46. Plastic Surgery

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Plastic surgery is best thought of as an organized body of surgical principles with unversal application throughout the body, emphasizing wound healing and transfer of tissues as well as the correction of congenital or acquired deformities and defects. The skills of the plastic surgeon have special application in the management of severe burns, in head and neck surgery, and in hand surgery.

The introduction of new technics for muscle, musculocutaneous, and free flap transfer now enables the plastic surgeon to cover large defects almost anywhere on the body in a single operation.

Precise technic and atraumatic handling of tissues are ideals sought by all surgeons but are perhaps even more important in the types of procedures commonly undertaken by plastic surgeons.

To obtain the best possible result in plastic surgery - ranging from simple wound closure to complicated procedures such as tissue transplantation - strict attention must be paid to the principles of atraumatic surgery. Improper or rough handling of tissue may cause necrosis and hematoma formation, which provides a medium for bacterial growth and sepsis. This results in further necrosis and tissue loss, delayed healing, and excessive scar formation. As a consequence, the desired fine-line scar or the successful "take" of the tissue transplant may not be achieved.

Important factors in atraumatic technic are as follows:

(1) Use of hooks to handle skin edges during wound closure rather than forceps or clamps that crush tissue.

(2) Inclusion of the smallest amount of tissue possible in the ligation of blood vessels.

(3) Minimal use of electrocoagulating instruments.

(4) Absolute hemostasis.

(5) Use of sharp, fine instruments, fine needles, and fine sutures.

(6) Avoidance of hot wound packs.

(7) Cutting done sharply under tension; suturing done precisely under no tension.

Wound Closure

Primary Closure

The ideal type of wound closure is primary approximation of the skin and subcutaneous tissues immediately adjacent to the wound defect, producing a fine-line scar and the optimal aesthetic result in skin texture, thickness, and color match. Closure by adjacent rotational or transposed flaps usually produces the next best aesthetic result. Closure by free skin grafts or nonadjacent skin flaps is less satisfactory and should be considered only when sufficient adjacent tissues are not available.

Normal Skin Lines & Fine-Line Scars

In most cases, fine "hairline" scars can be achieved only if the line or lines of incision are placed in or parallel to the skin lines of minimal tension. These lines lie perpendicular to the underlying muscles. On the face, they are obvious as "wrinkle lines" or lines of facial expression that become more pronounced with age, since they are secondary to repeated muscle contraction. On the neck, trunk, and extremities, the lines of minimal tension are most noticeable as horizontal lines of skin relaxation on the anterior and posterior aspects of areas of flexion and extension.

So-called Langer's lines, which were determined by cadaver study, probably show the direction of fibrous tissue bundles in the skin and are no longed considered accurate guides for placing skin incisions.

If the lines of expression cannot be followed, the line of incision should (if possible) be placed at the junction of unlike tissues such as the hairline of the scalp and the forehead, the eyebrow and the forehead, the mucosal and skin junction of the lips, or the areolar and skin margins of the breast. Scars will be partially hidden if incisions are placed in inconspicuous areas such as the crease of the nasal ala and cheek, the auricular-mastoid sulcus, or the submandibular-neck junction. Lines of incision should never purposely cross flexor surfaces such as the neck, axilla, antecubital fossa, or popliteal space or the palmar surfaces of the fingers and hand.

Elliptic Excision

If a lesion is to be excised, an elliptic excision placed parallel to the skin lines of minimal tension will give the best result if the amount of tissue to be excised does not preclude primary closure.

If the ellipse is too broad or short, a protrusion of skin, commonly called a "dog-ear", will occur at each pole of the wound closure. This is most easily corrected by excising the dog-ear as a small ellipse.

A dog-ear may also be present if one side of the ellipse is longer than the other. In this case, it may be easier to excise a small triangle of skin and subcutaneous tissue from the longer side.

Free Skin Grafts & Flaps

As its name implies, a free skin graft is completely detached from the body during transfer from donor to recipient site. From its new habitat, it derives a fresh blood supply and develops an attachment.

A flap, in contradistinction to the free skin graft, retains a vascular attachment to the body at all times during transfer, so it must possess a functioning vascular system, both arterial and venous, capable of maintaining an adequate circulation during the stages of transfer from donor to recipient site. This means that most flaps must include both skin and underlyijng superficial fascia or at times skin and underlying muscle (musculocutaneous flap).

Free Grafts

Types of Free Grafts

Free skin grafts are classified on the basis of their thickness as split thickness or full thickness.

A. Split Thickness Grafts: Split thickness grafts are further classified as thin, intermediate, and thick, depending upon the amount of dermis that is included with the graft. Since skin may vary in thickness from 0.017 inch to as much as 0.15 inch, an intermediate thickness graft from an area such as the eyelid would be much thinner than an intermediate thickness graft from the back. However, using the standard donor site areas such as the skin of the thigh or the lateral buttocks for reference, the average thin split thickness graft will measure 0.010-0.012 inch, the intermediate split thickness graft 0.016-0.018 inch, and the thick split thickness graft 0.022-0.024 inch.

Each type of split thickness graft has definite characteristics depending upon the thickness of the dermis and the number of skin appendage elements that are present.

Each thickness presents certain advantages and disadvantages. The major advantage of the thinner split thickness grafts is that they become vascularized more rapidly and thus survive transplantation more readily. This is of importance in grafting less than ideal recipient sites such as infected wounds, burn surfaces, and poorly vascularized surfaces. A second advantage in their use is that donor sites for these thinner grafts heal more rapidly, so that they can be reused within a relatively short period of time (7-10 days) in critical cases such as major burns.

In general, the disadvantages of the thin split thickness grafts outweigh the advantages. This grafts exhibit the highest degree of postgraft contraction, offer the least amount of resistance to surface trauma, and possess the least number of elements that are present in normal skin such as normal texture, suppleness, pore pattern, and hair growth. Hence, they are usually unacceptable from an aesthetic standpoint.

Conversely, the advantages of the thicker split thickness skin grafts are that they contract less, are more resistant to surface trauma, and possess to a greater degree the

desirable elements of normal skin. They are aesthetically more acceptable than thin split thickness grafts, though they are not as acceptable as full thickness grafts.

The disadvantages of thick split thickness grafts are relatively few. They are less easily vascularized than thin grafts and thus result in fewer successful "takes" when used on less than ideal surfaces. Their donor sites are slower to hear (requiring 10-18 days) and heal with more scarring than the donor sites for thin split thickness grafts, which may prevent their reuse.

Meshed grafts are usually thin or medium split thickness skin grafts that have been rolled under a perforating machine creating a mesh. Although initially advocated to expand the graft so that it can cover a wider surface (1.5-9 times), the 1.5 times expansion is most useful. Its advantages are that it can conform to a concave or irregular surface more easily, it can be placed on a granulating bed that is not as clean; and one does not have to be as meticulous with hemostasis. Its disadvantage is related to its poor appearance.

Donor sites for split thickness grafts heal spontaneously by epithelization. This process depends upon the presence of sweat glands, sebaceous glands, or hair follicles whose epithelial cells proliferate and spread across the wound surface.

B. Full Thickness Grafts: Full thickness skin grafts include the epidermis and all of the dermis. They are the most aesthetically desirable of all free grafts, since they include the highest number of skin appendage elements, undergo the least amount of contracture, and have a greater ability to withstand trauma.

There are several limiting factors in the use of full thickness grafts: the limited availability of donor sites, the necessity for closing the donor site, since no epidermal elements remain to produce epithelization, and the need for optimal conditions to obtain successful transplantation.

Areas of thin skin are best utilized as donor sites for full thickness grafts, because adequate vascularization of thick grafts will not occur before the graft dies. These areas of thin skin include the eyelids and the skin of the postauricular, supraclavicular, submammary, antecubital, inguinal, and genital areas. In grafts thicker than approximately 0.015 inch, the results of transplantation are consistently poor, except in the hand, where the hypothenal eminence provides an excellent donor site for thick split thickness grafts.

Composite Grafts

A composite graft consists of skin and other tissue, which is transferred without its blood supply as a free graft from the donor to the recipient area. The classic composite graft is a free graft of skin, subcutaneous tissue, and cartilage from the ear to the nose. Under optimal circumstances and for relatively small defects, it is reliable. Another example is the circular or rectangular graft of scalp that is used in hair transplantation.

Skin Grafting Techniques

Obtaining the Graft

Split Thickness

Various instruments are available for obtaining split thickness grafts. These include razor blades, skin grafting knives (Blair, Ferris Smith, Humby, Goulian), manual drum dermatomes (Padgett, Reese), and power-driven dermatomes of either the electric (Brown) or air variety (Hall).

The Blair and Ferris Smith knives are of limited value, since successful use requires the special skill of the surgeon who uses them constantly. Even the technically improved Humby knife with its adjustable roller to control the thickness of the graft is not to be recommended for the occasional user. Except in the hands of a very skilled surgeon, skin grafting knives generally produce narrow, inferior grafts of uneven thickness with irregular scalloped edges.

