Textbook of Oral and Maxillofacial Surgery

Gustav O Kruger

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Chapter 2

Principles of surgical technique

Theodore A Lesney

Sterilization of Armamentarium

Introduction

The prevention of infection is surely the mandatory requirement of surgical practice and is thereby foundational in the establishment of sound surgical techniques. Infection control is certainly not limited to the sterilization of instruments, supplies, and accessories alone or to the establishment of good dressing-changing routines in the clinic or in professional office practice. Equally important is an awareness of the need for reduction of pathogens in the general environment, and, of course, the responsible surgeon is ever-alert to the need for preventing cross infection among circulating personnel, reducing microbes in room air, and eliminating human error and carelessness that tends to break down the chain of asepsis.

Currently physical technology continues to remain preferable to chemical methods for the sterilization of armamentarium and supplies. Moist heat is still the most reliable and least expensive means for destroying undesirable microbes. There are other, less effective, physical methods than steam, such as filtration, irradiation, and ultrasonics, but these are generally employed where the application of saturated steam is not feasible.

In the field of sterilization some hard facts important for the student of surgery to understand should be quickly established. For one thing, the rhetoric used must not be confusing or compromising. So, it is hereby agreed that sterilization shall mean the total destruction of microbial and viral life. Terms that are often related to sterilization, such as sanitation, antisepsis, and disinfection, must be clearly recognized as representing conditions *less than sterile* that thereby fail to meet the total requirements of sterility. As a basic principles of asepsis, there can be only one form of sterilization, the complete destruction of pathogens.

Textbook rhetoric permits the use of some commonl accepted suffixes such as "cide" and "stat", to name only two. These suggest a varying effect on the life cycle of microbes. For instance, a bactericide destroys bacteria but a bacteriostat only inhibits its growth. Similarly, a virucide kills virus, a fungistat slows the growth of fungus, and so on. Spore-forming pathogens provide the ultimate test for efficacy of sterilization practices, and, in this regard, saturated steam has proved to be the most practical, the most economical, and the most currently effective sporicide.

Principles of sterilization

The basic fundamentals of sterilization procedures will be briefly discussed to ensure that requirements of undergraduate education are fulfilled. The fact remains that today one rarely sees a boiling-water sterilizer or a dry-heat oven in operation on a ward or in the clinic. Presterilized, singe-use disposables have largely eliminated the need for this equipment. Also, gas sterilization such as with ethylene oxide is being used on a progressively limited basis. Nevertheless, these are tried and proved techniques that have prevailed over the years and will continue to remain reliable until supplanted by better methods in the progressive evolution of medical technology.

Autoclaving. Autoclaving is the preferred method of sterilization and the most reasonably certain to destroy resistant spore-formers and fungus. It provides moist heat in the form of saturated steam under pressure. This combination of moisture and heat provides the bacteria-destroying power currently most effective against all forms of microorganisms. Instruments and materials for sterilizing in the autoclave are usually enclosed in muslin wrappers as surgical packs. Muslin for this purpose is purchased most economically in bolt lots and cut to desired size. It is used in double thickness, and each surgical pack is marked as to contents and date of sterilization.

Paper is now apparently supplanting muslin for wrapping surgical packs. Several manufacturers are producing various types of paper wrappers. These papers have clothlike handling properties and present several advantages over muslin. They are less porous than muslin and thereby are less likely to be penetrated by dust and microorganisms. However, they are sufficiently porous to permit required steam penetration under pressure. Crepe papers are currently in favor; they have some degree of elasticity and can be reused several times. Sterility under adequate paper wrapping appears to be effective for periods of 2 to 4 weeks' shelf life. This compares favorably with muslin-wrapped surgical packs.

Autoclaving time will vary directly with the size of the surgical pack. The smaller packs used for oral surgery usually require 30 minutes at 121°C under 1.40 kg^2 of pressure. Various sterilization indicators can be inserted into a pack to provide evidence that adequate steam penetration has been effected. Rubber gloves are more fragile than linens and most instruments. They are sterilized effectively after 15 minutes under 1.05 kg^2 of pressure at 121°C.

Boiling-water sterilization. Ordinarily boiling-water sterilizers do not reach a temperature level above 100°C. Some of the heat-resistant bacterial spores may survive this temperature for prolonged periods of time. On the other hand, steam under 1.05 to 1.40 kg^2 of pressure will attain a temperature of 121°C, and most authorities concur that no living thing can survive 10 to 15 minutes' direct exposure to such saturated steam at that temperature. If boiling-water sterilization must be used, it is recommended that chemical means be employed to elevate the boiling point of water and thereby increase its bactericidal efficiency. A 2% solution of sodium carbonate will serve this purpose. Sixty milliliters of sodium bicarbonate per gallon of distilled water will make a 2% solution. This alkalized distilled water reduces the required sterilization time and the oxygen content of the water as well, thereby reducing the corrosive action on the instruments.

Dry-heat sterilization. Sterilization in dry-heat ovens at elevated temperatures for long periods of time is widely used in dentistry and oral surgery. This technique provides a means for sterilizing instruments, powders, oils (petrolatum), bone wax, and other items that do not lend themselves to sterilization by means of boiling water or steam under pressure. Dry heat will not attack glass and will not cause rusting. Furthermore, the ovens have additional uses in dentistry, such as baking out and curing plastic pontics and other applications. The general design of the ovens permits a heating range between 10° and 200°C. Overnight sterilization in excess of 6 hours at 121°C is widely employed. Adequate sterilization of small loads is attained at 170°C for 1 hour. Manufacturers of dry-heat sterilizers provide detailed instructions for their effective use. The major disadvantage of dry-heat sterilization obviously is the long periods of time required to ensure bactericidal results.

Cold sterilization. None of the chemicals used for cold sterilization satisfactorily meets all of the requirements for true sterilization. Alcohol is expensive; it evaporates readily and also rusts instruments. The widely used benzalkonium chloride, 1:1.000 solution, requires an antirust additive (sodium nitrate) and long periods of immersion (18 hours). The more recently introduced cold-sterilizing chemicals employ hexachlorophene compounds as the active base. These chemicals claim adequate sterilization of heat-sensitive instruments in 3 hours. Fundamentally, most of the cold sterilizing media that may be safely used probably kill vegetative bacteria, but there is doubt of their effectiveness against spores and fungus.

Gas sterilization. The limitations of chemical solution sterilization techniques have made it necessary to exploit other methods for sterilizing the heat-sensitive or water-sensitive armamentarium. One of these methods employs a gas, ethylene oxide, which has proved to be bactericidal when used in accordance with controlled environmental conditions of temperature and humidity as well as an adequate concentration of the gas for a prescribed period of sterilzing exposure. Ethylene oxide sterilizers are currently manufactured in varied sizes from the small portable table model (chamber measuring about 7.5 cm in diameter), to the large, built-in, stationary apparatus found in many hospitals. Smaller chambers use gas that is provided from convenient metal cartridges. The large, built-in sterilizers are hooked up to multiliter tanks.

The relatively high cost of using ethylene oxide sterilizers frequently results in their being used only once or twice per day, more often for overnight sterilization of a capacity load. A hermetically sealed apparatus is necessary to economically ensure the retention of the expensive gas at its most effective concentration for a prolonged period of time ranging from 2 to 12 hours. Since ethylene oxide is highly diffusible, it requires a containing apparatus of precise manufacturing detail.

