruction of the skeletal structure required more number of implants. 6 (8%) of the cases required a second operation for removal of the implants due to implant rejection / secondary infection.

Maxillary (14.65%) and mandibular injuries (23.33%)

Fig. 2 : Eye prosthesis placement after reconstruction of orbital floor

Fig. 3 : Facial injuries as a result of IED blast

required establishment of functional occlusion, restructuring of the mid 1/3 and lower 1/3 of the face along with / without repair of the facial soft tissues. Almost all the cases of fracture maxilla and mandible required repair of the oral mucosa over the alveolus.

In majority of the cases, the results achieved were quite satisfactory, both functionally and aesthetically. Primary closure of soft tissues was possible in all cases except for two cases (1%) where requirement of plastic surgical correction was necessary due to extensive loss of facial tissues. Extensive rehabilitative process added to the surgical results and contributed immensely to the return of optimal aesthetics and function for the individuals. Follow-up of minimum one year was done for majority of the patients and the results were encouraging and satisfactory.

Discussion

American College of Surgeons committee on trauma has defined trauma as a wound or injury characterised by a structural alteration or physiologic imbalance resulting from acute exposure to mechanical, thermal, electrical or chemical energy or from absence of such essentials as heat or oxygen [3]. Kinematics explains what happens when two objects try to occupy the same place in space at the same time and one of the objects is the human body.

Table 4

Cause of injury

Cause of injury	Number of cases
IED Blast	106 (32.71%)
Grenade	59 (18.20%)
Artillery shelling	33 (10.18%)
GSW	75 (23.14%)
RTA	41 (12.65%)
Others	10 (3.08%)
Total	324

Trauma is a disease and is time related. The development of trauma care reflects the contribution of many civilisations, cultures and the painfully slow acquisition of scientific knowledge. The analysis and evolution of the treatment modalities of maxillofacial injuries received their share of the surgical advances achieved in war time. The major wars of this century have produced many advances in the management of facial, skeletal and soft tissue wounds along with the development of specialised maxillofacial centres.

Though the incidence of maxillofacial injuries in civilian environment is substantial, there have been controversies over the differences and similarities in the management of civilian and battle casualties. The basic differences between these two are the mode of injury, type of weapon, velocity of missiles, difference in cavitation, amount of tissue destruction, contamination, pre-hospital time and the number of injured reaching hospital at a time. Wherever the scenario of these injuries may be, majority of the persons injured in the maxillofacial region managing to reach a specialised treatment centre early, are salvaged with minimal functional and aesthetic deformities.

The distinct features of injuries associated with explosives have been recognized since the invention of gun powder. Many of the previous studies paid scant attention to ballistics. Ballistics is the science which is fundamental in understanding the characteristic of a particular injury and subsequent treatment. Characteristic of a missile injury is dependent on:

- Type of missile: Fragmentation missile (mortar, aerial bomb, grenade shells, artillery shells, IED etc)
Solid missile (bullets, antitank shells)
Land mines, Booby traps
Blast crush
Chemical
Other wounds

Out of these, the commonest injury in the maxillofacial region is from fragmentation missiles and solid missiles [4,6].

Fig. 4 : Missiles and splinters of various sizes removed from maxillofacial region

Fig. 5 : A 6.12 mm anti-aircraft bullet removed from the submandibular region

b) Wounding characteristics of various missiles:

Capacity of a missile to injure depends on the kinetic energy (KE) on impact. The formula : $KE = 1/2 \text{ Mass} \times \text{Velocity}^2$, suggests that terminal velocity is more important than mass in determining the energy dispersed at the point of impact and the impact velocity is the most important determinant of wounding capacity. Bullet velocity is classified as low (under 1000 feet/sec), medium (between 1000-2000 feet/sec and high (above 3000 feet/sec). When a bullet strikes bone, the KE is expended and transferred to fragments which in turn act as secondary missiles of much lower velocity. The impact of a bullet / missile in living tissue transforms that tissue into secondary missiles which are 'thrown away' from the passage of the bullet largely in a radial direction producing a very short lived temporary cavity in which pressures up to 10,000 kPa may occur for 5-10 ms. Occasionally the tissues are unable to contain the temporary cavity when the energy release is large and this accounts for the explosive nature of some ultra high velocity bullets where the exit wound is much larger than the entry wound. Cavitation results in entry of air

Fig. 6 : Interior wall (floor) fracture of orbit (Lt pic) reconstructed using Titanium mesh (Rt pic)

Table 5

Maxillofacial injuries treated

Conflict	Percentage
1965 Indo-Pak	3.8%
1971 Indo-Pak	1.34%
OP Vijay '99	10.42%
OP Rakshak 2000	17.7%
OP Rakshak 2001	19.46%
OP Rakshak 2002*	15.11% *

* till 30 Jun 2002

and contaminants into the cavity behind the missile and the pressure effect within the tissues results in extension of tissue damage well beyond the visible tract of the missile [6].

In the present series, the maxillofacial injuries were due to GSW, high velocity missile injury, IED blast injury, splinter and shrapnel injury from enemy small arm firing / artillery shelling across the LOC, RTA in mountainous terrain and other modes of injuries. Mode of evacuation of these individuals was military vehicles, armoured personnel carriers and helicopters. The type of transport was dependent on the availability of transport, terrain of conflict, distance of the site of injury from the hospital and the systemic status of the individual. Time taken for these injured individuals to reach hospital was between one hour to twelve hours. There were no fatalities during evacuation of individuals injured in the maxillofacial region alone. However, two individuals were brought in dead and had sustained polytrauma including extensive injuries in the maxillofacial region, sustained in IED blasts. Almost all the individuals had varying degrees of soft tissue injuries in the form of clean lacerations, contused lacerations, abrasions, penetrating wounds, perforating wounds, avulsive wound etc which were treated accordingly.