The more precise drum type dermatomes are more reliable. Because their thickness gauges are the most dependable, they more consistently produce a graft of the desired thickness. However, their use requires skill and experience as well as time, since their surfaces must first be coated with an adhesive or adhesive-bearing tape. Another disadvantage is that since the maximum length of the drum is 20 cm, longer grafts cannot be obtained without preparing the drum surface again between each cutting. They also require a fairly flat donor site if the surgeon desires a graft that measures the full 10-cm width of the drum.

Although the electric and air-powered dermatomes are not as precise as the drum type, they enjoy far wider popularity, since the average surgeon, even without prior experience, is able to obtain skin grafts successfully with these instruments. They do not require the use of an adhesive, and the fact that they can be rapidly assembled and used to cut multiple grafts quickly without cleaning and reapplying an adhesive is an important advantage in treating a patient with extensive skin loss (such as a burn patient), when it is desirable to limit the time of the surgical procedure. They also cut better than drum dermatomes on surfaces that are not perfectly flat, so that a wider choice of donor sites is available. The only major disadvantages are that they tend to produce grafts of uneven thickness and that the thickness tends to vary from the setting on the thickness gauge. The greatest width of graft that they will cut is 7.5 cm, which is narrower than that obtained with the drum dermatome. However, grafts of any length can be obtained depending only upon the length of the donor site.

Full Thickness

Full thickness grafts are almost always cut to fit a small defect with an irregular outline. Because of this - and because they are cut precisely at the level of the junction of the dermis and the subcutaneous adipose layer - they are best obtained free-hand with a small scalpel blade, generally a No 15. The plane of dissection is readily found if saline or lidocaine with epinephrine is injected into the subcuticular zone. A pattern is traced from the defect to be grafted by overlaying it with transparent plastic sheeting or exposed x-ray film and outlining the wound margins on the sheeting with marking ink. The pattern is then transferred

to the donor area and precisely traced with marking ink. An incision is made along these margins into the dermis but not into the adipose layer. Using adequate countertension, the graft is cut along the desired plane and any fat that is inadvertently removed withthe graft is trimmed away with a small curved plastic scissors.

Applying the Graft

After the graft has been applied directly to the prepared recipient surface, it may or may not be sutured in place and may or may not be dressed. Whenever the maximum aesthetic result is desired, the graft should be cut to fit the recipient area exactly and meticulously sutured into position without overlapping edges. Very large thick split thickness grafts and full thickness grafts will usually not survive without pressure. In areas such as the forehead, scalp, and extremities, adequate immobilization and pressure can be obtained by circular dressings. Tie-over pressure stent dressings are advisable for grafts in areas where pressure cannot be obtained by simple wraparound dressings (such as the cheek) or where movement is present (such as the anterior neck, where swallowing causes constant motion), and for grafts in areas of irregular contour (such as the axilla). This is accomplished by leaving the ends of the fixation sutures long and tying them over a bolus of gauze fluffs, cotton, sponge, or other suitable material.

When grafts are applied to freshly prepared or relatively clean surfaces, they are generally sutured into place and dressed with pressure. A single layer of damp fine mesh gauze is applied directly over the graft. Immediately over this are placed several thicknesses of flat gauze which have been cut by means of a pattern which exactly fits the graft. On top of this is placed a bulky dry dressing consisting of gauze fluffs, cotton, sponge, etc. Pressure is then obtained by wraparound dressings, adhesive tape, or the tie-over stent method.

In many cases it is permissible - and in some cases even preferable - to leave a skin graft site open with no dressing. This is particularly true in infected wounds, where the skin graft tends to "float off" in the purulent discharge that the wound produces. These wounds are better treated with meshed grafts so that any liquid material that forms between the graft and wound bed can be evacuated. This same principle holds true in noninfected wounds that produce an unusual amount of serous or lymphatic drainage, as occurs following radical groin dissections.

In severely ill patients such as those with major burns, where it is essential to keep anesthetic time to a minimum, large sheets of meshed split thickness skin grafts are rapidly applied without suturing, which is time-consuming. Skin staples may be used to fix the graft rapidly. Grafts on these wounds may be left open if the area is small, but if the area is large or circumferential, a dressing should be applied. Meshed grafts, however, should be covered for 24-48 hours to prevent dryness, because their dermal barrier has been partly disrupted.

Ensuring the "Take"

To ensure survival of the graft, 4 conditions must be satisfied: (1) adequate vascularization of the recipient bed, (2) complete contact between the graft and the bed, (3) adequate immobilization, and (4) relative freedom from infection as far as the recipient area is concerned.

Since survival of the graft is dependent upon the ingrowth of capillary budes into its raw undersurface, vascularization of the recipient area is of prime importance. Conditions such as advance radiation damage, chronic ulcers, bone or cartilage denuded of periosteum or perichondrium, and tendon without its paratenon are examples of avascular surfaces that will not generally accept free grafts. In these conditions, a bed capable of producing capillary budes must be provided by excision down to healthy tissues, removing and scraping all unhealthy granulation tissue, since the bacterial counts in granulation tissue are often very high. If bone is exposed, it can be decorticated into healthy cancellous bone with the use of a chisel, and a meshed split thickness skin graft can be applied. The technic of drilling holes through exposed cortical bone into the cancellous portion and waiting for granulation tissue to form is less desirable and more time-consuming. If an adequate vascular bed cannot be provided, skin or muscle flap (see below) are generally indicated.

Inadequate contact between the graft and the recipient bed can be caused by collection of blood, serum, lymph fluid, or purulent fluid between the graft and bed or by movement of the graft on the bed.

Thorough hemostasis is a cardinal rule in skin grafting and can be accomplished in most instances. In areas where adequate hemostasis with ligatures cannot be obtained, such as exposed cancellous bone from which the cortical surface has been removed, pressure must be relied upon for hemostasis. The standard tie-over pressure stent dressing is the best method of doing this.

The stent dressing is also useful in preventing serum or lymphcollection under the graft and is essential in areas where movement cannot be controlled, such as in anterior neck wounds, where constant swallowing is present. In these areas, basting sutures through the graft to the underlying surface may be used.

If infection is present in the wound that is to be grafted, it is best controlled by diligent local wound care withsaline compresses, conservative debridement, local antibiotics, and systemic antibiotics if indicated. complete freedom from infection in open wounds is never obtained, but local care should be given until the wound is in optimum condition to receive the graft as demonstrated by the presence of clean, healthy granulation tissue.

Healthy granulations are flat, red and vascular, do not bleed readily, and are free from a surface film of sloughing collagen.

Granulations left ungrafted for too long become more fibrous and less vascular, so that it becomes increasingly difficult to get a graft to take. Infection tends to add to the difficulties of grafting in those circumstances. Although a "good" granulating bed is considered imperative for the proper take of a skin graft, in fact, granulation tissue is only a necessary evil. Granulation tissue consists of young fibroblasts, capillaries, and bacteria. As this granulation tissue persists, the number of capillaries decreases as this is obliterated by the increasing amounts of fibrous tissue as well as bacteria. Granulation tissue then needs to be surgically excised (not merely scraped) so as to obtain a healthier bed with fewer bacteria, less fibrous tissue, and more capillaries.

Skin graft dressings may be left undisturbed for 5-7 days after grafting if the grafted wound was free of infection, if complete hemostasis was obtained, if fluid collection is not expected, and if immobilization is adequate. If any one of these conditions is not met, the dressing should be changed within 24-48 hours and the graft inspected. If blood, serum, or purulent fluid collection is present, evacuation of this collection should be accomplished - usually by making a small incision through the graft with a scalpel blade and applying pressure with cotton-tipped applicators. The pressure dressing is then reapplied and changed daily so that the graft can be examined and fluid expressed as it collects. Meticulous local care of the graft is essential, including debridement of any necrotic tissue that will allow colonization of bacteria beneath the graft surface, supporting infection that will further imperil the graft. When pondering when to change a skin graft dressing, remember that changing a dressing should never result in loss of a graft but that a graft may easily be lost if a dressing is not changed when it should be.

Donor Sites

Factors to Consider in Choosing the Donor Site

The ideal donor site woould provide a graft identical to the skin surrounding the area to be grafted. Since skin varies greatly from one area to another as far as color, thickness, hair-bearing qualities, and texture are concerned, the ideal donor site (such as upper eyelid skin to replace skin loss from the opposite upper eyelid) is usually not found. However, there are definite principles that should be followed in choosing the donor area.

A. Color Match: In general, the best possible color match is obtained when the donor area is located close to the recipient area. Color and texture match in facial grafts will be much better if the grafts are obtained from above the region of the clavicles. However, the amount of skin obtainable from the supraclavicular areas is limited. If larger grafts for the face are required, the immediate subclavicular regions of the thorax will provide a better color match than areas on the lower trunk or the buttocks and thighs. When these more distant regions are used, the grafts will usually be lighter in color than the facial skin in Caucasians; in people with dark skin, hyperpigmentation occurs, producing a graft that is much darker than the surrounding facial skin.

