Primary Management of Maxillofacial Hard and Soft Tissue Gunshot and Shrapnel Injuries

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Purpose: A 10-year retrospective study was undertaken of all patients treated for facial gunshot and shrapnel wounds at our medical center to evaluate the outcomes and assess the results of simultaneous management to treat the hard and soft tissue injuries primarily.

Patients and Methods: A total of 44 patients were treated. Medical documentation of the patients was compiled. All maxillofacial gunshot, shrapnel, and warfare injuries were treated by the oral and maxillofacial surgeon. Other concomitant bodily injuries were treated by pertinent consultant specialists. Patients ranged in age from 8 to 53 years, with a mean age of 24.7 years. Maxillofacial hard and soft tissue injuries were treated definitively in the first operation except when gross contamination, infection, extensive comminution, or general condition precluded this.

Results: There were 2 shotgun, 28 bullet, 10 shrapnel, 3 land mine, and 1 breech block injuries. Overall postadmission mortality in this series was 2.2%. Of the 97.7% of the patients who had an injury to the underlying craniofacial skeleton, all required surgical intervention. The soft tissue and underlying bony injuries were addressed concomitantly (in a single stage at the time of primary surgical debridement) in 86.3% of the patients. Nine percent of the patients had a tracheostomy emergently for management of the airway, 6.8% had an intracranial injury, and 2.2% of them required neurosurgery. In the series, 4.5% of the patients had neck wounds that required exploration. Comprehensive treatment was rendered in 1 to 3 major operations (average, 1.5).

Conclusion: All patients in this series required surgical intervention for treatment of their facial gunshot wounds. Primary treatment of hard and soft tissue injuries of the face at the time of surgical debridement was possible in the majority of our patients. This minimized the number of admissions and did not bear a higher complication rate than other reported series that advocate multiple staged operations to treat such injuries despite the fact that, in our series, flaps were also mobilized for wound closure in the primary phase.

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The severity of injury resulting from facial gunshot wounds varies according to the caliber of the weapon used and the distance from which the patient is shot. Although close-range, high-velocity gunshot wounds can result in devastating functional and aesthetic consequences, shrapnel and mortar shell projectiles may be just as destructive depending on the size, irregular shape, high-velocity, and jagged edges of the fragments.[1-6] Emergency care of warfare-injured patients focuses first on the basics of resuscitation and status of the airway as bleeding and subsequent swelling can compromise breathing. Control with an endotracheal tube or tracheostomy should be considered early, although, surprisingly, it is not always necessary. Hemodynamic resuscitation, followed by thorough patient evaluation, is done to rule out concomitant injuries often associated with warfare injuries, which may go unnoticed as attention is directed primarily to an extensive facial injury.[1-6]

Definitive management of warfare-injured patients remains controversial in terms of surgery and reconstruction. Many authorities advocate a nonoperative management or conservative approach to just debride the patient in the first operative stage and treat the hard tissues in another operation after soft tissues have healed and the chance of postoperative infec-

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tion is deemed lower.[6-13] However, more recent studies advocate early intervention for 1-stage management and open treatment of all involved structures.[1-6,14-18] Other series advocate an even more extensive approach, particularly with respect to primary reconstruction of facial soft tissue defects.[1-7,14-18]

This article reports our 10-year experience with facial gunshot and shrapnel wounds treated according to the protocol adopted at our trauma center, with an aim to assess the outcome of primary management of hard and soft tissue injuries performed at the time of debridement (first operation). The demographics of the patient population, the injury profile, subsequent stages of management, and treatment results are evaluated.

Patients and Methods

The medical records of 44 patients with facial gunshot or warfare injury treated at our center from 1991 to 2001 were retrospectively reviewed. One oral and maxillofacial surgery unit treated all maxillofacial injuries. Other concomitant bodily injuries were treated via pertinent consultant specialists. Information gathered was divided into the following categories: patient demographics, type and site of injury, initial management, reconstructive procedures, operations, and complications.

HARD TISSUE INJURIES

Treatment procedures of hard tissue injuries varied from debridement only (6.8%), primary debridement, closed reduction, and/or fixation (56.8%), primary debridement, open reduction, and wire osteosynthesis (13.6%), to primary debridement, open reduction and plate or screw osteosynthesis (9%). Hard tissue injuries were routinely treated primarily along with closure of the soft tissue injuries (86.3%). The remaining cases with severe communition, those requiring extensive grafts, or those with gross wound infection were selected for secondary treatment. Secondary graft procedures involved block grafts, block grafts secured to an AO plate, and corticocancellous iliac bone placed into titanium mesh trays. All grafts were harvested from the anterior iliac crest and placed extraorally. Implants were placed several months later to minimize bone resorption of the grafts when indicated.