The maximum number of injuries (61%) was from 'area weapons', blast injuries due to IED, grenades or

enemy artillery shelling. Majority of these cases had polytrauma along with extensive facial injuries. Loss of tissue was a markedly common feature along with multiple impregnated splinters of varying sizes. The maxillofacial skeletal injuries ranged from isolated bone fractures to multiple facial bone fractures presenting either as clean simple fractures or comminuted and compound fractures requiring extensive skeletal reconstruction with or without bone grafts and soft tissue repair primarily or with the help of local vascular flaps to meet the tissue deficiency. Subsequent plastic surgical repair was required for two (1%) such cases.

GSW of the oro-facial region comprised 23.14% cases and were comparatively cleaner wounds with much less destruction. Conforming to the ballistics of GSW, the exit wound size was much larger than the entry wounds. Depending on the region of the hit and exit, multiple cases showed avulsion and loss of skeletal structures following the principle of secondary missiles. Rarely more than one set of facial bones were involved in these injuries. Maximum damage was seen due to 7.62 mm caliber bullet compared to bullets of the caliber of 9 mm and 5.56 mm. One case sustained injury of the lower 1/3 of the face due to anti-aircraft bullet of 12 mm caliber fired across the LOC. The extent of damage is dependent on the proximity of fire, muzzle velocity of the weapon, caliber of the bullet and whether it is a direct or indirect hit [4].

Reconstruction of fractured orbital bone (8.85%) posed a great challenge especially when the eye had escaped injury. Some cases had suffered orbital blow out syndrome and presented with enophthalmus and diplopia along with associated sign / symptoms of orbital fracture. These cases were treated by reconstructing the floor of orbit / roof of maxilla using titanium mesh after retrieving the herniated periorbital fat content out of the maxillary sinus and restoring the orbital volume. All cases recovered uneventfully. In cases of penetrating eye injuries with fracture of bony orbit, repair / evisceration, whichever was necessary was carried out by the ophthalmologist after which orbital reconstruction was carried out with micro reconstruction system to facilitate subsequent orbital prosthesis placement (in case of evisceration only).

Maxillofacial injuries due to RTA (12.65%) had varying degrees of facial skeletal injuries either in isolation or in combination of multiple facial bones. There were minimal soft tissue injuries and were mainly limited to abrasions or minor lacerations. Recovery of these individuals was faster compared to twelve individuals who had associated elements of head injury (29.2%). Maxillofacial injuries due to animal attacks (3.08%- Animal Transport Company mules/wild animal attacks

in jungle) presented with more of soft tissue injury compared to bony injury. A case of bear attack was treated by extensive reconstruction of maxilla, zygomatic bone and lateral orbital margin comminuted fractures along with repair of soft tissue of the face and scalp. In general, recovery of all these individuals was satisfactory, both functionally and aesthetically.

Various complications faced in this series were infection and breakdown of wound, formation of hypertrophied scar, derangement of occlusion, transient altered sensation in the form of anesthesia / paresthesia / hyperesthesia of the branches of the trigeminal nerve and loss of motor function of extra parotid branch of facial nerve due to the initial injuries sustained.

Individuals with hypertrophied scar and deranged occlusion were reoperated for scar revision and realignment of bone respectively, with satisfactory results. All cases with sensory deficiencies of trigeminal nerve recovered in various degrees within four to six months.

Reviewing the various maxillofacial injuries in this series, the under mentioned facts dramatically alter the final outcome:

- (a) Energetic resuscitation at site/or arrival
- (b) Central venous access wherever required
- (c) Reducing the time from injury to hospital by improving the evacuation system
- (d) Air way/Ventilatory support (intubation/tracheostomy/life support)
- (e) Surgical intervention in form of ORIF of the facial skeleton/correction of dental injury along with primary repair of facial and oral lacerations restore optimum cosmetics and functional recovery
- (f) Diagnosis and treating associated injuries
- (g) Post-operative ventilatory support in some cases of polytrauma.

There is an increasing trend of injuries in the maxillofacial region (Table-5) which can be attributed to the increase of lethality and injuring capability of modern day weapons. Reviewing literature, a significant observation was the uniqueness of the Indian Army personnel being exposed to injuries due to such varied etiology in a single theatre of active duty. Active military engagement is associated with trauma / injuries. Improving upon the protective clothings, specially for the forces engaged in CPWP, may involve initial expenses but it is a small price to pay. It is also felt that improving the structural design of the combat head gear for safety and comfort will go a long way in preventing majority of maxillofacial injuries or can at least reduce the severity of these injuries. In the long run, trauma is

more expensive, initially, subsequently and for a longer duration involving the entire society and not just the injured person alone.

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Radiological Quiz

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MJAFI 2004; 60 : 362

A 22-year old serving soldier presented with history of seizures of recent onset. General and systemic examination was non-contributory. Non-contrast CT scan of the head was done which is shown in the figure. What is your diagnosis?

Fig. 1 : Non-contrast CT scan : axial image of the head

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Received : 20.5.2003; Accepted : 15.3.2004.