B. Thickness of the Graft and Donor Site Healing: Donor sites heal by epithelization from the epithelial elements remaining in the donor bed. These include hair follicles, sweat glands, sebaceous glands, and their ducts. The ability of the donor area to heal and the speed with which it heals thus depend upon the number of these elements present. Donor areas for very thin grafts will heal in 7-10 days, whereas donor areas for intermediate thickness grafts may require 10-18 days and those for thick grafts 18-21 days or longer. This may be of critical important in the treatment of severely burned patients, in whom sites may have to be reused within 7-10 days.

Since there is a normal anatomic variation in the thickness of skin, donor sites for thicker grafts must be chosen with the potential for healing in mind and should be limited to regions on the body where the skin is thick. Infants, debilitated adults, and elderly people have thinner skin than healthy younger adults. Grafts that would be split thickness in the

normal adults may be full thickness in these patients, resulting in a donor site that has been deprived of the epithelial elements necessary for healing.

C. Hair-Bearing Qualities of the Graft: Since the hair follicles are usually present at the lowermost level of the dermis and the upper regions of the subcutaneous adipose layer, they are rarely transplanted with split thickness skin grafts. However, it is generally advisable to avoid hair-bearing donor sites in obtaining thick grafts that are to be used on hairless surfaces.

D. Aesthetic Appearance of the Donor Site: While donor sites for very thin grafts may heal with minimal or almost invisible scarring, donor areas for thicker grafts can heal with scarring that is quite conspicuous. In these cases it is more desirable to obtain grafts from areas such as the lateral hips and buttocks than from the thighs, since these regions can more easily be hidden by clothing.

Care of the Donor Site

The care of the donor site must be as meticulous as the care of the grafted area. The method of care may vary, but the general principles are as follows: A layer of sterile, fine mesh, nonadherent gauze (such as 5% bismuth tribromophenate (Xeroform) or scarlet red) is placed directly over the wound. Several layers of sterile absorbent gauze bandages are placed over the nonadherent gauze. This dressing is then taped in place or held by a circumferential dressing. Oozing blood or serum will be absorbed by the dressing. This is removed in 24 hours, leaving in place the nonadherent gauze that is in direct contact with the wound. If a thin graft has been cut from this site, no further oozing will occur and the wound can be left open with the nonadherent gauze in place. If a thick graft has been cut, leaving a deep donor site, further oozing of serum can be expected. A fresh dressing of several layers of absorbent gauze is reapplied to collect this material, so that it will not form a crust over the wound under which bacteria will colonize. This is removed 24 hours later and the wound is left with only the nonadherent gauze covering. Heat lamps or warm air blowers may be used (with care) to facilitate drying of the wound. These may be dangerous, however, especially if they are used over areas that lack sensation, as in paraplegics. Serious burns have resulted. As epithelization occurs, the nonadherent gauze separates and is trimmed away. If isolated areas of superficial infection occur beneath the nonadherent gauze, the gauze is trimmed away over these areas so that saline compresses and local antibiotics can be applied. The entire gauze covering is not removed, since at this time there is a temporary adherence tothe wound and removing it will strip away the new epithelium that is being formed.

Flaps

A flap is a section of skin and subcutaneous tissue that is raised from one site and transferred to another. In contrast to free grafts, it always remains attached to its original donor site or its vasculature is reattached at a proper recipient level with microvascular technics (free flap).

There are 3 types of flaps: random, axial, and musculocutaneous.

The **random pattern flap** consists of a piece of skin and subcutaneous tissue from anywhere in the body and without any distinct pattern of arteries or veins; its blood supply comes at the subdermal level. This is the least reliable type of flap, because its blood supply is uncertain. It is risky when the ratio of length to width exceeds more than 1:1 or 1.5:1.

The **axial pattern flap** is a single-pedicled flap with a known arteriovenous system running along its long axis. Because of good vascular supply, it can be made comparatively long in relation to width. Foremost among the axial flaps are the deltopectoral and the forehead flaps, which are based on perforating branches of the internal mammary artery and superficial temporal vessels, respectively. Other axial flaps are McGregor's groin flap, based on the superficial circumflex iliac artery; and the dorsalis pedis flap, based on the artery of the same name. Less well understood but just as useful axial flaps include the cervicohumeral flap, the transverse back flap, and the transverse abdominal flap.

The **musculocutaneous flap** relies on the fact that skin overlying muscle is supplied from vessels that branch from the main arterial inflow to the muscle (perforating musculocutaneous branches). The muscle may be used as an independent flap without the overlying skin. It may then be covered with a skin graft after the transfer. In general, muscle and musculocutaneous flaps probably carry better blood supply to the recipient area than axial or random flaps.

Surface defects anywhere in the body can be covered with an appropriate flap. The most expeditious technic is usually chosen, but the flap must have an adequate blood supply.

Where an axial arteriovenous system already exists, no steps are required to enhance vascular efficiency. In random pattern flaps, vascularity may be enhanced by a "delay" in the transfer. This consists of dividing some of the blood vessels, so that the flap is "trained" to rely only on those vessels that will be functioning after the transfer. There is also some experimental evidence that the vascular efficiency of a random pattern flap can be increased by pharmacologic means, pretreating the animal or patient with isoxspurine or prostaglandins or even corticosteroids.

Types of Flaps

Flaps may be classified into several general categories: They may be local or distant, depending upon whether they were obtained from tissues adjacent to or distant from the recipient wound. They may be single or double, depending upon the number of points of attachment. If an exposed raw area exists on the undersurface between the donor and recipient sites, they are called open pedicle flaps; if no exposed raw surface exists, they are called closed flaps. If they consist of more than skin and adipose tissue - such as skin with attached cartilage or bone - they are called composite flaps. If they contain muscle, they are musculocutaneous flaps.

Flaps may also be classified as advancement flaps, transposed flaps, rotation flaps, jump flaps, and tube flaps.

A. Advancement Flaps: The advancement flap depends upon the skin being either loose enough or elastic enough to provide the necessary relaxation. It is the poorest and least

desirable method of flap design. The simplest example of the advancement flap is one produced by undermining the skin edges of a tense wound to provide adequate relaxation for closure. The fallacy of this design is that the limiting factor is the elasticity of the skin. If the skin is elastic enough, the wound will close without any necessary undermining. In fact, undermining causes no relaxatin or stretching of the skin; on the contrary, it is responsible for devascularization of the skin, creation of dead space with a possibility for hematoma formation.

Tbe V-Y advancement is a useful modification.

B. Transposed Flaps: Transposed flaps are local flaps that are advanced along an axis that forms an angle to the original position of the flap. They are usually rectangular and are generally transposed from an area where the skin is loose enough to provide for primary closure of the donor area.

If this laxity is absent, the donor site must be closed with another graft, usually a split thickness free graft. It is much better to cover the flap donor site with a skin graft than to perform a primary closure that places tension on the base of the flap.

On occasions, the flap cannot be transposed without tension. A short relaxing incision (back cut)) extending partially across the base may provide the needed relaxation if it does not interfere with the blood supply of the flap.

At times the flap may be open, a portion of its exposed undersurface passing over intervening skin to reach the recipient area. After a sufficient period of time has passed to allow for complete vascularization of the pedicle graft from the recipient site (usually 3 weeks), the pedicle is divided across its base and transfer is completed. The unused portion of the flap may be returned to the donor site or sacrificed.

C. Rotation Flaps: Rotation flaps are usually local closed flaps that are similar to transposed flaps but differ in that they are semicircular and rotate around a greater axis. As with transposed flaps, they are generally rotated from areas where the skin is lax enough to allow for primary closure of the donor area. A short relaxing incision (back cut) may be necessary, or as with transposed flaps, a split skin graft may be used to close the donor site when it cannot be closed primarily. One should resist the temptation to reclose the secondary donor defect under tension, which may cause flap ischemia and necrosis.

D. Jump Flaps: Jump flap pedicles are raised in the same fashion as the single based flaps. Instead of being transferred immediately to their recipient areas, they are "jumped" or transferred to an intermediate carrying site. An example would be a rectangular flap raised from the abdomen and attached to the forearm to be later transferred to another region of the body. They may be open or closed, depending upon whether the undersurface is closed primairly or skin-grafted.

E. Tube Pedicle Flaps: Tube pedicles are bipedicled flaps that are formed by undermining the skin and the adjacent adipose layer between 2 parallel incisions and then rolling the skin edges under and suturing them together. Therefore, they are closed flaps that are especially suitable for transfer to a distant recipient site via a carrier such as the forearm

or by migration by end-over-end transfer. Jump flaps and tubed flaps are rarely used today, having been supplanted by the faster and more elegant free flap.

Classic donor areas for tube pedicle flaps are the neck, the acromial-pectoral region of the anterior chest, the thoracoabdominal region of the trunk, the anterior abdominal wall, and the anteromedial aspect of the thigh. Any area onthe body can be reached by a minimum number of transfer or migration procedure from one of these areas.