CONCOMITANT SOFT TISSUE INJURIES

The soft tissue injuries were generally treated initially by debridement and primary closure by combining, modifying, and tailoring standard regional flap techniques to fit the location of the injury and compensate for the extent of tissue loss according to region.

Operations to Reconstruct the Lips

Three basic factors were considered before perioral reconstruction: 1) utilization of the remaining portions of the injured lips if possible, 2) when inadequate, possible use of the opposite lip as the next resort, and 3) use of local flaps from the sides of the defect if tissue is insufficient. When as much as one fourth of the lip was missing, direct linear closure or a Z-plasty, or double Z-plasty to prevent notching of the vermilion, was accomplished. Larger defects of the lips and perioral regions were treated via flaps. When reconstruction with flaps was contemplated, several options were considered depending on the lip involved and amount of tissue loss.

Lateral Lip Defects

For lateral defects assessed up to one third of the upper or lower lip, treatment was usually done using nasolabial flaps, a lateral flap combined with vermilion advancement, or the Estlander flap, which required a full-thickness wedge-shaped flap around the commissure, pedicled on the labial artery, and rotated through an arc of 180° to fill the defect. This was followed by a subsequent commissurotomy to obtain symmetry. We used the modified technique whenever possible as it precludes the need for a subsequent commissuroplasty.

Midline Defects

For midline defects of the upper lip, treatment was direct advancement of the remaining portions of the lip with perialar excisions from the upper part of the nasolabial fold or an Abbe flap, taken from the midline of the lower lip and rotated 180°.

Lower Lip Defects

Small to moderate-sized defects of the lower lip were treated similarly. Lateral rotation flaps, sometimes in combination with Z- or V-Y plasties, were used. In cases of complete loss of the lower lip and mentolabial soft tissues, we combined bilateral Dieffenbach flaps with double Abbe flaps of the upper lip and a cervical advancement flap, which proved quite functional and was effective in restoring lip competence and lip seal.

Superficial Deformities

Superficial deformities or residual defects that often occur due to contraction of linear scars that distort the contour of the lip by pulling the vermilion border out of line or cause notching were effectively treated by scar excision, recreation of the defect, and tissue rearrangement combined with supporting flaps, and Z- or V-Y plasty procedures, which proved useful when tissue lengthening was desired.

Cheek Defects

For reconstruction of defects of the cheeks, zygomatic, and midfacial regions, the lateral cheek ad-

vancement or rotation flap was used for both small and relatively large defects. Transfer of tissue was based on the laxity found in the preauricular tissues, the lower face, and the neck. The larger the defect, the more extensive was the flap preparation. The deep surface of the flap was usually anchored to the soft tissue, sometimes including the periosteum over the malar area, to also help prevent dragging down the eyelid. Additionally, this procedure was sometimes combined with a superiorly based nasolabial flap when ectropion was apt to occur. Smaller defects of the cheeks were treated with local undermining combined with plastic procedures such as Z-plasties and pedicled fat, or subcutaneous supporting flaps to fill in the defects and restore the natural prominence and bulk of the cheek.

Periorbital Defects

Reconstruction of defects of the lower lid or upper cheek basically used the versatile nasolabial flap. The donor site was the nasolabial fold. For defects of this area, the pedicle of this flap was based superiorly, on the angular artery, and rotated 90° to close the defect. Subcutaneous fat was also carried with this flap. The tip of the flap was anchored to the lateral canthus or periosteum, giving added support to the lower eyelid. It was also used to treat lower lid ectropion.

Results

A total of 44 patients were treated (Table 1). Patient age ranged from 8 to 53 years (mean age, 24.7 years; 97.7% [43 of 44] were male and 2.3% [1 of 44] were (female). Thirty of the 44 patients (68.1%) sustained a gunshot wound, and 22.7% (10 of 44) sustained a shrapnel wound. Three (6.8%) sustained a land mine injury, and 1 (2.2%) sustained a rare breech block injury to the eye (Fig 1). Overall mortality was 2.2% (1 of 44) due to pulmonary infection. The structures injured in the wounded patients are listed in Table 1. The most commonly injured bone was the mandible, with 72.7% of patients affected. The maxilla was injured in 34% of the patients, and 2.2% of the patients had an intracranial injury that required surgical intervention (Fig 2). Nine percent (4 of 44) required tracheostomy. All of these patients sustained gunshot wounds of the lower third of the face. Two patients (4.5%) sustained injuries to the neck and required exploration.

Complications involving the eye and the central nervous system were troubling. Ocular injuries were seen in 3 patients (6.8%), causing blindness. One patient (2.2%) had residual nerve palsy involving the facial nerve.

