Textbook of Oral and Maxillofacial Surgery

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Chapter 17

Wounds and injuries of the soft tissues of the facial area

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General Considerations

Trauma to the facial area produces a variety of injuries. These injuries may be simple and limited to the soft tissues, or they may be complex and involve the underlying skeletal structures. Of all injuries, none perhaps is of more concern to the patient than those involving the facial region. All efforts therefore should be directed toward restoration of the injured parts to normal or as near normal as possible. Regardless of the type of wound encountered, early care is of the utmost importance to ensure restoration of normal function and prevent facial disfigurement.

Wounds involving the soft tissues of the facial area are commonplace. In the past, the more severe wounds were encountered as the result of gunshot fire and implements of war. With the advent of the modern automobile, however, a devastating instrument has been placed in the hands of the public, and transportation accidents are occurring with increasing frequency. Injuries resulting from these accidents are severe and complex, and, with the exception of the loss of tissue, they often approximate the type of injury seen in war.

The use of power tools, such as chain saws, which has become popular in recent years, presents another means of inflicting severe soft tissue injuries on the facial areas.

Care of soft tissue injuries of the face is usually performed in the emergency rooms of hospitals by the assigned personnel. The oral surgeon, however, should be capable of rendering treatment for this type of injury. If he or she should be the only one available, the oral surgeon should certainly accept the responsibility for the early correct management of the facial wound. In times of war or civilian catastrophe, training in this field would prove of great value. In this age of thermonuclear warfare, with attack on large population centers an everpresent possibility, casualties would undoubtedly be produced in such catastrophic numbers that care of facial injuries might well be the responsibility of the oral surgeon. Although it is realized that in normal circumstances care of the facial soft tissue injuries might not be delegated to the oral surgeon, he or she should nonetheless be capable of proper management of these wounds should the occasion arise.

Unless the soft tissue injuries are associated with intracranial injuries, fractures of the skull, or other serious injuries, even severe facial wounds are usually not destructive to life. Therefore, initial attention should be directed to any concomitant condition that, if uncorrected, would have serious consequences. It has often been said, "It is better to have an asymmetrical body than a symmetrical corpse". First priority should therefore be given, when

indicated, to such lifesaving procedures as establishment and maintenance of a patent airway, arrest of hemorrhage, recognition and treatment of shock, recognition of associated head injuries, and treatment of intra-abdominal or thoracic wounds. These injuries are frequently of such severity that unless they are corrected early, the patient may die. Although facial wounds are important and should be treated as soon as possible, their management cannot take precedence over these lifesaving procedures.

When the general condition of the patient has stabilized and his life is no longer endangered, attention should be directed to the soft tissue wounds of the face. Open wounds in this area should be cleansed and closed as soon as possible, since conclusive evidence shows that early closure of these wounds is desirable. Wounds that are debrided and closed within the first 24 hours do much better, and results from an esthetic, functional, and psychological standpoint far exceed any result possible when treatment is delayed. Early closure seals off the pathways of infection and promotes rapid healing, which keeps scar tissue and contracture at a minimum. It also reduces the need for nursing care, improves the patient's morale, and permits an early return to a satisfactory method of feeding.

Classification of Wounds

Various types of soft tissue wounds are encountered, and a classification is indicated because of the individual management problems associated with various wounds.

Contusion

A contusion is a bruise, usually produced by an impact from a blunt object without breaking the skin. It affects the skin and subcutaneous tissue and usually causes a subcutaneous hemorrhage that is self-limiting in nature. Ecchymosis usually becomes evident in approximately 48 hours.

Abrasion

An abrasion is a wound produced by the rubbing or scraping off of the covering surface. It results from friction, is usually superficial, and produces a raw, bleeding surface.

Laceration

A laceration is a wound resulting from a tear. It is the soft tissue wound most frequently encountered and is usually produced by some sharp object such as metal or glass. It may be shallow or deep and may involve underlying vessels and nerves. When caused by a sharp object leaving a clean-cut wound with sharp margins, this type of wound is referred to as an "incised" wound.

Penetrating wound

Penetrating wounds are usually puncture-type wounds produced by a sharp object, such as a knife, ice pick, or nail. They are usually deep and frequently involve other structures, such as the mouth, nose, or maxillary sinus. They may be small or large, depending on the object producing the wound.

Gunshot, missile, and war wounds

These wounds are in reality penetrating wounds but are usually classified separately because of the extensiveness of the wounds and the specialized problems encountered in their management. They are often further classified as penetrating wounds when the missile is retained in the wound, perforating wounds when the missile produces a wound of exit, and avulsive wounds when large portions of the soft or osseous structures are carried away or destroyed. These wounds are produced by gunshot, shrapnel, or other projectiles. They vary greatly in character, depending on the speed, shape, and striking angle of the projectile. High-velocity bullets usually cause small wounds of entrance and large, ragged wounds of exit. When the bullet strikes bone or teeth, fragmentation of these structures frequently occurs, producing secondary missiles that cause extensive internal trauma. Low-velocity projectiles often become distorted on meeting resistance and cause marked comminution and internal destruction of the wound. Great tissue disorganization with associated fractures of the underlying skeleton and involvement of other facial structures, such as the eyes, nose, oral cavity, and maxillary sinus, are characteristic of these wounds. Shrapnel and blasts produce multiple penetrating wounds with the projective frequently becoming distorted and scattered throughout the wound. Although marked comminution of bone is seen in this type of wound, much less traumatic loss of the soft and osseous tissue is experienced. Multiple metallic foreign bodies are retained in the wound. Gross contamination is present in all these wounds. Fragments of clothing, dirt, metal, and other debris are often carried deep into the wounds and frequently result in infections of serious proportions.

Burns

Burns often involve the soft tissues of the face. They are caused by contact with flames, hot liquids, hot metals, steam, acids, alkalies, roentgen rays, electricity, sunlight, ultraviolet light, and irritant gases. Burns are classified as *first degree,* which produces an erythema of the skin; *second degree,* which produces vesicle formation; and *third degree,* which causes complete destruction of the epidermis and dermis, extending into or beyond the subcutaneous tissue.