F. Island Flaps: Island flaps consist of islands of skin and subcutaneous tissue that are transferred to new sites through a tunnel beneath the skin. The skin in the base of the island flap is removed, leaving only a neurovascular pedicle, so that skin will not be buried in the tunnel. The narowness of this pedicle provides for great mobility, so that the flap may be transferred from one area to another in one stage, eg, from the forehead to the nose or cheek, or from one finger to another.

The intact nerve in the neurovascular pedicle provides the flap with normal sensation. Sensation can be restored to the anesthetic tip of a thumb by transferring an island flap from the tip and radial aspect of the less important ring finger.

G. Free Flap: Popular now because of advances in microsurgery, free flaps are of axial pattern, muscle, and musculocutaneous flaps that are dissected out as island flaps and their vascular pedicles divided and later reattached to appropriate recipient vessels somewhere else in the body. The most commonly used axial pattern free flaps are the groin and dorsalis pedis flaps. The latissimus dorsi, gracilis, and tensor fascia lata muscle and musculocutaneous free flaps have become increasingly popular. Revascularized bone transfer in osteocutaneous flaps has also been performed successfully.

H. Z-Plasty: Z-plasty is actually a technic by which 2 triangular transposition flaps are elevated and transposed so that each flap occupies the other's original position. It has proved to be a very useful technic with 2 major applications: (1) lengthening a scar contracture line (flexion contractures across the neck, axilla, fingers, etc, congenital constriction bands, circular scars of body orifices); and (2) changin the direction of a scar (scars of the face that run across normal skin lines of minimal tension).

Maximum length is gained with a 90-degree angle but transfer is easier and gain in length is still substantial with a 60-degree angle.

Characteristics of Flaps

By definition, skin flaps remain attached to a donor site by a pedicle and possess their own blood supply through this pedicle. They also differ from free skin grafts in that they have a layer of subcutaneous adipose tissue lying beneath the full thickness of skin. These 2 factors make the use of flaps mandatory when the areas to be grafter are either avascular or require thick coverage to protect the underlying structures from trauma.

Examples of avascular surfaces are exposed bone, cartilage, or tendon without periosteum, perichondrium, or paratenon; exposed joint surfaces; wounds resulting from the excision of areas of radiation necrosis; and areas of extremely dense scar tissue.

Examples of structures or regions that require thick covering to protect them from trauma are bony surfaces and prominences; weight-bearing surfaces; densely scarred areas; and areas of decubitus ulcer formation.

There are numerous other characteristics of skin flaps that determine their use. Above all, they maintain all of the characteristics of normal skin. Their color and skin texture remain the same as before their transfer. For this reason, adjacent flaps usually provide for the best aesthetic appearance in reconstruction of facial defects if primary closure cannot be performed. By the same token, abdominal flaps are not desirable for use on the face, since they will continue to look like abdominal skin - different in color and with different skin texture, hair-bearing pattern, and thickness.

Hair growth, sebaceous secretion, and sometimes sweating are maintained by flaps. These factors - especially hair growth - make them undesirable for covering non-hair-bearing surfaces.

The bulkiness of flaps obtained from the abdomen and sometimes from the chest, buttocks, and thigh may be desirable when the defect to be covered requires this bulk to fill in depressed tissue defects. This bulkiness or thickness is especially desirable for covering bony prominences and decubitus ulcer sites. Bulkiness can be extremely undesirable on the face and neck, where it obliterates normal facial contours and features, and in the hand, where it interferes with normal function.

Sensibility is maintained in skin flaps to a degree related to that of the donor site. Flaps of abdominal or chest skin will not provide adequate sensibility to the fingertip, but flaps from adjacent fingers or the palmar surface will. Island flaps from adjacent fingers will provide for nearly normal sensibility, including 2-point discrimination.

Whereas free grafts undergo varying degrees of contraction, flaps do not. This is an advantage in areas of scar contracture when free grafting has failed, and in relaxing circumferential scar constriction around orifices and within tubular passageways such as nasal airways, the pharynx, the esophagus, and the vagina. In these instances, Z-plasty should usually receive first consideration. Before reopening a wound that has healed by contraction, remember that the resultant defect will approximate the size of the original wound before it heals.

The layer of adipose tissue present in flaps makes them less adherent to underlying tissues than free skin grafts. Normally movable tissues such as tendons, joints, and muscles should be covered by flaps so that their movement will be restricted as little as possible.

In some cases, coverage over alloplastic materials is necessary. Examples are coverage over a Vitallium or plastic cranioplasty and replacement of parietal pleura by a sheet of plastic mesh in wounds that extend completely through the chest wall. These materials must be covered by flaps with their own blood supply. This same principle applies to coverage of postradiation ulcers.

Flap coverage is essential wherever secondary procedures such as tendon or nerve repairs or bone grafts are necessary. Because of their excellent blood supply, incisions can

be made throughflaps, and they can be raised by undermining to expose the structures that they cover. Split thickness skin grafts are not sufficiently vascularized to permit this.

Another desirable characteristic of flaps is that they maintain the same growth rate as the donor site, so that contracture does not occur when they are used for coverage in children.

Clinical Uses of Axial, Muscle & Musculocutaneous Flaps

The deltopectoral and the forehead flap are teh axial flaps most commonly used in reconstruction following head and neck surgery. Pectoralis major, trapezius, and latissimus dorsi musculocutaneous flaps are also useful at times. These flaps can reach intra- or extraoral defects without preliminary delay procedures.

The **deltopectoral flap** is based on the perforating vessels from the internal mammary artery, the most important being the second perforator. It is a transverse flap that parallels the clavicle, and its inferior border is at the level of the axillary fold. The flap is elevated with the fascia, and it differs from other flaps in that it seems to stretch, thus reaching the area of the temple without difficulty. This stretching effect is explained by the fact that the skin of this area stretches as the arm is raised. This flap will cover defects anywhere in the neck and the face, and it has even been used to replace the cervical esophagus. It is less reliable as coverage for intraoral defects. Its donor site is somewhat objectionable, particularly in women.

Based on the superficial temporal artery, the entire forehead can be elevated on only one artery of either side. This **forehead flap** is most commonly used to cover intraoral defects or for partial or total reconstruction of the nose. The obvious disadvantage is the secondary defect, which may be quite objectionable.

The **groin flap,** based on the superficial circumflex iliac artery, parallels the inguinal ligament and may be extended 5 cm lateral to the anterior-superior iliac spine. It is useful for covering defects in the upper femoral and lower abdominal region or on the hand and wrist. The donor defect can usually be closed primarily.

The **transverse back flap** is based on the perforating vessels from the paravertebral area. It extends beyond the midline, and when used clinically it is in fact based on the contralateral paravertebral perforating vessels. Its most common use is for coverage of sacral ulcers.

The **transverse abdominal flap,** based on perforating vessels of the superior epigastric artery, can be used to cover defects on the lower chest.

The **dorsalis pedis flap** is technically difficult, but it can cover defects over the malleolus or heel. It is frequently used as a free flap, because of the size of the dorsalis pedis artery as well as the accompanying veins.

Musculocutaneous flaps are based on the principle that the skin overlying the muscle is supplied from perforating branches from the main arterial supply to the muscle. To perform a successful musculocutaneous flap is simple. One needs to know only the location of the major vascular pedicle, which must be preserved intact. The muscle and the overlying skin

may be completely circumscribed and transposed to cover an adjacent defect. The only precaution is to preserve the integrity of the perforating musculocutaneous vessels in the subcutaneous tissue by avoiding a disrupting shearing force between the skin and the underlying muscle. Clinically useful musculocutaneous units include the following: latissimus dorsi, pectoralis major, tensor fascia lata, trapezius, gluteus maximus, gracilis, and gastrocnemius musculocutaneous units.

The latissimus dorsi musculocutaneous unit is supplied by thoracodorsal vessels and has revolutionized one-stage reconstruction of the breast following radical mastectomy, providing the entire latissimus dorsi muscle, which, when disinserted from its origin, can be transposed to the anterior chest to simulate the pectoralis major muscle. An island of skin can also be included in the center of the muscle to restore the skin lost on the anterior chest wall. The breast mound is simulated by insertion of a Silastic gel implant at the same time, leaving only the nipple to be restored later. It is also useful for coverage of defects on the anterior chest, shoulder, head and neck, axilla, and even for restoration of flexion of the elbow.

The pectoralis major musculocutaneous unit obtains its vascular supply from the thoracoacromial axis of the subclavian artery just medial to the medial border of the pectoralis minor. The entire unit may be transposed medially, especially after dividing the insertion of the pectoralis major muscle from the humerus, to cover defects of the sternum, neck, and lower face. Also, an island of skin can be outlined low on the chest, pivoted on its vessels high up onthe clavicle, and made to reach intraoral defects following cancer excision. An elegant way of reconstructing full thickness defects in the head and neck region is to use the deltopectroal flap and on the same side to design a pectoralis major flap with an island of skin lower down, and then transpose both. The pectoralis flap is used for intraoral and the deltopectoral flap for extraoral coverage.