Under arid conditions, desiccated microorganisms are known to resist the bactericidal effectiveness of ethylene oxide. Therefore the relative humidity within the sterilizing chamber should be controlled at an optimum of 40% to 50%. Also the efficiency of the gas sterilizer is reduced directly by temperature drops below 22°C.

In general, gas sterilization as currently employed in ethylene oxide techniques does indeed fill a necessary void in presently available sterilization practices, but its shortcomings dictate the urgen need for better and less expensive methods.

Sterilization of supplies on industry-wide level

Our expanding population and the successful practice of geriactrics have greatly increased the demand for more medical services. Although the construction of hospitals to meet this demand has been slow, and the training of medical personnel has been even slower, it is encouraging to observe the notable achievements of the pharmaceutical and hospital industry in the mass production of medical supplies. One major achievement concerns the development and profession-wide acceptance of sterile disposable (single use) items. There are now so many disposable products in daily use that space precludes their individual discussion. Another achievement involves automation in manufacture, processing, sterilization, and packaging on an industrial scale. It is the *sterilization* of disposables and other mass-produced medical supplies that shall be discussed.

Modern manufacturing methods for medical supplies and their marketing have pointed out the shortcomings of former sterilization practices when applied to this industry. Although formerly heat, steam, gas, and bactericidal solutions were the only widely accepted means for sterilization, these methods could not be adapted to current mass production and marketing techniques. Many supplies, containers, illustrations, and enclosed printed matter could not withstand these sterilization procedures. The hermetic sealing of products and packages was impossible, since asepsis was dependent on permeation by heat, steam, gas, or batericidal solutions. Heat-sensitive and water-sensitive equipment and supplies required special handling that was inadaptable to mass-production practices.

Recently a radical change has been instituted in sterilization procedures for manufactured and packaged medical supplies. The change has been expensive but effective. Its success in industry has focused the attention of the professions on some of the rather archaic sterilization techniques. Briefly, the improved sterilization techniques employ ionizing radiation. The pharmaceutical and hospital industries are credited with developing, at considerable expense, a successful radiation sterilization technology. The military establishment of the federal government has also played a major role with its studies of irradiation sterilization of foodstuffs for preservation purposes. Both groups have contributed knowledge and standardization of irradiation techniques to the degree that now permits the safe and efficient use of gamma rays and accelerated beta rays on the wide scale employed in food and drug technology. The manufacturer is now able to package the product in a variety of containers that could not be used with previous sterilization methods. Directions, legends, illustrations, and heat-sensitive and water-sensitive materials can be included and yet meet the professions' requirements of sterlization. As a matter of fact, in much of the industry the contents are packaged for final shipment before they are run through an irradiation building on a conveyor-belt system for the efficient sterilization of the entire shipping container and its contents.

Radiation sources. Ionizing radiation for sterilization as currently practiced is available from two sources: (1) machines of low energy but high output (electron accelerators) and (2) radioisotopes. The machines convert the electron output in a manner somewhat comparable to the output of an x-ray machine but with a higher potential of several kilowatts beyond x-ray ouput. Of the isotopes, cobalt-60 and cesium-137 emit the highly penetrating gamma rays. At the present time, isotopes are more widely used. However, electron accelerators (machines) have a number of advantages, and it is expected that they will ultimately supplant radioisotopes for these purposes.

Insight into current sterilization practices strongly suggests the need for improving the methods presently employed in the hospital and in the clinic. As previously indicated, the pharmaceutical industry is spending much time and money in furthering the use of radiation sources for sterilization of a wide array of products. Certainly irradiation is currently an expensive process. The capital investment and operating ocsts are beyond the scope of small institutions and private practice. But the overwhelming advantages of radiation sterilization dictate the continued exploitation of this field until it can be made available on a wide scale to the professions as well as to industry.

The presentation of this subject matter has been oversimplified. For this reason the discussions of Artandi and Olander are recommended for a more detailed and authoritative review of the technological aspects of radiation for sterilization.

General Observations

1. Oils and grease are the major enemies of sterilization. Instruments exposed to oils should be wiped with a solvent and then vigorously scrubbed in soap and water before being put through a sterilizing procedure.

2. When instruments are completely immersed in boiling water, they will not rust because dissolved oxygen is driven out of the solution by the heat and is no longer available for corrosion. However, if wet instrumets are exposed to air for any considerable period of time, rusting will occur. After boiling-water sterilization, instruments should be dried with a sterile towel while they are still hot.

3. Instruments with movable joints will require much less oiling if sterilized by autoclave rather than by boiling. This is especially true if tap water is used in the sterilizer since such water has a high concentration of lime salts, which are deposited on the instruments in boiling.

4. Particular precautions must be exerted for the adequate sterilization of hypodermic needles and syringes. Injections with contaminated equipment may produce latent symptoms. With slow-incubating infections such as hepatitis, the infected patient may become jaundiced months after the injection. It is particularly recommended that hypodermic syringes and needles be sterilized preferably by autoclaving or by boiling water. Effectiveness of cold sterilization is always doubtful.

Currently almost all injectables are prepackaged as sterile, unit-dosing, single-use disposables. The closed-injection system is usually employed as a sterile, cartridge-needle unit. The injectable is accurately premeasured and identified as to contents, dosage, and expiration date. Since it is completely disposable after use, all risk of cross contamination is eliminated.

5. Instruments are best stored in autoclaved muslin or paper packs. If unused, these packs should be reautoclaved every 30 days unless there is a good reason for resterilization prior to that time.

6. Instrument packs should be organized in case pans so that the necessary instruments are included for routine procedures. Instruments can be removed from the pack and arranged on a tray, such as a Mayo tray or a dental bracket table. To this arrangement can be added any additional instruments required to meet the needs of a special situation. An unscrubbed assistant should handle sterile instruments only with a sterile pick-up forceps that is kept constantly in a container of cold-sterilizing solution.

Comment

Currently notable achievements are being made in the better aseptic control of the entire hospital environment, including operating rooms, clinics, and supporting services. For example, suffessful efforts are being made to control the direction of flow, the temperature, and the purity of the air circulated through the surgical operatories. Filterable microorganisms are removed, and the temperature of the air is adjused before it is permitted to flow at a measured rate in a predetermined direction. Furthermore, environmental technology has produced systems for air conditioning, heating, lighting, and ventilating many important patient-care centers of the hospital. This local environment is electronically monitored by means of computer (or mini-computer) control. Medical technology continues to strive for a goal of "germ-free" surfaces - and "germ-free" atmospheres - in surgical operating suites, acute-care units, and intensive-care centers. Progress in attaining these goals is slowed by the high cost of sophisticated equipment and the rapid obsolescence of this equipment occasioned by the accelerating rate of technological change.

Postoperative infection receives the constant vigilance of staff medical and nursing care. Dressings are changed, with strict adherence to aseptic principles. Resistant infections are identified and subjected to vigorous treatment when indicated, sometimes employing isolation of the patient or total bed rest or both. Infection committees composed of cognizant staff personnel are organized to ensure the proper care and disposition of unusual, acute, or persistent infections.

The central supply service must keep fully informed of the latest and best developments in the area of sterilization techniques so that there may be no doubt about the sterility of materials and equipment requested. Dietetics, food services, the many laboratories, and even the general overall housekeeping of the hospital environment require a thoughtful discipline and a constant surveillance in the maintenance of aseptic control.