Treatment of Wounds

General considerations

When trauma and wounding are inflicted, at least four major phenomena develop that may threaten life unless measures are instituted to control and finally correct the conditions. First, blood is lost, not only to the exterior, but also into the damaged tissue. Second, tissue is damaged, with derangement of the physiology of the tissue and production of a suitable medium for bacterial growth. Third, the defense against bacteria is broken, which allows the wounds to become contaminated by bacterial invasion of the tissues. Fourth, mechanical defects may develop. These defects may be of major proportions, such as blockage of the airway, hemothorax, pneumothorax, cardiac tamponade, or increased intracranial pressure, or they may be minor problems, such as defects of the soft tissues. These four factors frequently are not limited to the traumatized area alone but may provoke a response in every system of the body. The more severe the injury, the more pronounced will be the systemic response.

Nature has provided the body with an efficient and effective healing response to these major phenomena. Immediately after injury, vasoconstriction, coagulation of the blood, and retraction of blood vessels tend to arrest the local hemorrhage. Damaged, nonvital tissue

becomes necrotic and produces a slought that tends to rid the wound of damaged tissue. Wound contamination produces an antibody and leukocytic response that combats the invasion of infectious organisms. Finally, tissue defects may be corrected by proliferation of capillaries, fibroblasts, and epithelium. These natural reparative processes are often sufficient to bring about healing of minor wounds, but in the larger and more complicated wounds, surgical procedures are indicated to complement and assist these natural healing processes. The surgeon's aim should be to aid the body's healing response, and this chapter will deal with the surgical procedures involved in treatment of the specific types of wounds encountered in the facial areas.

Treatment of contusions

Contusions are minor injuries and treatment should be conservative. It consists for the most part of observation, and seldom are definitive measures necessary. Hemorrhage is usually self-limiting as pressure of the extravasated blood builds up within the tissues. The tissue usually remains viable, so necrosis and sloughing are absent. Since the trauma is produced by a blunt force, the skin is usually not broken and contamination and infection of the wound are seldom seen. No tissue defect results from this type of injury, and as the hematoma resorbs, normal contour and function are restored. Because of the hemorrhage in the deeper structures, the contused area first turns blue and later yellow. In this type of wound, nature's reparative processes are usually sufficient to produce complete resolution without surgical intervention. Surgical intervention is indicated only to control hemorrhage that does not stop spontaneously, to evacuate a hematoma that does not resolve, or to suture a superimposed laceration. These complications are rarely encountered.

Treatment of abrasions

Abrasions, being caused by friction, are superficial wounds involving varying amounts of the surface. They are usually painful, since removal of the covering epithelium leaves nerve endings in the subcutaneous tissues exposed. Hemorrhage is no problem because major vessels are not involved, and the involved capillaries retract and are occluded by thrombi. The tissue damage is superficial, and necrosis and sloughing usually do not occur. These wounds occasionally become infected but are so superficial that local therapy is usually sufficient to control the infectious process. If the wound does not extend below the level of the rete pegs of the epithelium, healing without mechanical defect or scarring can be anticipated.

Minimal treatment is indicated for the abraded wound. It should be thoroughly cleansed by mechanical scrubbing with one of the surgical detergent soaps, followed by an antiseptic solution such as benzalkonium (Zephiran). A dressing is usually not required, since an eschar that serves to protect the wound forms rapidly. Epithelization rapidly occurs beneath the eschar, and healing without scar formation is the rule. Occasionally, an infection develops under the eschar. When this occurs, the eschar must be removed to permit access to the infected areas. Local application of one of the aniline dyes or antibiotic preparations, together with continued mechanical cleansing, is usually sufficient to control the infection. Systemic or parenteral antibiotic therapy is seldom necessary for this type of wound.

Prevention of traumatic tattoo. Abrasions are often produced by traumatic episodes that cause dirt, cinders, or other debris to be ground into the tissue. It is extremely important that these foreign bodies be removed, particularly if they are pigmented. If allowed to remain in the wound, a traumatic tattoo will result that produces an unsightly defect. These particles should be removed by mechanical cleansing. The surrounding area should be cleansed with

one of the detergent soaps and then isolated by sterile towels. A local anesthetic solution is then injected and the involved area meticulously scrubbed with a detergent soap on sterile gauze. Frequent irrigation of the field with sterile saline solution aids in washing the particles from the wound. If the particles are firmly imbedded, it may be necessary to substitute a stiff brush for the gauze, and, frequently a sharp-pointed instrument must be utilized to remove the particles from the tissue. A dental spoon excavator is ideal for this procedure. Recently the use of an electric dermabrader for the removal of large areas of imbedded particles has been recommended. The dermabrader must be held perfectly parallel to the skin while the skin is stretched taut by the assistant to prevent gouging. The procedure is tedious and time-consuming, but the importance of the removal of these particles cannot be overemphasized. The golden opportunity is at the time of original treatment, for if allowed to heal in the wound, their removal at a subsequent time poses a difficult problem.

After this mechanical cleansing, a wound resembling a second-degree burn is produced. This may be left open, but it frequently requires the application of a dressing. This mesh gauze applied to the wound and then covered with tincture of benzoin forms a good protective dressing, although petrolatum or scarlet red gauze may also be used.

Treatment of lacerations

Early primary closure. Lacerations constitue the most common of the facial injuries and vary from superficial cuts to deep, complex wounds involving underlying body cavities. Whenever possible, these wounds should be treated within a few hours of the injury, and seldom is a patient so severely injured that early closure of the facial lacerations cannot be accomplished. Even though these wounds may be grossly contamined, primary closure early within the first 24 hours is preferred to the radial excision of suspected tissue and the open treatment of the resultant wound as recommended for wounds of other parts fo the body. Successful closure of facial lacerations requires meticulous attention to detail and depends on complete cleansing of the wound, adequate debridement, complete hemostasis, proper closure of the wound, and adequate supportive therapy.