Healing of the flaps was favorable in 75.7% of the patients; however, postoperative discharge from the suture sites was seen in 24.3% of the patients. This usually resolved within several weeks after daily irrigation and cleansing of the discharge site. None of the soft tissue flaps sloughed or developed necrosis. Form and function of the soft tissue reconstructed regions usually recovered within 1 year postoperatively. The aesthetic results obtained were also acceptable in our cases. None required facial nerve grafting, since only the peripheral nerve endings were injured in our cases and functional recovery was acceptable.

Discussion

Projectile injuries to the face can have minor or, more often, devastating consequences. The timing, sequence, and application of appropriate surgical procedures and techniques used for reconstruction and rehabilitation of maxillofacial warfare injuries have proved to be influential on the final outcome and aesthetic result.[2-6] The staged sequence of treatment as described by Behnia and Motamedi[6] stresses the importance of timing hard and soft tissue treatment, which is dependent to a large extent on surgical judgment, extent of injury, and the general condition of the patient. The selection of the appropriate surgical technique is as important as the timing because incorrect selection or improper application of surgical techniques may also lead to infection, sequestration, wound dehiscence, graft rejection, facial deformity, and subsequent revisional operations. Such complications will prolong hospital stay and postoperative morbidity and increase treatment costs.[2-6]

Surgical management of facial gunshot wounds is generally divided into 3 stages[2-6,19,20]: debridement, fracture stabilization, and primary closure; reconstruction of hard tissues, provided soft tissue coverage is adequate; and rehabilitation of the oral vestibule, alveolar ridge, and secondary correction of residual deformities. Often, more than one operation may be performed in any stage.[2-6] Early definitive and comprehensive treatment of the facial injury are the mainstay of treatment, and when included in the first stage, with minimal debridement, have been shown to result in lower morbidity.[6,19,20]

Underlying compound facial fractures (without extensive comminution) can be reduced, immobilized, and fixed in occlusion with appropriate hardware at the time of primary closure provided that soft tissue coverage can be obtained. Medial soft tissue attachments to the bone segments should be preserved if possible.[2-6] In selected patients without severe comminution or infection, osteosynthesis using plates in accordance with AO-ASIF principles may be indicated and performed concomitantly with debridement and primary closure. The pieces must be located and reduced (Fig 3). Often, the segments remain attached

Table 1. THE CLINICAL FINDINGS AND TREATMENT DATA OF 44 PATIENTS TREATED FOR FACIAL WARFARE INJURIES

Patient	Age (yr)	Gender	Diagnosis	Treatment Stages	Other Injuries	No. of Operations	Significant Complications	Treatment Type	Cause
1	25	M	L ant max + L ant mand fx, loss one-third upper lip + L commissure, nasal fx tongue laceration, palate perforation	1) Debridement, open red MMF 2) Scar rev nasolabial flap commissuroplasty, hair transplant rhinoplasty 3) Implants	No	3	Dental infection	Primary	Bullet
2	21	M	L + R body + symphysis fx chin defect lower lip loss	1) AO plate open red 2) Scar revision double abbe + Diffenbach + cervical flap commissuroplasty	No	2	Residual defects	Primary	Shotgun
3	19	M	L + R body + symphysis chin defect, one-third lower lip loss	1) AO plate open red + iliac BG 2) Scar revision V-Y plasty cervicofacial flap 3) Implants	No	3	—	Secondary	Bullet
4	32	M	R body + symphysis chin defect, one-third lower lip loss	1) Ti-mesh iliac BG 2) Scar revision V-Y plasty cervicofacial adv flap	No	3	—	Secondary	Bullet
5	20	M	R zygoma + maxilla cheek defect	1) Fx reduction, debridement 2) Scar revision pedicle fat graft cervicofacial + nasolabial flaps	No	3	—	Primary	Shrapnel
6	50	M	R + L body mand + chin defect	1) Fx red, debridement 2) Scar revision Ti-mesh iliac BG	Neck	3	—	Primary	Bullet
7	21	M	Ant mand dentoalv fx, avulsion one-third lower lip	1) Debridement fx red, adv flaps + supporting flaps + Z-plasty	No	1	Facial scarring	Primary	Shrapnel
8	19	M	Max dentoalv fx, due to one-third upper lip avulsion	1) Debridement fx red 2) Scar rev mucosal adv flaps + bilateral commissuroplasty	No	2	Microstomia	Primary	Shrapnel
9	18	M	Infraorbital wound L orbital rim fx enophthalmosis, ectropion eyelid	1) Debridement, fx reduction 2) Iliac BG to orbit, 3) Nasolabial + adv flap	No	2	Slight enophthalmia	Primary	Shrapnel
10	20	M	Ant mand dentoalv fx, one-half lower lip loss	1) Debridement, fx reduction 2) Abbe flap, commissuroplasty	No	3	—	Primary	Bullet
11	19	M	Ant max dentoalv fx, one-third upper lip + columella	1) Debridement, fx reduction 2) Perialar + nasolabial rotation-adv + columella reconstruction	No	2	—	Primary	Shrapnel
12	20	M	Ant fx of maxilla + mand symphysis, chin defect	1) Fx reduction debridement, cervicofacial adv + Z-plasty	Hand	1	Traumatic tatoos of face	Primary	Land mine
13	21	M	L condyle ramus fx mand + cheek wound	1) Debridement fx reduction 2) Block bone graft wire osteosyn, cervicofacial + adv flap	No	2	Scar in angle region	Primary	Bullet
14	20	M	Fx R orbit, frontal bone + ant cranial fossa + lacrimal system	1) Lobotomy tx of meningitis 2) Bone graft wire osteosyn frontal, ant fossa, orbit + skin graft	Brain	2	Meningitis, loss of R eye	Secondary	Bullet
15	26	M	Ant fx of max + mand symph + one-third lower lip loss	1) Debridement, open red wire osteosyn + local adv flaps	No	1	Shrapnel tatoos	Primary	Land mine
16	26	M	Bilat mand angle, body + symph fxs, one-third upper + lower lip loss	1) Debridement open red wire osteosyn + splints + colostomy	Abdomen	1	Died of pulmonary complications	Primary	Land mine