Metric System Conversion

At this point it may be appropriate to recognize the national commitment to converting all mathematical data to metric terms. All pertinent measurements in the text will henceforth be written in metric terms. In the medical and dental professions this turnover from the United States' system to universal metrics will be easier than in other, unrelated areas because large, component parts, such as pharmacology, radiology, and pathology, have been using metric terms in their readings for a long time. Like pharmaceuticals, body fluids have also been measured in metric form. Nevertheless, the general conversion process may be slowed somewhat by the economic impracticability of replacing good-functioning, major pieces of equipment, such as steam gauges, pressure valves, and thermometers, just because they are not calibrated in metrics. However, cooperative manufacturers can speed the process of equipment conversion by providing recalibrated dials that can be pasted or otherwise inserted over now outdated dials.

In addition to metric changes, a better recording of time is also being effected and henceforth only the 24-hour clock will be universally employed. This change also requires only a new dial and not a new clock. During the conversion period, when everybody is trying to use Celsius in lieu of Fahrenheit and kilograms per square centimeter rather than pounds per square inch, the student may find some need for conversion calculations. The most important of the metric measurements will be concerned with weight, linear measurements, temperature, and time.

Simple conversion data

A. To change Fahrenheit to Celsius (centigrade)

Subtract 32 from Fahrenheit and multiply by 5/9
Subtract 32 from Fahrenheit and divide by 1.8.

B. To change Celsius to Fahrenheit

Multiply Celsius by 9/5 and add 32
Multiply Celsius by 1.8 and add 32.

C. Linear comparisons

0.3937 inches	= 1 centimeter (cm)
1.0 inch	= 2.54 cm
1.0 foot	= 30.48 cm
39.37 inches	= 1.0 meter (m)
0.621 (or 5/8) mile	= 1.0 kilometer (km)

To change kilometers to miles, multiply kilometers by 6 and divide by 10.

D. Weight comparisons

1.0 ounce	= 28.35 grams (gm)
1.0 pound	= 453.5 gm
2.2 pounds	= 1.0 kilogram (kg) or 1.000 gm

E. Volume comparisons

1.0 quart	= 0.9468 liters (L) (1.0 L = 1.000 cubic centimeters (cc)
1.056 quarts	= 1.0 liter
1.0 gallon	= 3.78 liter.

Operating Room Decorum

The work of Lister has proved conclusively the role played by bacteria in wound infection. It is now mandatory in all surgery, including oral surgery, that all intelligent, precautionary measures be taken to avoid the contamination of wounds.

Although the means for providing strictly aseptic mouth surgery are sill unavailable, this is no reason for completely abandoning an aseptic routine. At the very least an aseptic routine for mouth surgery markedly eliminates some of the pathways of cross infection: the infection of the doctor from the patient, the infection of the patient from the doctor, or the infection of the patient from another patieht through the doctor or through the contaminated armamentarium employed by the doctor. It has long been established that surgical wounds are contamined chiefly from microorganisms harbored in the skin or mucous membranes that have been incised. Furthermore, the oral cavity is a normal breeding ground for a wide assortment of microorganisms. The noses, throats, and hands of the *operating team* are the next most common source of wound infection. Unsterile instruments and supplies follow in order of frequency. For the latter there is no excuse.

Complete asepsis in surgery may well be an ideal that is never fully attained. There may always be some doubt regarding the sterility of the skin or the mucous membranes to be incised. The air contamination of wounds is an omnipresent problem. But if wound infection in surgery is to be minimized, all logical precautions and preparations must be instituted. This should include the proper preparation of the operating team as well as the patient. Wherever surgery is done, in the hospital operating room or in the clinic, the surgeon wears a face mask of four-ply, fine-meshed gauze and a surgical helmet of linen or cloth such as the stockinette used under plaster casts. However, here as elsewhere throughout the hospital, paper is gaining favor over cloth for disposable face masks, headgear, and surgical gowns. The surgeon's hands are adequately scrubbed. Precently, highly detergent soaps containing hexachlorophene are commonly utilized in prescribed scrub techniques. Sterile gloves are employed for all surgery, and these, like sterile sheets, wraps, towels, and so on, serve bacteriologically to isolate the doctor from the patient.

Scrub technique

1. Street clothes are replaced with a scrub suit. This consists of clean linen trousers and a short-sleeved blouse. In the operating room where static electricity may be a complicating problem, the surgical personnel wear appropriate conductive footwear. Each shoe has a sole and heel of conductive rubber or conductive leather or equivalent material. Such shoes have metal electrodes fabricated into the inner soles so that conductive contact is maintained with the stockinged foot.

2. It is necessary to stress that hair and hairy areas are extremely difficult to sterilize. This is the chief reason for preoperative shaving of surgical sites. Medical and paramedical personnel circulating throughout an operating room are an alarming source of infection. Along with many other precautions, the hair of these personnel must be adequately covered. Changing hair styles, such as fashionable long hair, flowing beards, and grandiose mustaches, have indeed compounded the problem of cross contamination in the operating room. Surgical helmets and face masks are becoming larger and less comofortable in the effort to adequately

cover head and facial hair. One of these helmets is currently dubbed the "Lawrence of Arabia" helmet because it vaguely resembles the head and face wrappings that this legendary figure employed to protect himself against wind-blown sand. Such necessary full coverage of long hair and beards is most uncomfortable during prolonged and difficult procedures. Slits in these helmets must be cut for the ears when eyeglasses are to be worn or a stethoscope must be used.

In passing, a long-standing, unwritten rule can be repeated over and over again: "Sneezing and coughing are simply *not* permitted in the operating room."

3. The surgical scrubbing is carried out in the manner prescribed for major surgery. The hands and forearms are scrubbed to the elbows with brush and soap (or hexachlorophene detergents) and water according to prescribed plan. At many hospitals the recommended scrub technique is posted directly over the scrub sinks. Two-minute scrubs between operations may be acceptable. However, numerous hospital frown on any scrub technique requiring less than 10 minutes. During the scub, fingernails must be adequately cleansed. Sterile orangewood sticks are conveniently provided for this purpose. If nondetergent soap is used for the scrub, a longer scrub period is required, and a postscrub rinse with a low-surface tension antiseptic such as alcohol or Septisol is recommended.

4. The hands are dried in the operating room with a sterile hand towel. At this stage the hands are considered surgically clean but *not sterile.*

5. The surgeon is helped into the sterile gown by a properly gowned and gloved surgical assistant. A circulating assistant secures the gown ties at the surgeon's back. The surgeon's back as well as the gown below the level of the waist are considered *unsterile.*

6. The surgeon is helped into the gloves in such a manner that *only the interior* of the gloves is touched by the hands. The exterior and not the interior of the rubber glove is considered sterile.

Only a minimal amount of dusting agent is permitted in preparing the hands for the wearing of rubber gloves. Modified starch powder has replaced talcum as the dusting agent of choice. However, sterile creams are being used for this purpose more than dusting agents. In the surgery of open wounds consideration must be given to the irritating, granuloma-producing propensity of foreign materials, such as talcum, starch, and creams, when used in excessive amounts and when inadvertently introduced into the wound.