Cleansing of the wound. After local or general anesthesia has been obtained, mechanical cleansing of the wound is necessary. The skin about the wound should be scrubbed with a surgical detergent soap, and occasionally ether or one of the other solvents may be needed to remove greare or other foreign substances. The wound is then isolated with sterile towels and scrubbed vigorously. A constant stream of water applied by an Asepto or similar syringe assists in washing the debris from the wound. All areas should be investigated and cleansed, and any foreign bodies encountered should be removed. Great care in the removal of superficial pigmented foreign bodies to prevent a traumatic tattoo is again emphasized. If hematomas are found, they should be removed, since an ideal culture medium for infectious organisms will be produced if they are allowed to remain. Hydrogen peroxide flushed through the wound is of value in eliminating the hematomas.

Debridement. After the wound has been thoroughly cleansed, the area is redraped, and a conservative debridement is performed. The facial structures are richly supplied with blood and appear to possess a resistance to infection seen in few other tissues. Radical debridement is therefore not indicated. Only the necrotic, obviously nonviable tissue need to be removed. It is occasionally difficult to differentiate between viable and nonviable tissue. Bleeding from a cut surface or contracture of a muscle when stimulated is evidence of viability, but when in doubt about vability, conservatism is recommended. Rough, irregular, ragged, or macerated margins should be excised to diminish the ultimate amount of scar formation. Lacerations that

have been cut on the oblique require excision of the edges of the skin so that the margins will be perpendicular to the skin surface.

Hemostasis. Control of hemorrhage in lacerated wounds is essential. Nature provides a degree of hemostasis by vasoconstriction and thrombi formation, but hemorrhage from larger vessels or from the debrided surfaces of the wound must be controlled. Vessels that persist in bleeding are clamped and tied with ligatures. No 2-0 or 3-0 absorbable or silk ligatures may be used for the ties. Care in grasping the cut ends of vessels to avoid inclusion of excessive amoutns of subcutaneous tissue will limit the amount of scar formation. An alternate procedure for smaller bleeding points is to clamp the bleeding point with a hemostat and touch the instrument with the high-frequency coagulation current. Hemostasis must be complete, and the wound should be carefully inspected for frank hemorrhage or seepage of blood. No primary suturing is indicated until complete hemostasis has been secured.

Closure of the wound. After the wound has been cleansed and debrided and hemostasis has been achieved, the wound is ready for closure. The objective of closure is accurate coaptation of the layers of tissue with elimination of all dead spaces. Lacerations of the face that lie parallel to the lines of skin relaxation may be expected to heal in a favorable fashion with minimal skin closure. If lacerations transect these lines at right angles, immediate Z-plasty may be performed to prevent scar contracture. The tissues should be handled gently, by use of tissue hooks rather than forceps whenever possible. If the wound involves the mucosa, this structure should be accurately reapproximated as the first step. An attempt to form a watertight seal of the mucosa by interrupted No 4-0 or 5-0 nonabsorbable sutures is made. Polyglycolic acid sutures (Dexon), which are made of a slowly resorbable material, may also be used. This is especially advantageous for closure of intraoral lacerations associated with maxillary or mandibular fractures in which removal of sutures would be difficult if not impossible because the patient's mouth is closed by maxillomandibular fication.

If at all possible, any fractures of the facial bones that may be present should be reduced at this time before completing the closure of the soft tissue. If the soft tissue wounds are closed first, the subsequent manipulative procedures necessary for reduction of the fractures frequently cause a disruption of the soft tissue wound. After the fractures are reduced, deeper muscle and subcutaneous layers are closed by inverted buried interrupted sutures, with care being taken to eliminate all dead spaces. If tension appears to be affecting the wound, the employment of the Gillies near-far, far-near relaxing sutures will aid in approximating the subcutaneous tissue and in relieving the tension on the skin. Chromic gut or No 3-0 silk sutures are utilized for the closure of the deeper layers.

The final step in closure of the subcutaneous tissues is the placement of fine subcuticular sutures just beneath the cutaneous surface. These sutures should accurately reapproximate the subcutaneous tissues and relieve all tension of the skin margins. If any undue tension is encountered, undermining of the skin may be necessary prior to placement of the subcuticular sutures. Plain gut or polyglycolic acid sutures are most commonly used for subcuticular closure. The skin is approximated by No 4-0 or 5-0 silk or Dermalon interrupted sutures placed in adequate numbers to ensure apposition. Sutures should be placed at equal distance and equal depth on either side of the wound. They should be placed in such a manner that a slight eversion of the skin margins is produced. Interrupted sutures will produce this eversion if properly placed. An occasional vertical mattress suture, however, may be necessary as supplementary support.

Little difficulty is encountered in closing the small or moderately large wounds by this method, particularly if no tissue has been lost. In suturing extensive, complicated lacerations, it may be difficult to determine the proper position of the tissues. In these instances a start should be made at a known point, such as the corner of the mouth, ala of the nose, or the corner of the eye. Each remaining segment is then bisected with a suture until closure is complete. Key surface sutures at these points may be necessary. These may be placed deep into the tissue but should never be placed far from the wound margins, since wide placement is conductive to unsightly scar formation. Fine subcuticular sutures placed between the key sutures will approximate the subcutaneous structures before insertion of the skin sutures. Larger wounds in which no key points are involved may also present difficulties in realignment. Such wounds should be managed by placing a key suture in the center, dividing the wound in half. Each half is then bisected until final closure is accomplished.

Delayed primary closure. For various reasons all lacerated wounds cannot be treated within the initial safe period for primary closure. Such wounds become edematous, indurated, and infected, and early primary closure should not be attempted. A program of wound preparation should be instigated and followed by a delayed primary closure when conditions are suitable. Chipps and associates have outlined an excellent regimen for the preparation of wounds for secondary closure, and their observations stem from vast experience gained at Tokyo Army Hospital during the Korean conflict. The regimen they recommend includes an initial examination and debridement, at which time all obvious devitalized and infected tissues are removed. Concomitant fractures of the facial bones, if present, should then be immobilized. Adequate drainage should be maintained, and an effective and specific antibiotic regimen employed to combat any infection that may be present. Continuous moist dressings applied to the injured tissues assist greatly in preparing the tissues for closure. The wounds should be observed daily, and when necrotic areas are discovered, they should be removed by tissue forceps. Wounds involving the oral cavity should be isolated and oral feeding prohibited to eliminate contamination and fermenting food debris from entering the wound. To accomplish this, feeding by a Levin tube is usually employed. This regimen rapidly controls infection, reduces edema and induration, and renders the wound amenable to delayed primary suture in 5 to 10 days. The wounds are then closed as described under initial primary closure. Success depends on how well the surgeon adheres to the surgical procedures previously described.