The trapezius musculocutaneous unit, based on the descending branch of the transverse cervical artery, is useful for covering defects in the neck, face, and scalp. When skeletonized as an island, the flap will reach the top of the head. When it is used in conjunction with a neck dissection, the transverse cervical artery must be known to be patent. Functional preservation of shoulder elevation may be accomplished by selectively leaving the superior fibers of the muscle intact.

The tensor fascia lata unit has its pedicle high off the profunda femoris, the dominant artery of the thigh. It has a wide arc of rotation anteriorly and posteriorly. It is elevated with the fascia lata and thus can be used to reconstruct the lower abdominal wall. It provides a safe and reliable means of covering defects following excision of osteoradinecrotic ulcers of the pubis or groin. It is also the method of choice for coverage of greater trochanteric pressure ulcers.

The gluteus maximus is very useful as a muscle or musculocutaneous unit for covering pressure sores or traumatic defects over the sacrum and ischium. The muscle has a double blood supply from the superior and inferior gluteal arteries to the respective halves of the muscle. Either half may be used independently. In ambulatory patients, it is important to leave half of the muscle, as total detachment may lead to hip instability.

The gracilis muscle receives its dominant blood supply proximally from the medial femoral circumflex artery. Its arc of rotation makes it an excellent source for coverage of ischial pressure sores and vaginal reconstruction. Other recent uses have been use of the muscle alone for repair of persistent perineal sinus following abdominal-perineal resection and for total penile reconstruction.

The gastrocnemius musculocutaneous unit is based on either the medial or lateral head of the muscle. Each head is supplied by a vascularpedicle of the popliteal artery which enters the muscle at its most proximal third near its origin. The flap is most useful to cover defects of the knee and anterior tibia. Coverage of exposed bone in the lower leg, where this unit cannot reach, can be accomplished in most cases by the use of transposition muscle flaps without skin utilizing the soleus, flexor digitorum communis, or peroneus muscles.

Microvascular Surgery

The technic for microvascular tissue transfer and replantation of severed parts such as hands and fingers has improved tremendously in the past few years. By using an operating microscope for magnification, arteries, veins, and nerves with a diameter of 1 mm or less can be successfully anastomosed to restore vascularity and sensibility to the transferred part. Digital replantation is not common. Case selection and postoperative rehabilitation are critical to achieve the best results.

Since the advent of this new technique, large free flaps of tissue can be transferred to any area on the body in one stage. Donor sites, initially limited to the groin or chest, have expanded to include free flaps of omentum and musculocutaneous units. Vascularized bone grafts of ribs or fibula can be transferred to repair defects of the mandible or the bones of the extremities. Innervated free flaps are being used to provide protective sensibility to weight-bearing areas in paraplegics.

Specific Disorders Treated by Plastic Surgery

Hypertrophic Scars & Keloids

In response to any injury that is severe enough to break the continuity of the skin or produce necrosis, the skin heals by scar formation. Under ideal circumstances a fine, flat, "hairline" scar will result.

However, hypertrophy may occur, causing the scar to become raised and thickened, or a keloid may form. A keloid is a true tumor arising from the connective tissue elements of the dermis. By definition, keloids grow beyond the margins of the original injury or scar, and in some instances may grow to enormous size.

Healing and scar formation progress through 3 definite phases: exudative, proliferative, and maturation. During the exudative phase, blood and tissue fluids form an adhesive coagulum and a fibrinous network that serve to bind the wound surfaces.

Proliferation of endothelial and fibroblastic elements bridges the wound surfaces or fills in the spaces created by the loss of tissue. During this phase, the scar usually appears red

and may be quite firm or hard. In the case of a fine incision, this phase may be short and the response minimal; in the case of a large open wound following avulsive injuries or burns, it may be prolonged and the response maximal.

The maturation phase begins as soon as the phase of fibroblastic proliferation has ceased. As the fibroblasts mature, the scar becomes less cellular and less vascular and begins to appear flat and white. Slow contracture also occurs.

Hypertrophic scars and keloids are produced during the second and third phases of scar formation. The tendency should be resisted to regard all thickened scars as keloids and label as "keloid formers" all patients with unattractive scars. Hypertrophic scars and keloids are distinct entities, and the clinical course and prognosis are quite different in each case. The overreactive process that results in thickening of the hypertrophic scar ceases within a few weeks - before it extends beyond the limits of the original scar - and in most cases some degree of maturation occurs and gradual improvement takes place. In the case of keloids, the overreactive proliferation of fibroblasts continues for weeks or months. By the time it ceases, an actual tumor is present that typically extends well beyond the limits of the original scar, involves the surrounding skin, and may become quite large. Maturation with spontaneous improvement does not usually occur.

Hypertrophic scars and keloids can be differentiated by histopathologic methods. Clinical observation of the course of the scar is also a practical means of differentiation.

Treatment

Since nearly all hypertrophic scars will undergo some degree of spontaneous improvement, they do not require treatment in the early phases. If the scar is still hypertrophic after 6 months, surgical excision and primary closure of the wound are indicated. Improvement may be expected when the hypertrophic scar was originally produced by excessive endothelial and fibroblastic cell proliferation, as is present in open wounds, burns, and infected wounds. However, little or no improvement can be anticipated if the hypertrophic scar followed uncomplicated healing of a simple surgical incision. Hypertrophic scars across flexion surfaces such as the anterior elbow or the fingers cannot be improved unless a procedure such as a Z-plasty is performed to change the direction of the scar.

Pressure may help flatten a potentially hypertrophic scar. It is particularly useful for burn scars. A measured elastic garment or face mask (Jobst) is applied to the scarred area, providing continued pressure that causes realignment and remodeling of the collagen bundles. To be effective, pressure should be applied early, continuously, and for 6-12 months. Use of intermittent pressure (eg, only at night) or after the hypertrophic scar is established (6-12 months) is of little value.

The treatment of choice for keloids is the injection of triamcinolone acetonide, 10 mg/mL (Kenalog-10 Injection), directly into the lesion. In the case of larger lesions, injection is made into more than one site. There is evidence that keloids may respond better to early than to late treatment.

Lesions are injected every 3-4 weeks, and treatment should not be carried out longer than 6 months. The following dosease schedule is used:

Size of lesion	**Dose per Injection**
1-2 cm^2	20-40 mg
2-6 cm^2	40-80 mg
6-10 cm^2	80-110 mg

For larger lesions, the maximum dose should be 120 mg. The maximum dose for each treatment for children are as follows:

Age	**Maximum dose**
1-2 years	20 mg
3-5 years	40 mg
6-10 years	80 mg

There is a tendency to inject the drug into the scar too often or in too high a dosage. Either may produce too vigorous a response, resulting in excessive atrophy of the skin and subcutaneous tissues surrounding the lesion and in depigmentation of darker skins. Both of these adverse responses will improve spontaneously in 6-12 months, but not necessarily completely.

The response varies greatly; some lesions become flat after 2-3 injections, and some fail to respond at all.

Topical corticosteroid therapy is of no value.

Before the advent of corticosteroid injection therapy, surgical excision and radiation therapy were the only methods of treatment of keloids. Both methods are disappointing; surgical resection usually leads to recurrence of a larger lesion; with very few exceptions, radiation therapy produces no result. At present, surgical excision is used only in conjunction with intralesional corticosteroid therapy. Excision is usually confined to the larger lesions in which steroid therapy would exceed safe dosages. The wound is injected at the time of surgery and then postoperatively according to the schedule recommended above. Care should be taken to avoid extending surgical incisions out into the normal skin around the keloid, since the growth of a new keloid may occur in these scars.

Bedsores

Bedsores (pressure sores, decubitus ulcers) result from ischemia and necrosis caused by direct pressure on an area of the body with decreased sensation (eg, from paraplegia or a regional neurologic deficit). The most vulnerable areas overlie bony prominences, and 96% of pressure sores occur on the lower part of the body.

Absence of sensation is the basic deficit, and unless this is compensated for, bedsores will recur. Prevention requires meticuous care of the skin, especially over bony prominences,

with position changes at least every 2 hours in paraplegic patients. Areas that begin to show early signs of pressure (eg, erythema) must be protected promptly. Water and air mattresses, sheepskin pads, and foam rubber cushions may help, but there is no substitute for diligent turning and careful inspection of susceptible areas.

Once a dermal ulcer is established, it must be protected from pressure and kept clean and dry so healing can occur. If the causative factors are allowed to persist, the ulcer will enlarge, become infected, and then enlarge further. If the ulcer extends as far as bone, it is not likely to heal without operative treatment. Local care with a topical antibacterial agent such as silver sulfadiazine (Silvadene) should be instituted. Daily whirlpool baths may aid debridement. Dead tissue must be excised, infection controlled, and the patient brought into optimal nutritional balance before surgical closure.