Sterile isolation is provided only through the wearing of gloves. Sterile gloves are employed for the protection of the patient and the doctor. The dangers of cross infection make it imperative for the professional worker to wear gloves whenever the blood, tissue fluids, or saliva is contacted. Tuberculosis thrives in oral fluids. Serum hepatitis may be present in the blood of asymptomatic patients.

Isolation of patient from operating team

1. The site of incision is prepared. The operative field is cleansed by scrubbing with detergent soap, rinsing, and then painting with a suitable antiseptic.

2. The patient is further isolated from the doctor by means of sterile drapings of cloth or clothlike materials. The initial drape may be a single-thickness draw sheet measuring approximately 115 by 180 cm. A second drape called a front sheet, measuring about 115 by 175 cm, completes the major isolation.

3. The patient's head is wrapped with a double-sheet technique, using a drape as the lower sheet and a hand towel as the upper sheet.

4. Sterile drapings are secured with towel clips. In some oral surgical problems requiring the manipulation of the patient's head from side to side, it is good practice to suture to the skin those sterile drapings outlining the periphery of the incision.

5. The anesthetist and his or her equipment are isolated from the operating team by a drape-covered screen.

6. Only that field above the level of the surgical table is considered sterile. Hands, equipment, and supplies lowered below the level of the surgical table are considered as having been contaminated.

7. Organization is such that once the surgeon has completed the scrub, put on sterile gloves, and draped the patient, it will be unnecessary to break scrub to obtain needed items.

8. It is important at this point to establish that a gown, drape, or covering is considered to be *contaminated when wet* unless the gown, drape, or covering is made of waterproof material or otherwise backed by a waterproof lining or sheathing.

Modifications of aseptic routine for office pracice of oral surgery

One school of thought will insist that there can be no compromise with the aseptic measures employed in surgery. Another group may insist that a rigid aseptic technique is not practical in a busy office practice dealing with minor oral surgery in a large volume of patients. The fact remains that infection does not differentiate minor from major surgery, large numbers from small numbers of patients, or short operations from long operations.

It is generally believed that the reason for the relatively low incidence of oral infection after surgical procedures within the mouth can be traced directly to "man's acquired tolerance for his own microorganisms". No doubt these same organisms transmitted to another individual in cross infection are likely to result in virulent infection. In other words, man can tolerate his own organisms better than he can somebody else's. This fundamentally proper concept justifies the need for aseptic technique in surgical areas that defy complete bacterial sterilization, areas such as the mouth, the nasal and antral cavities, and the digestive and urinary tracts.

Despite the care that the operator may exert in preparing himself or herself, the instruments, the supplies, and the patient for oral surgery, the danger of cross infection is omnipresent. All reasonably intelligent efforts at limiting this danger of infection are the least that the patient should expect from the doctor.

Much of the operating room decorum employed for major surgery is within practical limits for oral surgical procedures. In the hospital operating room the level of the surgical table is the line of demarcation for asepsis. In the dental clinic the level of the armrests of the dental chair might be considered as a similar line of demarcation. Everything above the armrests should be subject to aseptic requirements.

The perioral facial skin should be as carefully prepared as the mucosa directly involved in surgery. This can be conveniently done by asking the patient to wash the face with detergent hexachlorophene provided in the washroom. Then a colorless, nonirritating antiseptic is applied to the perioral skin as well as to the mucosa. The patient's mouth is lavaged with a pleasant-tasting antiseptic solution, and the immediate area of the needle puncture or incision is painted with an antiseptic having staining qualities so that the area for surgery is clearly visualized as having been antiseptically prepared.

The patient's hair may be enclosed in a sterile wrapping such as that employing double hand towels.

Most patients are highly pleased with any extra effort that the doctor may choose to employ in assuring a safer operation. Many patients prefer that the doctor's hands be gloved before they invade the mouth. In short-duration large-volume surgery, rubber gloves need *not* be changed for each patient. Instead the gloved hands may be scrubbed between patients, using a 2-minute scrub technique with detergent hexaclorophene soaps. The difficulty with this method is that the rubber gloves, when washed and dried in this manner, become "tacky" and thereby somewhat difficult to use unless used wet.

Surgical caps and masks need not be changed for each operation. The surgeon's gown can be isolated from the sterile sheets over the patient by clamping a sterile hand towel over that portion of the surgeons gown contacting the patient's sterile coverings. Uninformed patients and some doctors will oppose such recommendations concerning the need for sterile approach to so-called minor surgery in the mouth. But less than a hundred years ago there was similar opposition to the doctor who "fussed so much" washing his hands preparatory to surgery - and then proceeded to turn up the contaminated sleeves of his frock coat before reaching of the scalpel. In those days, "laudable pus" was erroneously accepted as a necessary sequel to surgery. There can be no justification whatsoever for permitting the "laudable pus" concept in oral surgery today.

Disposable (single-use) materials and equipment

Modern manufacturing, sterilizing, and packaging techniques are currently providing an ever-wider array of supplies conveniently packaged for single use and disposal thereafter. In many instances the increasing cost of labor in the multiple handling of reusable hospital supplies has resulted in making the use of disposables a more economical practice.

Paper and similar man-made fibers are replacing woven cloth for sheeting, drapes, toweling and similar supplies. Operating room gowns, scrub suits, lap sheets, stand covers, and surgical wrappings are now available in sterile, ready-to-use packages conveniently and economically disposable after single usage. Seamless disposable latex gloves that can be placed on surgically scrubbed hands without the need of dusting powders or creams are now being used in many hospitals and clinics.

Hypodermic needles, syringes, and plastic collection tubes and containers for biological specimens are currently packaged as disposables. Intravenous techniques including those concerned with the collection and infusion of blood and administration of drug and fluid therapy are largely accomplished with displasable plastic supplies and equipment. Almost every department of the hospital or clinic concerned with dispensing professional care seems to be using more and more of the increasingly available disposables. Furthermore, improved packaging techniques have made disposables more reliable and more desirable. Sterility of the contents is better ensured by sequence wrapping and action folding. The package can be clearly marked in bold-faced type and color coded to facilitate differentiation or storage. The potential for single-use supplies seems limitless.

Of course, the more disposables used within an activity, the more an increased adequate storage area is required for supplies with such a rapid turnover.

Some fundamental precautions with gaseous mixtures in operating rooms

The following anesthetic agents are considered combustible, and precautionary procedures must be employed in their administration: (1) cyclopropane, (2) divinyl ether (Vinethane), (3) ethyl ether, (4) ethyl chloride, and (5) ethylene. An explosion in an operating room is indeed a dramatic hazard, and unfortunately, like the automobile or airplane accident, it is classified as "something that happens to somebody else". As a regular operating room routine, the following precautionary measures are employed:

1. Modern oeprating rooms are built with conductive flooring. Operating room personnel and visitors must wear conductive footwear. Such shoes are usually made with conductive rubber or conductive leather soles and heels. They contain stainless stell conductors built into the inner sole so that frictional static electricity may be grounded and sparking avoided. Other floor-contacting devices are employed to ground equipment used in the vicinity of explosive, gaseous mixtures.

2. Wool, silk, and synthetic textures are known to produce electrical charge when subjected to friction. For this reason no woolen blankets and silk or nylon garments are permitted in the operating rooms.

3. Electrical equipment and anesthetic and other apparatus commonly used in the presence of combustible gases must be periodicalliy examined to assure freedom from any defect that might emit spark in the presence of explosive mixtures.