Table 1. THE CLINICAL FINDINGS AND TREATMENT DATA OF 44 PATIENTS TREATED FOR FACIAL WARFARE INJURIES (Cont'd)

Patient	Age (yr)	Gender	Diagnosis	Treatment Stages	Other Injuries	No. of Operations	Significant Complications	Treatment Type	Cause
17	20	M	R orbital fx, globe injury, imp breech block, eyelid inj	1) Fx debridement, breech block removal, eye enucleation	Loss of R eye	1	Scarring	Primary	Breech block
18	20	M	Mult comp comm fxs L max + zygoma + orbit + ant mand, tissue loss of check	1) Open red wire osteosyn, facial adv rotation flaps + Z-plasty 2) Bone graft to orbit rim	Loss of L eye	2	Ectopion scarring	Primary	Bullet
19	22	M	L mand body avulsion defect, one-fourth lower lip loss	1) Ti-Mesh, iliac graft + adv lip repair + Z-plasty	No	2	—	Secondary	Bullet
20	36	M	Infected L mand angle-ramus fx, cheek wound	1) Debridement, fx red 2) Iliac BBG wire osteosyn, cervical flap, Z-plasty	No	2	—	Secondary	Bullet
21	8	M	L comm fx mand angle-ramus, subcond fx + neck	1) Debridement, closed red carotid exploration, local adv flaps	Neck	1	—	Primary	Bullet
22	28	M	R comm fx mand angle + symph + ramus, cheek inj	1) Debridement closed red, local adv flaps + Z-plasty	No	1	—	Primary	Bullet
23	21	M	Fx L mand angle + condyle + L orbit	1) Debridement, closed red, removal of condyle + adv flaps	No	1	Removal of avulsed condyle	Primary	Shotgun
24	20	M	R zygoma trauma + R eye	1) Repair lower lid 2) V-Y plasty	R eye	2	Vision loss R eye	Primary	Shrapnel
25	34	M	R + L body of mand + symph + chin fx	1) Debridement, plate osteosyn 2) Osteotomy for asymmetry	No	2	—	Primary	Bullet
26	24	M	R max + mand dentoalv fx	1) Debridement, closed reduction 2) Removal of fibrous ankylosis	Thoracic injuries	2	Fibrous ankylosis	Primary	Bullet
27	20	M	Comm fx L mand angle-ramus + L symp + ant max	1) Debridement, open red wire osteosyn 2) Osteotomy	No	3	Slight asymmetry	Primary	Bullet
28	22	M	R body mand + PS fx + ant max fx, 2-cm ONF	1) Debridement, closed reduction, finger flap for ONF	No	1	—	Primary	Bullet
29	21	M	Comp comm fx L mand angle + body, cheek wound	1) Debridement, closed reduction, tissue rearrangement + Z-plasty	No	1	—	Primary	Bullet
30	20	M	Comm fx L mand angle, cheek wound	1) Debridement, closed red, adv flaps	No	1	—	Primary	Bullet
31	18	M	Comm ant max + mand fx + nasal floor, floor of mouth	1) Debridement, open red screw fixation, rearrangement + Z-plasty	No	1	Osteomyelitis	Primary	Bullet
32	33	M	Comp comm fx L mand body angle ramus, cheek	1) Debridement closed red, tissue rearrangement + Z-plasty	No	1	—	Primary	Bullet
33	20	M	R + L comp comm mand fxs, cheek	1) Debridement, closed red, tissue rearrange, adv flaps	No	1	—	Primary	Bullet
34	36	M	R fx max + palate	1) Debridement, Caldwell-Luc and antrostomy + OAF closure	No	1	—	Primary	Shrapnel
35	36	M	Comp comm fx L mand angle, infraorbital wound	1) Debridement, closed red, adv flap	No	1	—	Primary	Bullet
36	16	M	Comm fx L max + sinus, oroantral + antrofacial fistula	1) Debridement, palatal flap, Caldwell + antrostomy, pedicle fat grafts, adv flaps + Z-plasty	No	1	—	Primary	Shrapnel
37	22	M	Bilateral ant mand fxs, chin wound	1) Debridement, reconstruction using AO plate, adv flaps	No	1	—	Primary	Shrapnel