The objectives at operation are to debride devitalized tissue, including bone, and to provide healthy, well-vascularized padded tissue as a covering. All of the original tissue that formed the bed of the ulcer must be excised. Coverage is usually accomplished with a muscle, musculocutaneous, or, sometimes, an axial or random pattern flap. Well-vascularized muscle appears to help control established low-grade bacterial contamination. The flaps used for the more common bedsores are as follows: greater trochanter - tensor fascia lata; ischium - gracilis, gluteus maximus, or hamstrings; sacrum - gluteus maximus or transverse backflap. Suction drainage and irrigation with topical antibiotic solutions are used postoperatively.

Occasionally, it is possible to provide sensibility to the area of a pressure sore with an innervated flap from above the level of paraplegia. The most common example is the tensor fascia lata flap with the contained lateral femoral cutaneous nerve from L4 and 5, which is used to cover an ischial sore. Rarely, an innervated intercostal flap from the chest wall may be used to cover an anesthetic sacrum.

Postoperatively, the patient must be positioned to avoid pressure on the sore for at least 7-10 days. Systemic antibiotics are given only for the first 24-48 hours postoperatively. When healing is uncomplicated, it may be possible to discharge the patient within 2 weeks after operation, but discharge planning with a home care program is essential.

Facial Injuries

Initial emergency care of severe facial injuries should be directed toward maintaining the airway and control of hemorrhage. Manual removal of blood clots and suctioning, if available, will usually free the oral airway. The unconscious patient should be positioned prone, so that the tongue and the structures of the floor of the mouth do not occlude the oral pharynx. Tracheostomy is rarely necessary except in severe crushing injury of the mid face.

Bleeding is best controlled by pressure until careful clamping of severed vessels under direct inspection can be done. Unless there has been massive bleeding from a major arterial laceration or other associated injury, shock is usually not present in maxillofacial injury. However, the face and scalp are well vascularized, and it is easy to underestimate blood loss.

In managing maxillofacial trauma in the emergency room, one must be aware that progressive swelling of the face and neck may compromise the airway and make intubation

difficult. Therefore, anticipate problems and have the patient intubated early before complications develop.

Extensive soft tissue injuries of the face should be repaired in the operating room under aseptic conditions as soon as possible. Treatment of concomitant injuries to the central nervous system, chest, or abdomen may take precedence. Because of the generous blood supply to the head and neck, repair of soft tissue lacerations may be safely delayed for up to 24 hours after injury. Soft tissue injuries should not be repaired until the possibility of injury to deeper structures has been ruled out by careful examination. This includes evaluation of facial nerve function, levator muscle function in the eyelid, and signs of injury to the parotid and lacrimal ducts. Delayed wound repair usually should be accompanied by antibiotic coverage. As in wounds elsewhere, which may be contaminated, tetanus prophylaxis is indicated. In immunized patients, a booster will suffice; tetanus-immune human globulin must be considered in nonimmunized patients with severely contaminated wounds.

Surgical Treatment

Local anesthesia (0.5% lidocaine with epinephrine 1:200.000) is preferred to general anesthesia except in the case of very severe injuries when prolonged operation time and extensive skin grafting may be necessary. If intracranial injury is suspected, the type of anesthesia should be chosen after neurosurgical evaluation. With preliminary analgesic sedation, even small children and infants are usually cooperative when local anesthesia is used.

After local infiltration of the anesthetic, meticulous mechanical cleansing of the wound and adjacent skin is performed. Sterile drapes are then applied and the wound carefully explored using sterile saline irrigation to remove any imbedded foreign material. Suspected injuries to deeper structures can be verified at this time.

Debridement must include removal of all obviously devitalized tissues.

In special areas such as the eyelids, ears, nose, lips, and eyebrows, debridement must be very cautiously done, since the tissue lost by debridement may be difficult to replace. Where tissues are more abundant, such as in the cheek, chin, and forehead areas, debridement may be more extensive. Small irregular or ragged wounds in these areas can be excised completely to produce clean, sharply cut wound edges which, when approximated, will produce the finest possible scar.

Because the blood supply in the face is plentiful, damaged tissues of questionable viability should be retained rather than debrided away. The chances for survival are good.

After debridement and wound irrigation, meticulous suture approximation will often obviate the need for secondary revision or reconstruction. A lacerated parotid or lacrimal duct should be reparied over silicone or polyethylene catheter of appropriate size. Several major branches of the facial nerve should be repaired by fine sutures using optical magnification.

Closure of skin wounds should begin by approximation of key points. These include accurate rejoining of the borders of the lips, ears, and nose and reapproximation of such

features as the vermilion border of the lip, the margins of the eyebrow, and the scalp hairline. Dead space, which can lead to hematoma formation and infection, is prevented by approximation of subcutaneous adipose and muscular tissues by buried absorbable sutures.

Undermining of the skin at the subdermal layer is minimized or even avoided where there has been significant skin loss. Either 5-0 or 6-0 sutures should be used, either nonabsorbable or absorbable. Where extensive contamination has occurred, absorbable material is preferable for buried sutures. Careful closure of the wound with subdermal sutures is followed by accurate approximation of the skin edges with fine nylon sutures. Approximation without tension, using sutures that are not tied excessively tightly, provides the most aesthetically satisfactory result.

Complicated lacerations such as complex stellate wounds or avulsion flaps often heal with excessive scarring. Because of the associated subcutaneous tissue injury, U-shaped or trap-door avulsion lacerations almost always become unsightly as a result of wound contracture. Small lacerations of this type are best excised and closed in a straight line initially; larger flaps that must be replaced usually require secondary revision. Extensive loss of skin is generally best treated by initial split thickness skin grafting followed later by secondary reconstruction. Primary attempts to reconstruct with local flaps may fail because of unsuspected injury to these adjacent tissues. The decision to convert avulsed tissues to free grafts that may not survive and thus delay healing requires sound surgical judgment.

Pressure dressings are useful in preventing hematoma formation and severe edema, which may result in poor wound healing. Dressings should be changed early and the wound inspected for hematoma or signs of infection. Hematoma evacuation, appropriate drainage, and antibiotic therapy based on culture and sensitivity studies may be required. Removal of sutures in 3-5 days, followed by splinting of the incision with paper tape or collodion gauze strips, will minimize scarring from the sutures themselves.

Prognosis

The final result of facial wound repair depends on the nature and location of the wounds, individual propensity to scar formation, and the passage of time. A year or more must often pass before resolution of scar contracture and erythema results in maximum improvement. Only after this time can a decision be made regarding the desirability of secondary scar revision.

Fractures of the Facial Bones

The bones of the nose are the most commonly fractured facial bones. Next in frequency are the mandible, the zygomatic-malar bones, and the maxilla. Multiple combined fractures are common as a result of automobile collisions at high speeds. Although soft tissue edema may develop rapidly following facial injuries, the key to diagnosis is an adequate clinical examination. Pertinent questions are helpful, along with inspection of the face for swelling and asymmetry and actual palpation of the fracture lines.

If the patient is conscious, one should ask if his or her teeth fit properly. If not, there is a displaced maxillary or mandibular fracture.

Beginning along the mandibular rims, feel for irregularities of the facial bones. The dental occlusion is noted. With bimanual palpation, placing the thumbs inside the mouth, one can elicit bony crepitus if there is an associated fracture. The maxilla and mid face can be rocked forward and backward between the thumb and the index finger in the presence of a midfacial fracture. Nasal fractures may be detected by palpation. Irregularities and steps along the infraorbital border, lateral orbital rim, or zygomatic arch regions indicate a depressed zygomatic fracture.

Radiologic examination should include the Waters view, basal view of the skull (submento-vertex), oblique views of the mandible, and panorex views. A CT scan of the face may be helpful.

Nasal Fractures

Fractures may affect the nasal bones and nasal septum. Fractures occur in 2 patterns, caused by lateral trauma or head-on trauma.

With lateral trauma, the nasal bone on the side of the injury is fractured and displaced toward the septum; the septum is deviated and fractured; and the nasal bone on the side away from the injury is fractured and displaced away from the septum, so that the upper part of the nose, as a whole, is deviated. Depending upon the degree of violence, one or more of these displacements will be present, and the degree of comminution is variable.

Head-on trauma gives rise to telescoping and saddling of the nose and broadening of its upper half as a result of the depression and splaying of the fractured nasal bones. This of course produces severe damage to the septum, which usually buckles or actually suffers a fracture.

The diagnosis of a fractured nose is made on clinical grounds alone, and x-rays are unnecessary.

Nasal fractures requiring reduction should be trated with a minimum of delay, for they tend to become fixed in the displaced position in a few days. The surgical approach depends on whether the fracture has resulted in deviation or collapse of the nasal bones. Local anesthesia is preferred using either topical tetracaine or cocaine intranasally or lidocaine for infiltration on the skin. The nasal bones may be disimpacted with intranasal forceps or a periosteal elevator and aligned by external molding or pressure. collapsed nasal fractures can be repositioned with Walsham's nasal forceps, introduced into each nostril and placed on each side of the septum, which is then elevated to its proper position. A septal hematoma should be recognized and drained to prevent necrosis of the cartilaginous septum with associated collapse of the entire nose. Componoud fractures of the nose require prompt repair of the skin wound and, if possible, early reduction of the displaced nasal bones.