4. Electrocautery, electrocoagulation, and other equipment employing open spark are of course not permitted in the vicinity of combustible gases.

Oxygen cylinders

Ordinarily oxygen is not considered an explosive agent, but it does support combustion, and thereby it may be considered as secondarily contributory to explosion. Some basic precautions must be taken with the care of oxygen cylinders.

1. Fundamentally, oils, greases, and lubricants may be highly combustible with oxygen. Therefore their proximity to oxygen must be avoided. Regulators, gauges, and other fittings on oxygen cylinders must not be lubricated when the cylinder contains the gas under pressure.

2. Oxygen cylinders must not be handled with oily hands or greasy gloves or rags.

3. Before applying fittings to the cylinder, clear the duct opening by allowing a momentary escape of gas.

4. Open the high-pressure valve on the cylinder *before* bringing the oxygen apparatus to the patient. Open this valve slowly and take common precautionary measures concerned with unexpected explosion.

5. Avoid covering the oxygen cylinder with gowns, linens, or other equipment that may serve to contain leaking gas.

6. Never use oxygen from a cylinder that does not have a pressure-reducing regulator.

7. Do not attempt to repair any attachments on a cylinder containing oxygen under pressure.

Basic Oral Surgery

Incision

The efficient employment of a scalpel requires a basic knowledge of convenient fulcrum points already taught the dental surgeon during instruction in the use of motor-driven instruments within the mouth. The scalpel is gripped firmly but lightly in any one of several grasps. It should not be grasped too rigidly or in such a manner as to produce digital tremors and otherwise influence the unrestricted movement that is required in producing a clean, atraumatic incision or both.

Two scalpel grasps that are most commonly employed in oral surgery are illustrated. The "pen grasp", in which the handle of the blade is engaged between the thumb and first two fingers, is favored for the delicate short strokes frequently required for intraoral surgery.

Skin is more difficult to incise than mucosal tissue, and the steady pressure required for such cutting may be better obtained by grasping the scalpel in the "table-knife" manner.

The choice betweenone scalpel grasp and another becomes a matter of individual preference. It is more important that an atraumatic technique for incision and excision procedures be developed so that a sharp scalpel may be safely and efficiently employed. It is much safer to use a fulcrum point during surgical incision so that the scalpel may be braced by fingers resting on bone or tooth structure conveniently adjacent to the line of incision. A clear visualization of the area about to be incised is imperative.

Intraoral incisions involving the reflection of the mucoperiosteum for exposure of bone or dental structures are direct, straight-line, or curvilinear incisions taking the shortest distance through the tissues. However, where underlying bone may be remote from the site of the incision, such as when operating on the soft palate, tongue, cheeks, lips, and floor of the mouth, the incision is not necessarily direct. In these cases the incision is made only through the mucosa. Thereafter blunt dissection is combined with further sectioning, or scissors section, so that important anatomical structures are not needlessly sacrificed. Such dissection may be carried out with blunt instruments; the tissues layers are separated by actual tearing. Hemostatic forceps, rounded scissors, the handle end of a scalpel, or the gloved finger of the surgeon is commonly used for blunt dissection.

Cleavage dissection, in which the tissue layers are exposed by accurate snipping of the tissues with a sharp scissors or scalpel, produces less blind trauma than does blunt dissection. This, however, requires more detailed anatomical knowledge. The actual cutting is necessary only to expose a line of cleavage between tissue layers, permitting easy separation of the layers until another line of cleavage is exposed. The next tissue layer is then cut and dissected until another cleavage is encountered. Thus an orderly and atraumatic approach is made to the pathological area.

Skin surgery on the face carries the cosmetic requirement that the postoperative scar be minimal in size and so uncomplicated as to be esthetically acceptable. Whenever possible, these incisions are concealed in natural wrinkles, in the hairline, along the mucocutaneous junctions, or in shaded areas such as the nasolabial fold and the immediately submandibular-cervical zones.

The skin of the face and neck is generously endowed with wrinkles and creases representing lines of tension and relaxation of the skin in its response to the action of the muscles of expression and mastication. The depth of the skin wrinkles varies with the age and weight of the patient and the placement of these creases is generally symmetrical. Planning the surgical scar for best esthetic results demands that the incision be placed into one of the creases of skin relaxation or, as a second choice, into an immediately parallel area. Furthermore, it is desirable that skin incisions be made along, not across, the grain of the skin. Incisions made in skin wrinkles will permit wide exposure of the operative field, since these are really cleavage lines of the superficial tissue planes. If incisions are made across these lines of tensions, sutures will be placed under maximum stress, and the possibility of unfavorable cicatricial formation will be enhanced.

Hair clipping, of course, is necessary when hairy areas are invaded. However, eyebrows are not shaved and eyelashes are not clipped.

Particular attention must be given to the prevention of wound infection because septic wounds may heal with irregular and extensive scarring. Depression contraction and hypertrophy along the line of incision produces unsatisfactory cosmetic results, which oftentimes require corrective surgery that might have been avoided if adequate early care had been thoughtfully administered. Incisions must be made with a sharp scalpel, perpendicular to the skin surface, and preferably in the natural skin creases. The capable surgeon is especially adept at the gentle handling of soft tissue. "Heavy-handed" retracting may result in the necrotizing of such injured tissue with subsequent healing by second intention and considerably more scarring than was necessary. In sutiring a skin incision about the face, a slight eversion of the skin edges is preferred. This will compensate for anticipated swelling and permit the levelling out of the eversion without loss of the edge contact of the skin incision. It is simply a means for aborting a spreading of the line of incision.

Skin edges must not be sutured too tightly, and sutures should be removed on the third or fourth day to avoid suture scars. Halsted's basic teachings can well be repeated - the suture material should be no stronger than the tissue itself; a greater number of fine stitches is better than a few coarse ones; fine silk or cotton, Nos 3-0, 4-0, and 5-0, is used to best advantage for skin incisions on the face. When it is necessary to support such fine skin suturing, this may be done by the following methods:

1. Deep, dermal tension sutures.

2. Antitension elastic and adhesive bandaging across the suture line.

3. Pressure bandaging.

4. Subcuticular (intradermic) suturing with fine-gauge, stainless steel wire.

Any history of keloid scar formation should be recorded in the patient's history, and both doctor and patient should be fully aware of the calculated risks assumed in this regard. The black race is thought to be most predisposed to keloid formation, but this problem is not limited by racial boundaries.

Comment. In terminating the discussion concerning the surgery of tissue injury and repair, the following thoughts prevail as basic requirements:

1. It is necessary to answer the question: "When are wounds left open?" Wounds should be left open in the following situations:

a. When the injury is the result of human bite and thereby contaminated by highly pathogenic organisms. Human bite wounds are never sutured.

b. When contamination appears certain or when infection with suppuration is already evident.

c. When there is so much loss of tissue substance as to preclude adequate primary approximation. In massive loss of tissue, such as the cheek or a lip, the oral mucosa of the defect can be sutured to the surrounding peripheral skin so that the circumeference of the defect is maintained free of puckering and scarring while plastic surgery is pending.

2. Persistent complaint of pain in a sutured wound is most likely to be caused by skin sutures or retention sutures that are too tight. Usually after 3 to 4 days most sutures have fulfilled their greatest benefit and can be removed.