Supportive therapy. The successful treatment of wounds requires consideration of several other factors such as the need for drains, the type of dressing, and the prevention or treatment of various infections.

Drains. Superficial lacerations do not require drainage. Deeper wounds, however, particularly those involving the oral cavity, should have a Penrose or rubber dam drain inserted. This allows the escape of serum and tissue fluids and prevents the collection of these substances in deeper structures. Drains may be placed between the sutures or through a stab incision approximating the original wound. Drains should be removed in 2 to 4 days.

Dressings. After suturing, some type of protective dressing is indicated. Small wounds may be covered by fine-mesh gauze, which is then painted with collodion and allowed to dry. Larger wounds require a secure pressure dressing. This dressing should offer tissue support and exert sufficient pressure on the tissue to prevent additional bleeding or the collection of fluid in the subcutaneous areas. A strip of fine-mesh gauze or nylon is usually placed over the sutured wound, and then gauze fluffs, reinforced by elastplast, are added. Ace bandages, followed by adhesives tape, are applied to exert moderate pressure on the wound. Dressings

should be changed in 48 hours. Sutures are removed on the fourth or fifth day, and a collodion dressing is placed over the wound for another 3 to 4 days.

Prevention of infection. All lacerated wounds are contaminated and infected by the time they are seen for treatment. Although this infection is frequently subclinical, efforts should be made to keep the infection at a minimumm and to eliminate it as soon as possible. This is accomplished by strict adherence to sterile techniques, thorough cleansing of the tissue, complete hemostasis, conservative but adequate debridement, wound closure that eliminates all dead spaces, and adequate supportive care. This supportive care includes the intelligent utilization of antibiotics or chemotherapy or both. Prophylactic utilization of these substances is indicated in all major wounds as a safeguard against infection.

Prophylaxis against tetanus. Because all wounds of the face are contaminated and are often produced by accidents that force dirt and debris into the wound, protection against infection by the *Clostridium tetani* organism must be provided. This is particularly true of laceration, puncture, and gunshot wounds. Tetanus infections are so catastrophic and have such a high mortality rate that if any possibility exists of a wound being contaminated by this organism, active prophylaxis must be provided.

Tetanus is a relatively easy disease to prevent. Active immunization has proved to be both effective in prevention and long lasting. In a large segment of the population, an active immunity against tetanus has been developed as a result of inoculation with alum-precipitated toxoid in three subcutaneous doses of 0.5 mL each. The second dose is given 6 weeks following the first dose and the third dose, 6 to 12 months after the second dose. Active immunization is effective for a minimum of 1 year, and a repeat booster dose of 0.5 mL of tetanus toxoid given any time within the next 10 years will provide a rapid rise in antitoxin titer.

Tetanus toxoid alone is of little value in those patients in whom no active immunization exists by prior prophylactic inoculation with tetanus toxoid. In these patients passive immunity may be provided using human antitetanus globulin by intramuscular injection of 250 units. Active immunity should then be established immediately by the regimen described previously.

Antibiotics such as penicillin and tetracycline are effective against vegetative tetanus bacilli; however, they have no effect against toxin. The effectiveness of antibiotics for prophylaxis remains unproved, and if used, they should be given for at least 5 days.

Failures in primary closure. Whereas the majority of lacerated wounds heal by primary intention without complications, some do break down. Chipps and co-workers report that 30% of facial wounds observed at Tokyo Army Hospital during the Korean conflict failed to heal by primary intention. In any analysis of these cases, they found that six major factors were responsible for this wound breakdown. There were (1) tight closure of the wound without provision for deep tissue drainage, (2) inadequate use fo pressure dressings, (3) failure to close the mucosa on the oral surface of the wound, (4) secondary hemorrhage, (5) secondary manipulation of the repaired wound, and (6) inadequate antibiotic therapy. It is obvious that these problems in wound disruption stem primarily from failure to meticulously apply the standard surgical principles of wound treatment. If these principles are strictly adhered to, failure will be kept to a minimum.

For breakdown of small lacerations, conservative management consisting of frequently changed saline-moistened gauze dressings and healing by secondary intention may suffice. In wounds in which breakdown leads to unsightly scar formation or deformation of adjacent tissues, a secondary plastic procedure may be performed but only after complete healing and revascularization have occurred.

Treatment of puncture type of penetrating wounds

Most objects producing wounds to facial areas also produce lacerations, so the isolated puncture wound is rarely seen in this region. When it does occur, the wound of entrance is usually small but may penetrate deeply into the underlying tissue and involve the mouth, nose, or maxillary sinus. This type of wound is dangerous in that it may carry infection deep into the tissue, and the possibility of tetanus infection is always present.

Treatment should be conservative and directed primarily at the control of infection. The wound should be thoroughly irrigated and cleansed under sterile conditions. Hemostasis usually presents no problem because the bleeding stops spontaneously unless larger vessels are involved. Excision of the wound is not usually indicated, since it would require a wide incision to expose and explore the depths of the wound and the resultant scarring would be objectionable. Debridement is not indicated with most wounds of this type, and unless an infection complicates the wound, necrosis and sloughing are rare. Measures to control infection are of primary interest, with particular emphasis being given to prophylaxis against tetanus. The wound should not be closed by primary suture but should be allowed to remain open to heal by granulation. Because of the small wound of entrance, healing usually occurs with little deformity. If an unsightly scar or depression results, it should be managed as a secondary procedure after complete healing and revascularization have taken place.