External splinting, which is essentially a protective dressing, and intranasal packing using nonadhering gauze are appropriate after reduction. The intranasal packing provides support for the septum in its reduced position and helps prevent development of a hematoma. It also provides counter pressure for the external splint immobilizing the nasal bones and prevents them from collapsing. The packing is usually removed within 48 hours.

In severe comminuted nasal fractures, the medial canthal ligaments, which are easily felt by applying lateral traction to the upper eyelid, may have dislodged. If they have been avulsed, they should be reattached in position to prevent late deformities. For these severe fractures involving the entire naso-orbital and ethmid complex, the coronal approach, which offers wide exposure, allows for proper anatomic reduction of all small nasal fragments as well as repositioning of the canthal ligaments with transnasal wire and correction and elevation of the telescoped bone fragments at the root of the nose and glabella.

The lacrimal apparatus is commonly disrupted in these injuries and should be repaired and stented appropriately.

Mandibular Fractures

Mandibular fractures are most commonly bilateral, generally occurring in the region of the mid body at the mental foramen, the angle of the ramus, or at the neck of the condyle. A frequent combination is a fracture at the mental region of the body with a condylar fracture on the opposite side. Displacement of the fragments results from the force of the external blod as well as the pull of the muscles of the floor of the mouth and the muscles of mastication. The diagnosis is suggested by derangement of dental occlusion associated with local pain, swelling, and often crepitation upon palpation. Appropriate x-rays confirm the diagnosis. Special views of the condyle, including tomograms, may be required. A sublingual hematoma may be diagnstic of a mandibular fracture.

Restoration of normal dental occlusion is the most important consideration in treating mandibular fractures. In patients with an adequate complement of teeth, arch bars or interdental wires can be placed. Local nerve block anesthesia is preferable for this procedure, though certain patients may require general anesthesia. Intermaxillary elastic traction will usually correct minor degrees of displacement and bring the teeth into normal occlusion by overcoming the muscle pull. When the fracture involves the base of a tooth socket with suspected devitalization of the tooth, extraction of the tooth should be considered. Particularly in the incisor region, such devitalized teeth may be a source of infection, leading to the development of osteomyelitis and nonunion of the fracture.

If the patient is partially or completely edentulous, either dentures or appropriate dental splints are used to maintain the mandible and maxilla in normal occlusion and provide a means of intermaxillary fixation. The dentures or splints may be wired directly by circumferential wires to the mandible and fixed to the maxilla either by pinning to the alveolar process or by suspensory wiring from above, entering the mouth through the upper buccal sulcus.

Intermaxillary fixation with wires immobilizes the mandible to the maxilla. This fixation should be maintained for 6 weeks in the case of fracture of the body and ramus. Earlier resumption of mandibular motion is indicated in cases of condylar fractures to prevent fibrotic ankylosis, which may accompany injury to the temporomandibular joint.

Open reduction of mandibular fractures is indicated where there is marked displacement that cannot be reduced or maintained by simple intermaxillary fixation. This may be the case in severely displaced fractures at the angle with muscle interposition that

prevents reduction. Fractures of the body of the mandible in edentulous patients may require open reduction and wiring or plating the fragments together for adequate fixation. Open reduction is followed by intermaxillary fixatin, using arch bars or splints, after normal occlusion is achieved.

With bilateral parasymphyseal fractures, anterior stabilization of the tongue may be lost, so that it may fall back and obstruct the airway. Anterior stabilization and splinting must be accomplished early in these patients.

Open reduction is not advised in condylar fractures except in the rare case where the condylar fragment may be so severely displaced as to prevent motion of the mandible because of impingement on the coronoid process or zygomatic arch. Even markedly displaced condylar fractures remodel after simple intermaxillary fixation to maintain normal occlusion. Early guided motion generally results in normal function.

Subcondylar fractures in children are almost always treated conservatively, with excellent functional results.

Zygomatic Fractures

Fractures of the zygomatic bones may involve just the arch of the zygomatic bone or the entire body of the zygoma (the malar eminence) and the lateral wall and floor of the orbit. The so-called tripod fracture characteristically occurs at the zygomatic frontal and zygomatic maxillary sutures as well as at the arch. Displacement of the body of the zygoma results in flattening of the cheek and depression of the orbital rim and floor.

Important diagnostic signs are subconjunctival hemorrhage, disturbances of extraocular muscle function (which may be accompanied by diplopia), and loss of sensation in the upper lip and alveoli on the involved side as a result of injury to the infraorbital nerve. Reduction of a displaced zygomatic fracture is seldom an emergency procedure and may be delayed until the patient's general condition is satisfactory for anesthesia. Local anesthesia will suffice only for reduction of fractures of the zygomatic arch. More extensively displaced fractures usually require general anesthesia. At least 2-point fixation with direct interosseous wiring is necessary for these fractures. The frontozygomatic and zygomaticomaxillary disruptions are most amenable to direct wiring. If instability remains, a 3-point fixation is desirable, which may be accomplished by transantral Kirschner wire fixation or an external head cap fixation device. On rare occasions, the zygomatic arch may be wired directly.

Depressed fractures of the zygomatic arch can best be elevated using the Gillies technic. Through a temporal incision above the hairline, an instrument is passed beneath the superficial layer of the temporalis fascia and under the arch and the body of the zygoma. The fracture can also be elevated percutaneously with a hook in conjunction with overlying palpation to achieve accurate reduction.

If extensive disruption of the orbital floor is suspected in conjunction with the zygomatic fracture, reduction of the fracture should be accompanied by direct visualization and repair of the orbital floor. Several approaches may be used for disimpaction and reduction of the displacement. These include the Gillies elevation and the transantral (Caldwell-Luc)

approach directly through the antrum to the orbital floor. This latter technic is particularly helpful when there is extensive comminution of the antral portion of the zygoma and the adjacent maxilla. The transanatral approach should not be done, however, without accompanying direct visualization of the orbital floor through a lower lid incision. Blind packing upward of the orbital floor may be hazardous, because spicules of bone may be pushed into the ocular globe. In complicated fractures, one or more of the approaches may be combined with direct visualization of the fracture sites and, if necessary, direct interosseous wiring to maintain reduction of unstable fragments. Elevation by grasping the zygoma with a towel clip is not recommended, since it is difficult to control the reduction of comminuted fractures by this method and since unsatisfactory scarring may develop where the instrument pierces the skin.

"Blowout" fracture of the orbit refers to extensive disruption of the orbital floor that may occur as a result of blunt trauma directly to the orbit with no associated fracture of the body of the zygoma or the orbital rim. Such fractures may result in depression of the ocular globe due to prolapse of orbital fat into the antrum. The extrocular muscles may also be entrapped by fragments of the disrupted floor. Diplopia occurs in either case. Careful x-ray examination, including orbital tomograms, is required to evaluate such an injury.

Repair of blowout fracture is effected after surgical exploratin of the orbital floor. This may require the transantral (Caldwell-Luc) approach to elevate the depressed fragments of the floor, accompanied by packing of the antrum for support. In cases where there is extensive comminution and loss of bony fragments into the antrum, an implant to the orbital floor may be required to maintain support for the ocular structures. A thin sheet of alloplastic material such as silicone has been satisfactory for this purpose, although bone grafts have been recommended. Even with careful anatomic reduction of the disruption of the orbital floor, there may be late ocular problems, particularly enophthalmos, which is due to resorption of the injured orbital fat. Pre- and postoperative ophthalmologic evaluation is mandatory.

Maxillary Fractures

Maxillary fractures range in complexity from partial fractures through the alveolar process to extensive displacement of the midfacial structures in conjunction with fractures of the frontonasal bones and orbital maxillary region and total craniofacial separation. Hemorrhage and airway obstruction will require emergency care, and in severe cases tracheostomy is indicated. Mobility of the maxilla can be elicited by palpation in extensive fractures. "Dish-face" deformity of the retruded displaced maxilla may be disguised by edema, and careful x-ray studies are necessary to determine the extent and complexity of the midfacial fracture. Treatment may have to be delayed because of other severe injuries. A delay of as long as 10-14 days may be safe before reduction and fixation, but the earliest possible restoration of maxillary position and dental occlusion is desirable to prevent late complications.

In the case of unilateral fractures or bilateral fractures with little or no displacement, splinting by intermaxillary fixation for 4 weeks may suffice. Fractures are usually displaced inferiorly or posteriorly and require direct surgical disimpaction and reduction. Early reduction may help control bleeding, as torn, stretched vessels are allowed to reestablish their normal tension. In certain severe cases, external traction may be necessary. Manipulation is directed

toward restoring normal occlusion and maintaining the reduction with intermaxillary fixation to the mandible in association with direct fixation or supporting wires from other intact facial or cranial bones. Complicated fractures may require external fixation utilizing a head cap and intraoral splints in conjunction with multiple surgical incisions for direct wire fixation. Coexisting mandibular fractures usually necessitate open reduction and fixation at the same time.