3. Contrary to common belief, an itching wound is certainly not indicative of normal healing. More likely, it suggests a hypersensitivity reaction to suture materials, bandages and dressing materials, topical medications, or other treatment materials.

4. Persistent suppuration in an otherwise healthy patient suggests a retained foreign body in or about a wound.

Suture materials

Currently in oral surgery there appears to be a preference for nonabsobrbale suture materials for cutaneous, mucosal, and deeper layer approximations. However, absorbable suture materials are still widely used in subsurface closures. Of the absorbable sutures, catgut is commonly used. Actually catgut is a misnomer because the material is made from the serosa layer of sheep intestine. It is provided by manufacturers as plain and tanned (chromic) in a suitably wide range of sizes.

Of the nonabsorbable suture materials, black silk is widely used. It has an adequate tensile strength, produces minimal tissue reaction, and can be readily seen for convenient removal. No 4-0 is popular in oral surgery. If purchased in spool lots, it is inexpensive. Ordinary cotton sewing thread, No 40, quilting, has many of the advantages of silk and is even less expensive.

Atraumatic-type sutures of both absorbable and nonabsorbable materials are provided by various manufacturers in sealed ampules containing a cold sterilizing medium. The atraumatic feature comprises a fine, 1/2-circle or 3/8-circle needle, which is swaged on one end of the suture material.

Wire mesh

In oral surgery, wire mesh is sometimes used to fill in bony defects and to develop lost bony contours. Tantalum mesh is most satisfactory because it is best tolerated when buried in the tissues. However, it is expensive. Stainless steel mesh has been gaining popularity as a satisfactory, less expensive substitute for tantalum. Wire mesh is made of extremely thin wires about 0.008 cm in diameter. The mesh is woven with about 22 wires to the centimeter. This allows sufficient spacing to permit tissue to grow through the wire meshing. The mesh must be sutured with wire of the same material or with nonabsorbable silk or cotton to eliminate the possibility of galvanic current activity.

Dressings

The primary intent of dressings is to keep the surgical field free of infection. Second, dressings support the incision, protect it from trauma, and absorb drainage. Intraorally, dressings are not used for these purposes. Within the mouth they are utilized as drains or as vehicles for carrying medicaments and obtundents to the operative site. Sterile strip gauze, 1 to 2 cm wide, is preferred. This gauze may be plain or iodoform. The iodoform gauze has antiseptic qualities, but it also has a strong, persistent, medicinal odor. When used as a drain, strip gauze may be saturated in petrolatum to facilitate removal after its purpose has been served.

Dressing intraoral injuries. The propensity for thorough and rapid healing of oral mucosa is well-known. For this reason, minor injuries, such as bites, burn, and limited surgery, will heal in a clean mouth without treatment. Large lacerations and surgical flaps require adequate positioning and approximation by suturing or other splinting of the injured tissues. Denuded areas within the mouth are acutely painful until granulation and coverage has been effected in healing. During this short but painful period of healing, intraoral dressing may be beneficial. Such dressings find wide usage in postperiodontal surgery in which a denuded area is covered not only for the relief of postoperative pain but also to control desired gingival contour.

Many intraoral dressings combine a medicament with other substances that produce a cementlike set. The medication is usually an obtundent for the local relief of pain. The cement often comprises combinations of zinc oxide, powdered resins, and gums mixed with tannic acid. Topical varnishes that produce a protective film over denuded areas are also helpful in relieving pain and salvaging blood clots. Many topical varnishes are available for this purpose. Some employ ether and collodion; others use cellophane, Teflon, and the polycarboxylate, waterproof cements. In general, it is difficult to maintain any dressing comfortably within a wet mouth for any prolonged period. However, since oral epithelium regenerates so rapidly in an injured mouth, just a few hours of topical dressing may carry a patient through the most painful period and also provide protection for the continued healing of a granulating wound. A more detailed discussion of intraoral dressings ranging from adhesive foils to waterproof cements is readily available in any current periodontal textbook.

Dressing extraoral injuries. For extraoral wounds, gauze pads that are 5 by 5 cm and 10 by 10 cm squares are practical. Such gauze pads are maintained in position by adhesive or elastic bandage. Elastoplast bandage is a cotton elastic with adhesive on one side. Because it is elastic, it does not constrict, yet it provides the desirable gentle, even pressure required to firmly support a dressing and avoid incisional hernia. Pressure bandaging is frequently employed for dressing facial incisions. Pressure dressings are used chiefly to spling the soft tissues and minimize edema that might tear through sutures and reopen the incision. They also serve to eliminate dead space, control secondary capillary oozing, and aborh heamtoma. Pressure dressings consist essentially of bulky materials, such as fluffed gauze, mechanic's waste, sea sponges, and foam rubber. The bulky material is place directly over the sterile gauze pads covering a wound ansd is retained in position by an elastic bandage.

A few problems caused by compression bandaging should be pointed out so that they may be recognized and eliminated if possible. These dressings are constrictive by design and are painful when used over a progressively swelling area. They may be responsible for lymphatic and venous blockage and thereby increase rather than decrease the swelling for which they were used. Pressure bandages should be heavily padded to be effective. The bandaged areas should be carefully observed for stasis and swelling *beyond* the edges of the bandage. If this occurs, the bandage should be either eliminated or the compression released for short periods of time to relieve the stasis.

Compression bandaging, when intelligently employed, will promote good wound healing with excellent cosmetic results at the line of incision. When poorly employed, such dressings will not only retard healing but may also stimulate fibrosis through lymphatic and venous obstruction in areas somewhat remove from the site of actual wound healing.

Operative Technique

General anatomy

It is not the purpose of this chapter to deal with the detailed anatomy in the oral surgery field. This information is readily and authoritatively available in many well-known sources. Fundamentally, the major facial vessels concerned in oral surgical exposures run a course that is (1) deep to the superficial muscles of expression (including the platysma but excluding the caninus and buccinator muscles) and (2) superficial to the muscles of mastication and, of course, the deeper facial bones. In a similarly general sense, the facial vein drains areas supplied by the facial artery and the posterior facial vein drains those deeper facial areas supplied by the terminal branches of the external carotid artery. The major sensory nerve to the face is the fifth cranial nerve. The major motor nerve to the face (other than to the muscle of mastication, which are supplied by the fifth cranial nerve) is the seventh cranial nerve. Surgical injury to the fifth cranial nerve may be considered of minor significance, since sequel to such injury most likely would be sensory paresthesia, with good chance for regeneration. However, surgical injury to the seventh cranial nerve and subsequent loss of function of the muscles of expression presents extreme cosmetic problems, without much hope for spontaneous and functional regeneration.

A thorough knowledge of the anatomical relations of the tissues that the surgeon is about to invade is of course mandatory. It is common practice among young surgeons of limited experience to perform the proposed surgery in cadaver dissection prior to the actual operation. Such procedure is good technique and is not to be misinterpreted as indicating deficiency.

Submandibular approach to the ascending ramus and body of the mandible

Most extraoral surgery requiring exposure of the mandible is done through a submandibular approach. The area about the angle of the mandible is considered more complex than are the more anterior zones, and this area will be discussed surgically.