Table 1. THE CLINICAL FINDINGS AND TREATMENT DATA OF 44 PATIENTS TREATED FOR FACIAL WARFARE INJURIES (Cont'd)

Patient	Age (yr)	Gender	Diagnosis	Treatment Stages	Other Injuries	No. of Operations	Significant Complications	Treatment Type	Cause
38	53	F	Comm comm fx R mand body-angle, cheek wound	1) Debridement, closed reduction, adv flaps 2) Secondary tx defects	No	1	—	Secondary	Bullet
39	22	M	L angle fx mand	1) Debridement, closed reduction	No	1	—	Primary	Bullet
40	17	M	L angle fx mand + L lower lid laceration	1) Debridement, closed reduction, lid repair	No	1	—	Primary	Bullet
41	39	M	R fx maxilla + zygoma	1) Debridement, closed reduction	No	1	—	Primary	Shrapnel
42	27	M	L fx mandible	1) Debridement, open red wire osteosynthesis	No	1	—	Primary	Bullet
43	31	M	R hemi Le Fort	1) Debridement, closed red	No	1	—	Primary	Bullet
44	27	M	L ramus condyle fx mand	1) Debridement, closed red	No	1	—	Primary	Bullet

Abbreviations: L, left; ant, anterior; max, maxilla; mand, mandible; fx, fracture; red, reduction; MMF, maxillomandibular fixation; rev, revision; R, right; BG, bone graft; dentoalv, dentoalveolar; adv, advancement; osteosyn, osteosynthesis; tx, treatment; bilat, bilateral; imp, impacted; comm, comminuted; inj, injury; mult, multiple; comp, compound; ti, titanim; BBG, block bone graft; PS, parasynthesis; ONF, oronasal fistula; OAF, oroantral fistula.

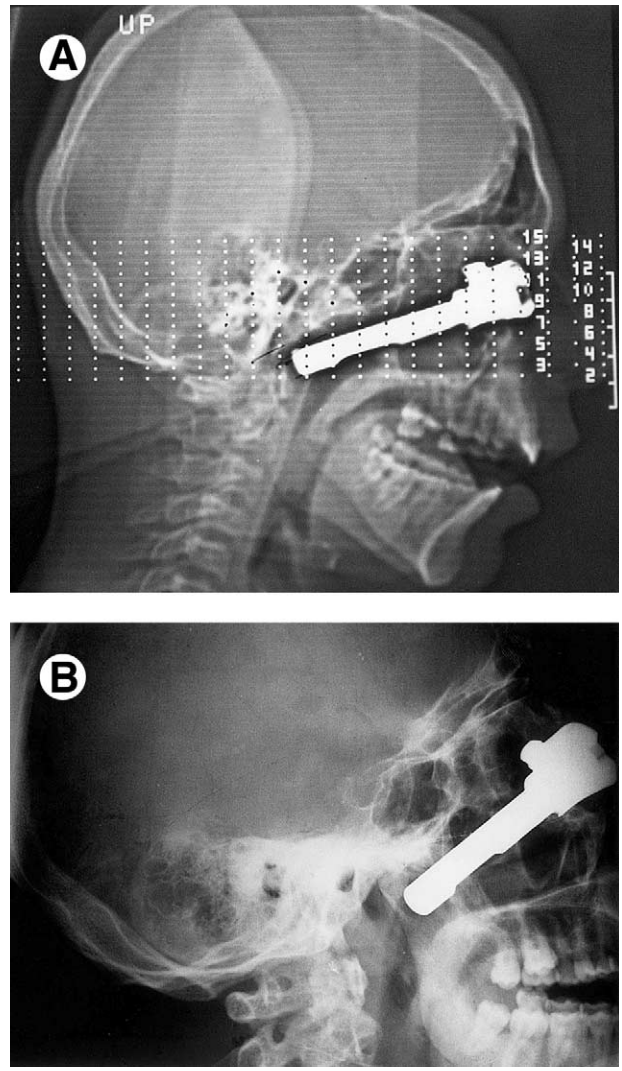

FIGURE 1. *A,* Computed tomography scan of a dislodged breech block impacted into the right orbit of a patient who fired a shot in the air when attempting to halt a vehicle. *B,* The object prevented mandibular opening.