Treatment of gunshot, missile, and war wounds

Injuries produce by gunshot and other missiles traveling at varying speeds will be considered together, since the resulting wounds present the same problems. These wounds are only occasionally seen in civilian practice, but they become an immediate and major problem in time of war. With the changing pattern of warfare and the possibility of mass casualties resulting from thermonuclear attacks, wounds resulting from missiles and other flying projectiles assume new importance. As seen with lacerations, these wounds vary considerably in extent and character. Many appear hopeless at firs sight, but surprising results are usually obtainable by careful surgical technique.

In no other type of facial wound is attention to emergency lifesaving procedures so important. Since these wounds are usually extensive, first attention must be given to the general condition of the patient, and measures to ensure an adequate airway, arrest of hemorrhage, and control of shock must be instigated. The very nature of these wounds produces conditions that tend to interfere with the upper respiratory passages, and if not corrected early, they may lead to disastrous consequences. If any doubt exists as to the ability to maintain a patent airway by conservative methods, no hesitancy should delay the performing of a tracheostomy. Control of hemorrhage is usually not a major problem. Although the facial areas are well supplied with blood vessels, they are mostly small in caliber and well supplied with elastic fibers, and when severed, they retract into bony canals and are occluded by thrombi. The searing action of the missile itself occludes many of the vessels. If hemorrhage becomes a problem, pressure to the bleeding area is usually sufficient to control the bleeding; however, on occasion it may be necessary to clamp and ligate larger

vessels. Shock is not a constant finding but is observed in the more severe injuries. When encountered, hemorrhage must be arrested and the blood volume restored as soon as possible to prevent the condition of shock from progressing to its irreversible stage. Surgery can usually be performed as soon as the blood pressure and pulse become stabilized at the desired levels. Neurological disorders must be recognized and carefully evaluated before instigation of treatment. As a rule, treatment of the soft tissue may be started when the vital signs have stabilized.

The method of treatment depends on the problems encountered in each individual case. Gunshot wounds in civilian practice usually receive definitive treatment within a matter of hours, whereas definitive treatment of war wounds may be early or markedly delayed. Regardless of which situation exists, when certain fundamental principles are followed, satisfactory results may be obtained.

Whenever possible, this type of wound should be managed by early primary closure. A general policy of working from the inside out should be followed. Wounds involving the maxillary sinus, palate, and tongue should be sutured first, followed by suturing of the oral mucosa. Associated fractures should then be reduced and immobilized, followed by closure of the soft tissue wound.

Unfortunately not all gunshot and missile wounds can be treated early, and many are seen after edema, necrosis, and gross infection are present. Perhaps in no other group of wounds is the delayed primary suturing after a period of wound preparation more effective. By adequate wound cleansing, debridement, utilization of continuous moist dressings, and control of infections, these wounds may be prepared for closure in from 5 to 10 days. The wound is ready for suturing when the edema and inflammation have subsided, when the suppuration has ceased, and when healthy granulation tissue is present. Wound edges containing the granulation tissue are excised and the tissues sutured in layers as described earlier in this chapter.

Not all gunshot and missile wounds can be closed by primary or delayed primary suture. The large avulsive-type wounds, particularly those in which considerfable loss of osseous structures has occurred, are not amenable to this procedure. If closed primarily, such wounds may show marked distortion of the remaining tissue and produce unsightly cosmetic defects. However, if the bony fragments can be immobilized in proper position or if an intraoral splint can be utilized to restore normal facial contour, either primary suturing or delayed primary suturing should be utilized if sufficient soft tissue is present. This practice will often produce an acceptable cosmetic result and reduce the number of reconstructive procedures needed later. Avulsive wounds in which it is impossible to restore the normal facial contour by immobilization of fractures or utilization of intraoral splints or wounds with extensive loss of soft tissue must be handled differently. In such instances suturing the skin margins to the oral mucosa is an acceptable procedure. Reconstructive surgery to restore facial contour can be performed later.

Foreign bodies

Gunshot and missile-type injuries are often complicated by foreign bodies carried into the wound. These foreign bodies range from superficially located debris resulting from explosions and powder blasts to deeply penetrating bullets or metallic fragments of gunfire. They include such objects as pigmented debris, clothing, bullets, and splinters of metal, wood, glass, and stone. Fractured teeth and detached segments of bone may also act as foreign

bodies. The question often arises as to the advisability of the removal of these objects. No rule applicable to all conditions can be set forth, but several fundamental principles are worthy of mention. The superficial blast-type of multiple foreign bodies should be removed within the first 24 hours to prevent the development of a traumatic tattoo. Any foreign bodies encountered during the cleansing and debridement of the wound should, of course, be removed. This is principally true of glass, gravel, wood, teeth, or unattached bone segments, because if they are allowed to remain, infection and delayed healing may result. Metallic bodies present a different problem. Many of these become fragmented and are often so widely scattered throughout the tissue that complete removal is virtually impossible. In evaluating metallic fragments in a wound, the possible deleterious effects of these objects must be weighed against the effect of the surgical procedure necessary for their removal. Many metallic fragments are sterile and will remain in the tissue indefinitely without injurious effect. An old adage often quoted is, "When a bullet cease to move, it ceases to do damage". Although this is not literally true, it is worth remembering. It is considered unwise to perform an extensive surgical procedure to remove these fragments if they are not readily accessible at the time of debridement. It is better to allow them to remain in the tissue, and if any complications develop, removal can be accomplished as a secondary procedure.

Gunshot, blast, and missile wounds are notoriously contaminated, and special precautions are indicated to prevent infection. Antibiotic therapy should be instituted as soon after injury as possible and continued until primary healing is complete. War wounds inflicted in the Korean conflict were for the most part badly contaminated, yet infection was rarely seen by the time the casualties arrived at definitive treatment centers in the USA. This is attributed to the fact that the patients were given antibiotic therapy soon after injury and maintained on this therapy until healing has occurred. If infection did develop, definitive bacteriology and antibiotic sensitivity trests were available to ensure that the proper antibiotic was being used. Tetanus is also an ever-present possibility, and prophylaxis against this infection must be provided. It must also be remembered that tetanus may be a late development in these wounds. Once the organisms are established, they are capable of forming spores that are highly resistant and may remain viable for years. They may lie dormant in the tissues and be activated by some secondary surgical procedure and produce typical tetanus infections. When secondary procedures are necessary on these previously contaminated wounds, it is wise to provide additional protection against this infection.