The location of the incision must be given careful consideration to be sure that deeper anatomical structures are exposed to view in normal relationship. Positioning of the patient or rotating or extending his head may considerably alter the location of the incision as compared to its location when the patient is seated at rest. The incision in the submandibular approach should be made in one of the lines of skin tension, and it should be predetermined and marked either by superficial scratching with the back edge of a scalpel or by marking with an anyline dye. The gonial angle of the mandible and the notch in the inferior border of the mandible (produced by the pulsating facial artery) should be marked as points of reference, the former indicating the posterior terminus of the operative field and the latter suggesting the location of the facial artery and the facial vein. The incision is placed in the shadow line of the mandible about 2 cm below the inferior border of the mandible and curved in best cosmetic conformity with that bone. This distance below the mandible will avoid the cutting of the mandibular branch of the facial nerve. The total length of the incision may vary between 6 and 8 cm.

Crosshatching the line of incision. With the line of incision predetermined and marked, the patient's head is extended and turned as far as possible to one side. This is for the convenience and comfort of the operating team. A final, brief consultation is held with the anesthesiologist relative to the patient's readiness for immediate surgery. The line of incision, clearly marked, is then crosshatched by scratching vertical lines with the back edge of a scalpel, perpendicular to the prospective line of incision. These vertical scratch lines should be about 1.5 cm apart and extend, so spaced, throughout the length of the incision. Such crosshatching serves only to ensure that subsequent skin closure is perfectly approximated, with the least possible scar.

The incision. The skin is stretched superiorly so that the marked line of incision rests on solid bone and thereby provides a firm base for a clean incision in one deft incising move. The depth of the incision should be vertical and completely through the skin. Cutting on the bias may result in widening of the ultimate scar. A Bard-Parker blade No 10 or No 15 is well suited to skin incisions in this area, but the choice of scalpel rests with the operator's individual preference. Some bleeding points may be anticipated at this subcutaneous level. If the bleeding is arterial, the vessel is clamped with a Halsted mosquito hemostatic forceps and ligated with either fine cotton (No 3-0 or 4-0) or plain surgical gut (No 3-0). A square knot is recommended for vessel ligation, and the free ends are cut short on the knot.

deeper soft tissue dissection. With the skin and subcutaneous areolar tissue incised, they may be widely undermined by blunt dissection, using a 14 cm curved Mayo scissors, a hemostatic forceps, or the butt end of a knife handle. This will permit the insertion of retractors (such as a Kny-Scheerer trachea rake retractor) on each side of the incision to allow wide exposure and visualization of the underlying platysma muscle. A few points of interest relative to retraction technique might be developed now:

1. Good retraction includes gentle elevation as well as tractile force.

2. Good retraction should be reasonably firm and steady. Tissue is unnecessarily damaged and the operation time prolonged by the assistant who is persistently changing the position of the retractors.

3. When the operative technique so permits, the tractile force on the retractors should be periodically released without removing the retractors; thus circulation may be restored to the soft tissue flaps during that brief period.

4. Retraction must be continual and adequate during unexpected arterial hemorrhage until that immediate problem is solved.

With adequate exposure of the platysma muscle and its overlying and rather poorly defined superficial fascia, this muscle is now made ready for sectioning. It should be remembered that this muscle will later require suturing in closure by layers. At this time the muscle should be carefully dissected, elevated, and cleanly sectioned so that it can be conveniently found for later suturing. Immediately under the platysma muscle and along the border of the mandible, exploration should be provided for identification of the mandibular branch (ramus marginalis mandibulae) of the facial nerve. It is small and sometimes difficult to locate, especially if there has been surgical shredding of fascial tissue in the immediate field. It is often best found in the potential fascial space, just deep to the platysma and superficial to the anterior border of the masseter, or over the depresson anguli oris. Suspected segments of this nerve can be identified when stimulated with faradic current or by gentle clamping with a hemostatic forceps. The effect of such stimulation will be seen in noticeable contracture of the musculature at the corner of the mouth. The Bovie unit employing low current (noncoagulative) is frequently used in operating rooms to provide faradic current for such stimulation. Many surgeons consider that the most constant point of reference for convenient identification of the mandibular branch of the seventh cranial nerve is its relationship to the large, pulsating facial artery. The nerve is found lying directly over the facial artery as that vessel passes over the mandible. If the artery and vein are reflected superiorly from their location at the inferior border of the mandible, such retraction is certain to include and thereby salvage the more superficial mandibular branch of the seventh cranial nerve. This important nerve has considerable cosmetic and some functional significance, and it should not be inadvertently sacrificed.

The next step in orderly surgical approach concerns the identification and retraction of the facial artery and vein as they pass over the notching in the inferior border of the mandible just anterior to the angle. The parotideomasseteric fascia and other sheaths from the ascending deep cervical fasciae are first brought into surgical view. After adequate orientation by palpation of the inferomandibular nothc, this fascia is separated by blunt dissection, permitting the large, pulsating facial artery to bulge into the created opening. The larger facial vein will be found slightly superficial and posterior to the artery but in close approximation. Both vessels are sacrificed if necessary. This is best done by first clamping each vessel and then ligating proximally and distally before sectioning. White cotton sutures, No 2-0, are well chosen for this ligation. For smaller vessels, finer cotton sutures, Nos 3-0 and 4-0, are used. Of course, other subcutaneous suture materials such as chromicized surgical gut and similar absorbable ligating sutures are equally acceptable for this purpose.

Glandular tissue will be observed in the dissection at this point. This is the submandibular gland (glandula submandibularis). Some difficulty may be encountered in separating the lower pole of the parotid gland from the submandibular gland. The stylomandibular ligament is often surgically viewed as a heavy fascial plane that serves to separate these glands. The glandular tissues should be separated by blunt dissection and carefully retracted. If incised, they may produce persistent hemorrhage that may be difficult to control. With the glandular tissue retracted, the facial vessels subsequently ligated and sectioned, and the seventh cranial nerve salvaged and protected in careful retraction, the remainder of the surgical exposure can proceed with greater speed and impunity. Other smaller vessels will be encountered, but these will be of no surgical significance, unless requiring ligation to preserve blood volume and maintain a dry surgical field. Surgery on the body of the mandible anterior to the facial artery and veins is seldom complicated by excessive bleeding. Minor and smaller bleeders will often coagulate under pressure tampons. Sometimes the clamping of such a minor bleeder with a hemostatic forceps for a few minutes will serve to enhance coagulation so that ligation is not required. However, when the hemostatic forceps is removed, the bleeding site must be carefully evaluated to establish that hemostasis is complete. If in doubt, ligate the bleeding point.

Minor variations of the soft tissue surgery described will be required to meet the demands of surgery in more anterior aspects of the lower face. If the body of the mandible is to be approached, the location of the incision is placed more anteriorly. The amount of exposure required determines the length of the incision. Usually 6 to 7 cm will be found adequate, but accessibility should not be sacrificed only to produce a slightly smaller scar. To do so may result in unnecessary trauma to adjacent soft tissue, postoperative swelling, poor healing, and ragged scarring. It is good technique to identify and retract or identify, ligate, and retract blood vessels overlying the operative field. It is *necessary technique* to identify and salvage nerve supply - especially *motor nerve* supply.

Soft tissue closure. As in all surgery, closure of the soft tissues in the submandibular approach to oral surgery is carried out in an orderly manner. The field is first scrutinized to assure that hemorrhage is controlled and ligated vessels are adequately secured. It is better that the time be taken to ensure these necessary precautions at this stage of surgery rather than that they be inadequately performed and the patient suffer postoperative hemorrhage on the ward in the middle of the night.