to periosteum and muscle, and in such cases, it is prudent to take care and ensure the periosteal blood supply and tissue attachments during the application of hardware. Whatever the mode of osteosynthesis, application of arch bars for gunshot injuries of the jaws has proved to be invaluable in reestablishment of arch form, occlusion, and stabilization of the dentoalveolar fragments. Local undermining and use of regional soft tissue advancement rotation flaps for primary closure of maxillofacial soft tissue defects from projectile injuries at the same operation have also proved beneficial from both an aesthetic and functional point of view.[2-6] Leaving defects open results in extensive scarring of the facial tissues, complicating subsequent surgical procedures, and should be avoided even in contaminated projectile wounds.[2-6,19,2] In such situations, debridement and loose closure of the

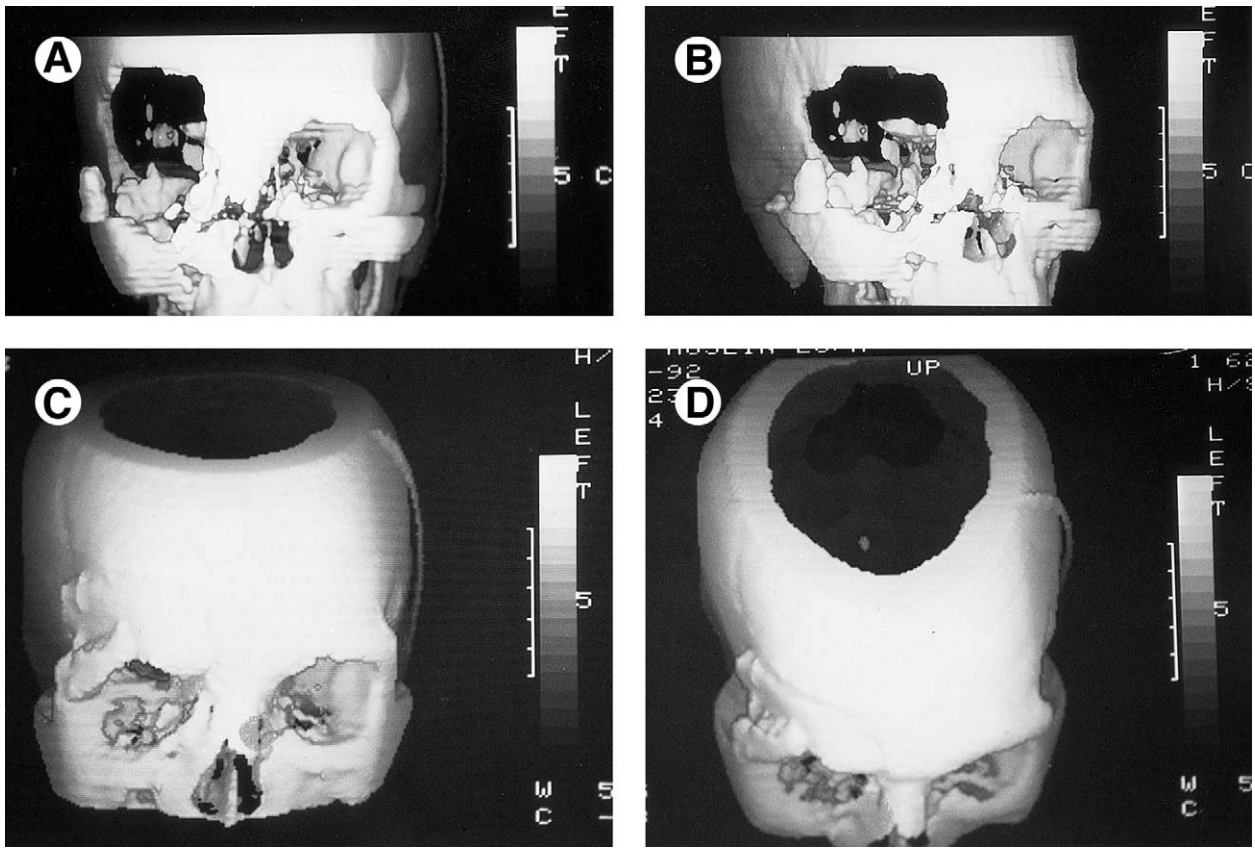

FIGURE 2. Three-dimensional computed tomography scan of an extensive high-velocity bullet wound exiting the right orbit and anterior skull. *A, B,* Note the amount of damage that may be inflicted by high-velocity projectiles. *C, D,* After neurosurgery, reconstruction of the hard tissues was done with iliac bone grafts.