Treatment of Burns

The treatment of burns is usually not included in textbooks on oral surgery and rightly so, since the specialist in this field is seldom called on to treat this type of injury. Because of the current emphasis on mass casualty care, however, and the need for all members of the healing arts to have basic knowledge of the problems that will be encountered in the event of a thermonuclear attack, brief coverage of burns of the facial region is included, with particular emphasis on initial treatment measures.

Burns are perhaps the most severe injuries to which man is exposed, and like so many of the injuries discussed previously, they may vary greatly in extent and severity. Their classification as first, second, and third degree burns depends on the depth of tissue involved. The severity of a burn wound can be estimated from the depth of the wound and the amount of the body surface involved. The deeper the wound and the greater the surface involved, the more severe the burn. Burns, like other wounds, invoke a systemic response that is proportional to the extent of the wound. It has been estimated that a burn of the entire face involves only approximately 3% of the body surface. Thus isolated burns of the face seldom

produce a serious systemic reaction. The isolated facial burn, however, is the exception, since facial burns are usually associated with burns on other portions of the body. Collectively these wounds may produce systemic problems of major proportion; therefore, brief consideration of these problems must be given.

The major systemic problem is shock. Immediately after a burn injury a diminution of blood volume occurs as a result of the loss of fluid from the wound and into the interstitial spaces. This results in a hemoconcentration and a loss of colloids and electrolytes. Oligemic (hypovolemic) shock will occur unless the loss of blood volume is corrected. Consequently, therapy to prevent shock is of primary importance and consists of restoration of the normal blood volume, including colloids and electrolytes. The amount of fluid to be replaced is sometimes difficult to determine, and the exact ratio of colloids to electrolytes has not been determined. Use of the hemoglobin determination and hematocrit are of value in replacement therapy, and a workable estimate of replacement needs can usually be determined by knowing the patient's weight and the extent of the burned surface. The estimated need for replacement in the first 24 hours can be derived from the following formula:

Colloid (blood, plasma, or plasma expander) =
Percentage of body burned x Body weight x 0.25

Electrolyte = Percentage of body burned x Body weight x 0.50

Glucose in water = 2.000 mL

Requirements for the second 24 hours are half the amount of colloids and electrolytes estimated for the first 24 hours plus 2.000 mL of glucose in water. By the third day the moderately burned patient can usually be maintained on oral intake of fluids, whereas the severely burned patient will continue to require intravenous therapy, which should consist primarily of electrolyte-free water.

In addition to the loss of fluids and electrolytes, other systemic responses frequently occur. Destruction of red blood cells, certain endocrine abnormalities, as well as aberrations in protein and carbohydrate metabolism are encountered. It is obvious that the systemic involvement is of major concern in the overall treatment of the burned patient.

The burn wound varies with the depth of the injury. First degree burns first become blanched, and then an edema and erythema appear. Small intraepithelial blisters may form. In a few days the surface epithelium may slough, leaving a healthy granulating epithelium. Second degree burns rapidly produce vesicles and blisters that separate the epidermis into layers. Sloughing is more prominent that in first degree burns. Third degree burns produce complete destruction of all layers of the skin. Necrosis deep in the wound is seen, and suppuration is common. Sloughing occurs in approximately 2 weeks, leaving healthy red granulation tissue in the base of the wound.

Therapy

Treatment of the burned patient may be divided into two categories - supportive care and local care of the wound. Only the initial therapeutic measures and first-aid procedures will be considered.

In supportive care the prevention and treatment of shock are of primary importance. With minor burns, this problem is not encountered, but it is of major importance in extensive burns. Control of infection is important, and the aggressive use of prophylactic antibiotics is efficacious in prevention and control of infections. Grossly contaminated burn wounds also call for prophylaxis against tetanus.

Pain is a problem in the burned patient. This is usually controlled within a few days by the local treatment of the wound, but in the early periods, systemic sedation is indicated. This sedation should be administered with caution, particularly to the patient in shock, and doses should be kept to the minimum.

Thorough cleansing of the burned surface is the first consideration in the initialcare of first and second degree burns. Bland soap and sterile water gently applied are usually sufficient to cleanse the wound, but occasionally some solvent is necessary to remove oil or grease. The wound is then debrided of all devitalized epithelium, and any vesicles or blisters are removed. Hemorrhage is not a problem in the burn wound, and infection at this initialstage is seldom encountered. Treatment from this point may utilize either the open or closed method. In the former the wound is left open without covering, and within 48 hours, a dry, firm, brownish eschar will form. This eschar protects the underlying wound, and unless infection develops, epithelization will proceed under this protective covering. If cracks in the eschar develop, it should be debrided for a short distance on either side and moistened fine-mesh gauze should be packed into the defects as a precaution against infection. The eschar will eventually fall off, leaving healthy healing tissue exposed.

In the closed method of burn therapy, after the wound has been cleansed and debrided, fine-mesh plain or petrolatum gauze is applied directly to the burned area. A large, occlusive-type dressing is then applied and supported by an elastic bandage reinforced with adhesive tape. This dressing affords protection to the open wound, prevents infection, and relieves pain. It is not necessary to redress the burned areas, except to change the outside bandages, until the wound is healed. If infection becomes a complication, the dressings must be changed, but if the wound has been thoroughly cleansed and the primary dressing is adequate, infection seldom occurs.

Local treatment of third degree burns that involve the full thickness of the skin is essentially the same as for second degree burns. After early cleansing and debridement, a dressing is applied, which is allowed to remain for 10 to 14 days. When the dressing is changed the necrotic, destroyed tissue can be removed with tissue forceps. If the wound becomes suppurative, the dressing will require changing before this time and local as well as parenteral antibiotic therapy should be employed. Third degree wounds should be treated as soon as possible by skin grafting. If no infection is present, grafting is possible when the necrotic tissue is removed. If this wound is allowed to heal by granulation, marked scarring with contracture and deformity will result.