Closure of the soft tissues is then done in layers, with anatomical repositioning in proper relation. Periosteal tissues are difficult to suture. Fine surgical gut, No 3-0 or 4-0, on a 3/8-circle, side-cutting needle is best used for this procedure. Whether the surgical gut is tanned (chromic) or plain is of small consequence. The chromic gut will resorb more slowly that will the plain, and this may be desirable in ligating large vessels and in suturing fascia. The cervical fascia is likewise closed. In operations on the ramus of the mandible in which the masseter muscle is detached and elevated, it is especially important that this muscle be well sutured at its origin in the vicinity of the angle of the mandible. This can be accomplished by suturing the lower end of the masseter muscle to the lower end of the medial pterygoid muscle (on the medial aspect of the mandible) at the angle of the mandible. The positions of these muscles may be slightly altered by this procedure, but no appreciable residual effect will be evident in their function.

It is important in closing by layers that approximation be reasonably accurate so that all dead space may be eliminated. Dead space is a harbor for a hematoma.

As the platysma is recognized and closed, assistants should hold skin hooks tautly at each end of the incision. In this manner, the longitudinal relation of this muscle is reestablished and smoother skin closure can be effected. Muscle closure at this superficial level can be established with No 4-0 plain surgical gut (although silk or cotton may be acceptable) on a small 3/8-circle, round needle. To approximate skin with minimal scarring, it is wise to use first a subcuticular suture of plain surgical gut or stainless steel wire. If the wire is employed, it can be conveniently removed after the tenth day. The subcuticular approximation serves to relieve suture tension on the skin incision.

If subcuticular suture has not been employed, the skin wound may be closed with vertical mattress sutures. Interrupted sutures are preferable to continuous sutures, since approximation may be maintained even if one of the sutures should slip. The skin sutures should be of nonabsorbable material of extremely fine gauge (No 4-0 or 5-0) on a 3/8-circle, cutting needle and spaced about 3 mm apart. The skin closure is initiated at each of the preoperatively marked crosshatchings to facilitate the exact repositioning of the skin.

It is considered good technique to slightly evert the line of skin incision in suture closure. Sutures must be removed on the fourth postoperative day to avoid suture scarring, and at that time there may be a tendency for some seapration in the suture line. Everting the skin edges permits some subdermal contracture without separation in the line of incision. Irrespective of the care devoted to skin closure, unless careful attention has been paid to the closure by anatomical layers of alll of the tissues, the cosmetic result may be unsatisfactory.

The skin incision line is first covered with a single-layer pad of sterile, lubricated gauze. The lubricant may be sterile petrolatum jelly. Over this is placed a 10 by 10 cm sterile gauze pad, and this is covered with a pressure dressing to limit postoperative edema. The dressing is part of the surgical procedure and is the responsibility of the surgeon. It is most important that all dressings, primary and reapplied, be sterile. The greatest complication to all wound healing is infection.

Surgical approach to the temporomandibular joint

Many of the so-called classic approaches to surgery of the temporomandibular joint mechanism have been complicated by the danger of surgical damage to the cosmetically significant seventh cranial nerve.

Blair used an incision resembling a reverse question mark or an inverted L, commencing in the temporal hairline and curving downward in close proximity to the anterior auricle. Wakely used a modification resembling a T incision with the horizontal bar of the T placed over the zygomatic arch. Lempert's endaural approach to the middle ear suggested to numerous observers that, with some modification, this basically could be employed as perhaps the safest surgical route to the glenoid fossae.

In 1951 Dingman and Moorman reported such a new approach, which appeared to be initiated somewhat similarly to Lempert's second endaural incision. The major objective of this approach concerned sectioning the minor fibrous attachment of the lamina tragi at its superior aspect and reflecting this cartilage anteriorly and down over itself. Rongetti in 1954 reported another modification of the second stage of Lempert's endaural approach to the middle ear, which promised safe and direct invasion of the temporomandibular joint. However, for practical purposes Rongetti's approach is similar to Dingman's, differing chiefly in that Rongetti invades the extenral auditory meatus to a greater depth and does not extend his incision as far superiorly and inferiorly as does Dingman. Both are endaural approaches, and both are designed to avoid injury to the facial nerve and to leave behind the least noticeable scar.

The endaural incision to expose the glenoid fossae has been used successfully for meniscectomy and condyloidectomy, but it is not necessary limited to that surgery.

The hair in the temporal fossa is shaved, and the head is prepared and draped for sterile surgery. The incision is started in the skin crease immediately adjacent to the anterior helix. It is carried downward to the level of the tragus, at which point it passes in a gap to the deeper aspects of the external auditory meatus where it is cosmetically concealed. The gap is filled with a fibrous attachment for the lamina tragi, and no damage is done in this sectioning. While in the auditory meatus, the incision remains in contact with the bony tympanic plate. As the incision leaves the external auditory meatus, the incision remains in contact with the bony tympanic plate. As the incision leaves the external auditory meatus, it becomes just visible at the lower aspect of the tragus. It is not necessary to section the cartilage at this point since the cartilage has sufficient elasticity to permit adequate retraction without hazarding incision at this close proximity to the stylomastoid foramen (exit point for the facial nerve). In the upper aspects of this incision, the superficial temporal vessles and the auriculotemporal nerve may be encountered. These vessels are either retracted or the artery and vein may be ligated and sectioned. The next landmark will be the temporalis fascia and then the exposed cartilage of the tragus. The fascia is sectioned with a scalpel or scissors, and the temporalis muscle is undermined with a periosteal elevator and raised from the root of the zygomatic arch. Some small portion of the upper upper pole of the parotid gland may be identified in this field. It is better to dissect and retract the glandular tissue since incising may produce troublesome bleeding. Mandibular excursions at this point will clearly demonstrate the condyle enclosed in a rather loose articular capsule. Further exposure may be effected by blunt dissection. Any further incising at this stage is best made directly over the condylar head or along the inferior margin of the zygomatic arch.

No surgical danger is anticipated deep to the temporalis fascia and lateral to the condyle. There may be some retraction paralysis of some of the branches of the facial nerve, since the area of exposure is small although adequate. This will be a temporary paralysis.

If further surgery deep to the neck of the condyle is required, this must be done with diligent respect for the maxillary artery, the middle meningeal artery, and the auriculotemporal nerve. Invasion of the pterygoid plexus of veins will result in persistent hemorrhagic seepage, but this is controlled by pressure tampons or Gelfoam strips saturated with a hemostatic. All gauze sponges used in this area should be tied on one end with long black suture silk to facilitate convenient removal.

The endaural approach to the temporomandibular joint, as for meniscectomy or condyloidectomy, is thought by many to be the most direct and perhaps the safest approach to a difficult area. The chief objections to it may be a limited range of exposure of the joint mechanism and the possibility of secondary infection of aural cartilage. However, these are small objections. Any surgical approach to this area that promises to eliminate the danger of damage to the facial nerve and provides a cosmetically acceptable postoperative scar is to be desired.

The Lempert operation for otosclerosis forms the basis for this modified approach to the temporomandibular joint by way of the external auditory meatus.

Armamentarium

Some of the more frequently used instruments and supplies for oral surgery are illustrated and identified in the figure. These are normally set up in sterile packs or case pans for routine use in oral surgical problems. To these routine setups the surgeon will add the special armamentarium required for a particular surgical problem.