locally transferred tissue provide a better alternative.[2-6]

ANTIBIOTIC THERAPY

Antibiotic therapy plays a major role in the prevention of infection of both hard and soft tissues after primary closure of Class IV wounds. Early and appropriate surgical debridement, copious irrigation, fixation and immobilization of injured tissues, detailed wound closure, drainage, and maintenance of clean dressings, nutrition, and circulating fluid volume are equally important in this regard.[2-6,19,20] The hemodynamics of the patient must also be addressed as the oxygen-carrying capacity is influential in both wound healing and prevention of infection in multiply-injured warfare victims who have sustained extensive blood loss.[2-6,19,20]

REVISIONS

Revisions and secondary operations are often necessary and were performed in 48% of our patients in the final phase. Revisions are usually needed near the eyes, the alar base of the nose, and oral commissures and the vermilion border of the lips. Many of these operations, including masticatory rehabilitation and restoration of occlusion with osseointegrated implants, were performed under local anesthesia and sedation on an outpatient basis.

An interesting finding of this study was the relatively low incidence of associated injuries to the body (22.5%). One patient sustained loss of the hands; 1, abdominal injuries; 2, thoracic injuries; 3, cranial injuries; and 3, ocular injuries. The latter finding underscores the importance of a careful ophthalmologic examination in the case of facial gunshot wounds. It is particularly important to document visual abnormalities in the case of traumatic optic neuropathy. Visual perception may be progressively compromised by swelling of the optic nerve caused by the gunshot wound.[1] Such a finding may mandate the postponement of all nonemergent operative procedures to minimize the progression of this swelling.

Although the mandible was the most commonly injured bone, with 72.7% of patients affected, only 9% (4 of 44) required tracheostomy. It was interesting for us to note that 1 patient (Fig 3) with an extensive anterior mandibular gunshot wound had had the tip of his tongue sewn to the skin of his sternum before being referred to us for definitive treatment. This