Burns of the face do equally well with either the open or closed method of treatment. The open method is usually employed, but this has the disadvantage of pain during the first 48 hours while the eschar is forming. This pain can be controlled by sedation. Utilization of the closed method is sometimes difficult to apply to facial wounds because of the difficulty in maintaining pressure dressings on the face. If dressing changes become necessary, pain becomes a factor.

First-aid treatment depends a great deal on the extent and seriousness of the wound. For minor burns, which include most of the isolated burns of the face, local care of the wound and relief of pain are usually all that is necessary. Close observation of the patient is essential, and any signs of shock or other systemic reactions call for aggressive therapy. Prophylaxis against infection should be administered as indicated. Patients with severe burns should be hospitalized and replacement therapy started immediately. The burned surfaces may be treated by either the open or closed method, depending on the conditions encountered in each individual case.

One type of burn that presents a serious emergency is the flash or flame burn that involves the upper respiratory passages. Such burns often damage the mucosa of the respiratory tract, and the resultant edema may progress so rapidly that respiratory embarrassment and asphyxia may occur. In such an emergency, tracheostomy may be lifesaving.

Burns in mass casualty care

In the case of mass casualties resulting from thermonuclear attack, burn injuries will undoubtedly constitute a major problem. They will result primarily from exposure to the flash of the explosion or from fires ignited by the explosion. In planning for the types of burn casualties from such an explosion, it has been convenient to divide them into four categories, depending on the magnitude and severity of the injury: self-care burns, moderate burns, severe burns, and overwhelming burns.

Because of the great number of casualties that may occur simultaneously, undoubtedly insufficient personnel will be available to provide complete medical care, and many patients will of necessity have to depend on self-care for survival. It is expected that this group will represent the largest number of burn casualties. Most of these burns will be of the flash variety, which are primarily second degree burns on the exposed surfaces of the body.

Flash burns do well without covering, and the open method of treatment may be the only treatment available. The chief deterrent to this method is pain, and most patients would undoubtedly attempt to cover their wounds. Since sterile dressings may be a critical item, a bland nonirritating ointment applied to the burned surface would afford considerable relief. Fluids should be taken by mouth, and if electrolytes are necessary, the oral fluids can be fortified with the following substances: 3 g of salt (NaCl) and 1.5 g of soda ($NaHCO_3$) added to a liter of water; this makes a satisfactory electrolyte solution for oral use. Prophylaxis against infection should also be provided.

Persons with moderate burns would require more extensive therapy. They would undoubtedly need some intravenous colloids and electrolytes. During the early period when definitive care is not available, however, they could be managed with oral electrolytes, oral antibiotics, and sedation to control pain. Wounds should be covered by anything available to prevent further contamination.

Severe burns would require aggressive therapy. Patients with severe burns would be unable to tolerate large quantities of fluid by mouth and would be dependent on intravenous therapy. Antibiotics to control infection and sedation for pain should be administered, and, if available, some occlusive type of dressing should be applied to the wound. This type of casualty should be given a high priority for definitive care.

Overwhelming burns would carry a poor prognosis. Even under ideal situations with optimum care administered by trained personnel, the mortality in these cases would be at least 50%. In event of mass casualties, treatment under such adverse conditions would be anything but ideal, and few of the patients with overwhelming burns would be expected to survive. Patients with this type of injury should be made as comfortable as possible and given the lowest priority for definitive treatment.

Miscellaneous Wounds

Intraoral wounds

Because of the isolated position of the oral cavity and the protection afforded by the lips and cheeks, wounds of the intraoral soft tissues are relatively rare. The majority of these injuries are part of the complex wounds involving other facial structures and have been considered under other sections of this chapter. Isolated wounds, however, do occur, and they warrant separate attention.

Any type of wound may occur in the oral cavity. Direct blows to the oral mucosa are virtually impossible, so primary contusions seldom occur. Secondary contusions of the oral mucosa, however, are frequently seen as a part of extensive contusions involving the lips or cheeks. In these wounds the mucosa becomes swollen as blood extravasates into the submucosal tissue, and with time the entire area takes on a purplish hue. Treatment of intraoral contusions is not necessary. Infection is no problem, and, as normal reparative processes take place, the blood clot is gradually resorbed, the discoloration fades, and the tissues return to normal in approximately 10 days.

Abrasions are common in the oral cavity. They may result from any type of trauma that produces a frictional or scraping effect on the mucosa. Characteristic abraded wounds are produced by the irritation of a dental prosthesis, a malposed tooth, or a rough filling. Abraded mucosal surfaces are also caused by habitual lip or cheek chewers or by the occasional accidental self-inflicted bite. These wounds are superficial and require little therapy other than removal of the traumatizing force. Once the irritation has been corrected, the wounds heal rapidly without scar formation. If pain is a factor, the local wound may be covered with tincture of benzoin, which will seal off the nerve endings and afford relief for varying periods of time.

Lacerations are the most common of the isolated intraoral wounds and, for the most part, present little difficulty in management. Lacerations of the oral mucosa are frequent findings in traumatic injuries of the face. This is particularly true of lip lacerations, since the external trauma forces the lip against the sharp incisal edges of the anterior teeth. Accidents caused by the slipping of dental burs or disks during dental procedures or the injudicious use of exodontic instruments are added causative factors for lacerations of the mucosa. If treated early most of these lacerated wounds can be closed by primary suture without debridement. Hemorrhage can usually be controlled by pressure, although it may occasionally be necessary to clamp and tie larger bleeding vessels or active bleeding points. Lacerations limited to the oral mucosa are seldom of sufficient depth to warrant closure of the submucosal tissues as a separate layer, and suturing of the mucosa with No 4-0 or 5-0 interrupted, nonabsorbable sutures is usually all that is necessary. Deep wounds of the tongue, lip, or floor of the mouth that are occasionally of sufficient magnitude to warrant closure in layers are the exceptions. Mucoperiosteummm that has been stripped from the bone should be repositioned and sutured at the earliest opportunity.

A lacerated wound that deserves special mention is the one resulting from tears of the palatal mucosa produced by injuries of the maxilla, which include vertical fractures of the hard palate. These maxillary fragments are occasionally displaced laterally, which may result in a tear of the covering mucosa and produce a communication with the nasal fossa. If these mucosal tears are not sutured early, a nasal-oral fistula may develop that requires a difficult secondary plastic procedure to obtain a closure. If treatment is possible within a few hours after the injury, the maxillary fragments are usually sufficiently mobile to permit the manual molding of the fragments into their proper position, where that can be stabilized with an arch bar. The tears of the palatal mucosa may then be sutured without difficulty. It is obvious that these palatal lacerations must be sutured before intermaxillary immobilization of the fractures. This early primary suturing of the palatal mucosa is a gratifying procedure and, if properly carried out, will prevent the formation of a troublesome fistula.

Intraoral puncture wounds are usually the result of falls or accidents while some hard, pointed object is being held in the mouth. This is a common accident of young children, who frequently run and play with lollipop sticks or similar objects in their mouth. A puncture-type wound results whenthe sharp object is forcibly driven into the soft tissue. When the soft palate is involved, an actual perforating wound may be produced. Similar puncture wounds of the cheek, tongue, floor of the mouth, or palate are seen as the result of accidental slipping of an elevator during exodontic procedures. Wounds resulting from these injuries are more alarming than dangerous. The puncture wound seldom bleeds profusely, and the tissues usually collapse and obliterate the defect when the penetrating object is withdrawn. The perforations of the soft palate are eliminated by contracture of the muscles around the perforation. Examination to ensure that no part of the perforating object is left in the wound as well as measures to prevent infection are usually the only therapy indicated. Suturing is not necessary. In fact, this is contraindicated, since the wounds should be allowed to heal by granulation. Any accompanying lacerations should, of course, be sutured.

Most burns of the mouth are minor problems and closely simulate first or second degree burns of the skin. They result most frequently from heated instruments or from drugts used during dental procedures that accidently come in contact with the mucosal surface. Treatment is almost entirely directed to the local wound, since systemic reaction to such limited burned surfaces is highly improbable. The mucosal surface sloughs early, leaving a raw, denuded submucosal surface. These exposed surfaces are painful, and treatment is directed toward relief of pain and prevention of secondary infection. Systemic sedation is frequently necessary, but considerable relief can be obtained if the burned areas are dried and coated with tincture of benzoin. When large areas of the mucosa are involved, such treatment is not feasible. These patients should be given one of the topical anesthetic solutions such as the viscous type of lidocaine or a 0.25% solution of tetracaine (Pontocaine) to apply to the burned surfaces. A bland, nonirritating diet should be prescribed, since any tart or acid food will aggravate the pain. Secondary infection of the wounds should be prevented. Local application of one of the aniline dyes is helpful, and occasionally systemic antibiotic therapy is indicated. These burns heal rapidly without scarring, and the mucosa returns to normal in approximately 10 days.

Serious burns do occur in the oral cavity. The flash or flame type of burn of the upper respiratory tract may also involve the oral cavity, and the rapidly developing edema of the mucosa may create a real emergency. In such instances, tracheostomy is indicated as a lifesaving procedure, and general supportive therapy should be instigated immediately. The oral burn is usually superficial, and treatment of the local wound should be delayed until the patient's general condition has stabilized. Treatment of the oral wound is essentially the same

as previously outlined.

Burns from accidental contact with strong acids and alkalies may be serious. As a rule these substances are swallowed rather than retained in the mouth, and damage to the esophagus and stomach are more common and dangerous than the injuries of the oral cavity. When these substances are retained in the mouth for any appreciable time, however, full-thickness mucosal burns resembling third degree burns of the skin may result. They produce deep necrosis of the tissue that sloughs in from 10 to 14 days, leaving a red, granulating bed. These wounds usually heal by granulation with marked scarring and contracture. When feasible, split-thickness skin grafts should be placed on the granulating surfaces when the slough is removed. This, however, is frequently impossible, and the skin grafting must be done as a secondary procedure. The seriousness of these chemical burns may occasionally be minimized by prompt first-aid measures. If they are neutralized with an agent that in itself is not destructive to tissue and then followed by repeated irrigations of the mouth, the depth of the burn may be limited and the resultant scar contraction minimized.

Another oral burn that causes serious consequences is the electric burn. This is seen most frequently in babies who place electric cords in their mouth and chew the cord until a direct short is established. Flash burns occur from arcing of the electricity, and deeper tissue burns result from the electricity surging through the tissues. Changes ranging from erythema to actual charring may result. In severe electric burns the systemic response is severe and immediate and must be treated vigorously if the child is to survive. Treatment of the local wound depends on the extent of the injury. Superficial burns heal spontaneously without incident, but deeper burns that destroy considerable tissue heal by granulation with marked distortion of the tissues, which usually requires secondary procedures for correction. In all instances, control of infection is essential.

Severed parotid ducts

Facial lacerations in the region of the parotid gland occasionally sever the parotid duct. This should receive attention at the time of original wound closure to prevent the formation of an external salivary fistula. If both ends of the duct are visible, direct anastomosis of the severed ends is possible. A metal probe or polyethylene catheter is placed into the lumen of the duct, bridging across the severed portion. The duct is then repaired by suture over this probe or catheter, followed by closure of the remaining portions of the exteral wound. The probe or catheter is removed in approximately 3 days and the flow of saliva stimulated. Once salivary flow has started through the repaired duct, danger of stricture or stoppage of salivary flow is minimal.

Repair of the parotid duct is not always feasible, but a simple alternate procedure produces excellent results. It consists of placing a rubber drain from the mouth into the lacerated region of the cheek through a stab wound in the oral mucosa adjacent to the severed duct. The external wound is then tightly closed, and the saliva is forced to flow along the rubber drain, thus creating a fistulous opening into the mouth. The rubber drain is maintained in position with sutures for 5 or 6 days, and a permanent fistula that functions as a new opening for the parotid secretions is established.