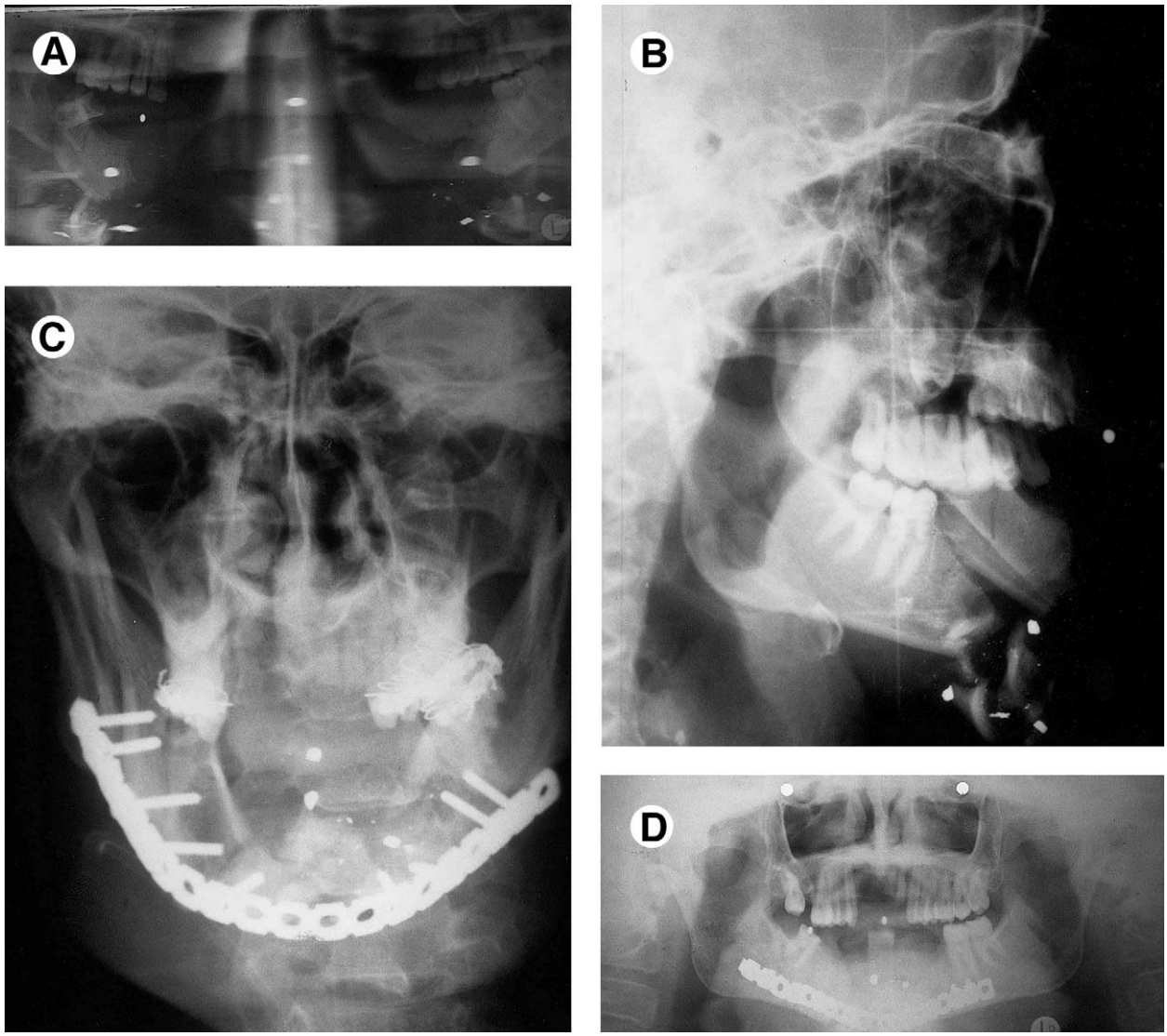

FIGURE 3. *A,* Orthopantomogram of a patient with an extensive gunshot wound to the anterior mandible; bone appears to be lost anteriorly. *B,* Lateral skull radiograph reveals fragments displaced inferiorly into the neck. *C, D,* Segments were located intraoperatively and secured to an AO 2.7 reconstruction plate with screws to restore continuity obviating bone grafts. This is a typical case where primary management of both hard and soft tissues is indicated.

method had obviated the need for a tracheostomy and proved to be a lifesaving maneuver.

Also of note in this series was that surgical intervention was required for repair of all injuries from the gunshot wound. With respect to bony injuries, surgical repair was required 97.7% of the time, depending on the injury. Mandibular injury most frequently required surgery (72.7%), with the patients undergoing either open reduction and internal fixation, or the application of maxillomandibular fixation.

Although it has been argued that gunshot wounds and the bony injuries resulting from them can frequently be managed nonoperatively,[1,13] this argument is in direct contradiction to most of the more recently published experiences with facial fractures.[1-6,11,20,21] It has been advocated that early operative repair of facial fractures resulting from blunt trauma and reconstitution of the soft tissue position is critical in obtaining an optimal result. This may be done today with rigid fixation techniques. Failure to do so may result in displacement of the bone and/or scarring of the soft tissue into the bone defect.[1-6,19,20] Once this has happened, subsequent repair is exceedingly more difficult. Bone injuries resulting from facial gunshot wounds are no different. Indeed, the need for early surgery and bone grafting is greater, mainly because bone loss and soft tissue injury are usually more severe in these injuries than they are in blunt facial trauma. The soft tissue injury may even mandate coverage with distant tissue, including microvascular tissue transfer, which may be performed at the time of bone repair to obtain an optimal result.[1] This is often

unnecessary, however, as local flaps are often adequate for this purpose and have yielded excellent results in our experience. Operative intervention may also be needed in the case of intracranial injuries. Three patients in the series sustained an injury to the brain from the gunshot wound, and one of them required neurosurgery while the bony and soft tissue orbital reconstruction were done secondarily using iliac bone and skin grafts (Fig 2). Graft take was successful in all of our patients.

From the available information from our series, it seems that facial gunshot wounds are associated with a very high incidence of injuries requiring surgical intervention. It is our belief that these injuries should be addressed early, with procedures designed to repair both bone and soft tissue injuries simultaneously whenever feasible. More often than not, the hard tissues are found to be scattered and displaced rather than avulsed. Locating and securing them in place is better than aggressive debridement to remove them, which devitalizes and strips the fragments from their attachments in fear of sequestration.

Even when such a comprehensive primary management approach is undertaken, maxillofacial warfare injuries are associated with a significant number of residual problems. The majority of these, however, can be addressed on an outpatient basis. Nonetheless, treatment options necessitate clinical judgment and are based on similar experiences; no strict protocol can be uniformly applied. However, with the antibiotics and surgical hardware at hand, the majority of maxillofacial warfare injuries can be treated definitively at the time of debridement, when the general status of the patient permits and when this is in the best interests of the patient.

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