Congenital Anomalies

Head & Neck Anomalies

Cleft Lip & Cleft Palate

Cleft lip, cleft palate, and combinations of the 2 are the most common congenital anomalies of the head and neck. The incidence of facial clefts has been reported to be 1 in every 650-750 live births, making it second only to clubfoot in frequency as a reported birth defect.

The cleft may involve the floor of the nostril and lip on one or both sides and may extend through the alveolus, the hard palate, and the entire soft palate. A useful classification based on embryologic and anatomic aspects divides the structures into primary and secondary palate. The dividing point between the primary and the secondary palate is the incisive foramen. Clefts can thus be classified as partial or complete clefts of the primary or secondary palate (or both) in various combinations. The most common clefts are left unilateral complete clefts of the primary and secondary palate, and partial midline clefts of the secondary palate, involving the soft palate and part of the hard palate.

Most infants with cleft palate present some feeding difficulties, and breast feeding may be impossible. As a rule, enlarging the openings in the artificial nipple or using a syringe with a soft rubber feeding tube will solve difficulties in sucking. Feeding in the upright position helps prevent regurgitation or aspiration. Severe feeding and breathing problems and recurrent aspiration may complicate Pierre Robin syndrome, in which the palatal cleft is associated with a receding jaw and posterior displacement of the tongue, obstructing the oropharyngeal airway. The baby must be laid prone with a folded towel under the chest to allow the mandible to drop forward. Insertion of a small (No 8) nasogastric tube seems to provide enough of an airway to prevent respiratory distress and to help avoid complications such as tongue-lip adhesions. The small nasogastric tube not only opens the airway, but may also be used to supplement the baby's feedings.

Surgical repair of cleft lip is not considered an emergency. The optimal time for operation can be described as the widely accepted "rule of ten". This includes body weight of 10 lb or more and a hemoglobin of 10 g/dL or more. This is usually at some time after the 10th or 12th week of life. In most cases, closure of the lip will mold distortions of the cleft alveolus into a satisfactory contour. In occasional cases where there is marked distortion of the alveolous, such as in severe bilateral clefts with marked protrusion of the premaxilla, preliminary maxillary orthopedic treatment may be indicated.

General endotracheal anesthesia via an orally placed endotracheal tube is the anesthetic technic of choice. A variety of technics for repair of unilateral clefts have evolved over many years. Earlier procedures ignored anatomic landmarks and resulted in a characteristic "repaired harelip" look. The Millard rotation advancement operation that is now used for repair employs an incision in the medial side of the cleft to allow the cupid's bow of the lip to be rotated down to a normal position. The resulting gap in the medial side of the cleft is filled by advancing a flap from the lateral side. This principle can be varied in placement of the incisions and results in most cases in a symmetric lip with normally placed landmarks. Bilateral clefts, because of greater deficiency of tissue, present more challenging technical problems. Maximum preservation of available tissue is the underlying principle, and most surgeons prefer approximation of the central and lateral lip elements in a straight line closure, rolling up the vermilion border of the lip (Manchester repair). The prolabium, seemingly small, grows rapidly after repair and represents the entire length of the lip.

Secondary revisions are frequently necessary in the older child with a repaired cleft lip. A constant associated deformity in patients with cleft lip is distortion of the soft tissue and cartilage structures of the tip of the nose. Some correction of these deformities can be done at the time of initial surgery, but most cases require late revision after growth of the cartilaginous structure is complete. Many of the secondary procedures are minor in nature, including revisions of the scar and adjustments of local tissue deficiencies by either Z-plasties or V-Y advancement procedures. A tight upper lip due to severe tissue deficiency may be corrected in a 2-stage transfer of a flap from the lower lip - the Abbé flap operation.

Palatal clefts may involve the alveolus, the bony hard palate, or the soft palate, singly or in any combination. Clefts of the hard palate and alveolus may be either unilateral or bilateral, whereas the soft palate cleft is always midline, extending back through the uvula. The width of the cleft varies greatly, making the amount of tissue available for repair and reconstruction also variable. The bony palate, with its mucoperiosteal covering, forms the roof of the anterior mouth and the floor of the nose. The posteriorly attached soft palate is composed of 5 paired muscles of speech and swallowing.

Surgical closure of the cleft to allow for normal speech is the treatment of choice. However, in certain instances of severe tissue deficiency or in older patients with unrepaired clefts, closure of the defect with a dental prosthesis may be desirable. The consensus is that repair of the palate should be done between first and second year, since more tissue is available in the older baby. It is desirable to have the palate repaired and functioning as well as possible by the time the child undertakes serious speech, usually around age 2. If the soft palate seems to be long enough, simple approximation of the freshened edges of the cleft after freeing of the tissues through lateral relaxing incisions may suffice. If the soft palate is too short, a pushback type of operation is required. In this procedure, the short soft palate is retrodisplaced closer to the posterior pharyngeal wall, utilizing the mucoperiosteal flaps based on the posterior palatine artery.

Satisfactory speech following surgical repair of cleft palate is achieved in 70-90% of cases. Significant speech defects usually require secondary operations when the child is older. The most widely used technic is the pharyngeal flap operation, in which the palatopharyngeal space is reduced by attaching a flap of posterior pharyngeal muscle and mucosa to the soft palate. Various other kinds of pharyngoplasties have been useful in selected cases.

Craniofacial & Other Anomalies

The first and second branchial arch syndrome presents with deformities of variable severity. Deformities include absence of the external ear, partial or complete absence of the involved hemimandible, and lateral facial clefts. Craniofacial clefts have been classified and numbered according to Tessier.

Treacher Collins' syndrome presents a characteristic facies associated with mandibulofacial dysostosis.

Crouzon's syndrome, due to premature fusion of the facial sutures, is a rare anomaly. The major problems in these cases are related to the marked exophthalmos, hypertelorism, and maxillary hypoplasia.

In the past 15-20 years, craniofacial surgery has advanced to the point where several conditions, previously considered untreatable, can be successfully corrected. These are the craniofacial dysostoses, including Crouzon's disease and Apert's disease, and plagiocephaly, orbital hypertelorism, and facial clefts.

In addition, craniofacial surgery has improved the treatment of several other conditions such as congenital or traumatic orbital dystopia, traumatic or postsurgical orbital-cranial defects, congenital hemifacial microsomia (Teacher Collins' and Goldenhar's syndromes), Romberg's disease, nasomaxillary hypoplasia, fibrous dysplasia, and exophthalmos.

The principles of craniofacial surgery include the use of a coronal incision to approach the skull and facial bones through a combined intra- and extracranial approach. The abmnormally displaced bones are then moved to their normal position by the en bloc movement of large segments of bone or, at times, the entire facial mass. Autogenous bone grafts are used to fill the gaps created by displacing the bony segments. The entire operative procedure usually can be completed in one stage, and the incidence of complications is surprisingly low.

Anomalies of the Hands & Extremities

The most common hand anomaly is syndactyly, or webbing of the digits. This may be associated with normal digits or with absence of portions of the fingers and occasionally with an extra digit. Surgical correction by division of the webbed cleft - and repair with appropriate local flaps and skin grafts - should be accomplished prior to school age.

Flexion contractures of the hands or digits may require surgical release and appropriate skin grafting. Congenital ring constriction of the extremities may be associated also with cogenital amputation. The ring constrictions are best treated by excision and Z-plasty.

Poland's syndrome refers to abnormalities of the hand, usually syndactyly, and absence of the pectoralis major muscle. The latter deformity can be corrected by transposition of the entire latissimus dorsi muscle as an island, freeing its origin and inserting and reattaching it to the exact location of the absent pectoralis major muscle.

Skin Tumors

Tumors of the skin are by far the most common of all the tumors that are seen in humans. They arise from each of the histologic structures that make up the skin - epidermis, connective tissue, gland, muscle, and nerve elements - and are correspondingly numerous in variety.

Skin tumors are conveniently classified as benign, premalignant, and malignant. Only those tumors commonly seen by the plastic surgeon will be discussed here.

Benign Skin Tumors

The many benign tumors that arise from the skin rarely interfere withfunction. Since most are removed for aesthetic reasons, they are quite commonly treated by the plastic surgeon. The majority are small and can be simply excised under local anesthesia following the principles of elliptic excision and wound closure discussed above. General anesthesia may be necessary for larger lesions requiring excision and repair by skin grafts or those occurring in young children.

When the diagnosis is not in doubt, most superficial lesions (seborrheic keratoses, verruca vulgaris, squamous cell papillomas) can be treated by simple technics such as electrodessication, curettage and electrodessication, cryotherapy, and topical cytotoxic agents.

Seborrheic Keratosis

Seborrheic keratoses are superficial noninvasive tumors that originate in the epidermis. They appear in older people as multiple, slightly elevated, yellowish, brown, or brownish-black, irregularly rounded plaques with waxy or oily surfaces. They are most commonly present on the trunk and shoulders but are frequently seen on the scalp and face.

Since the lesion is raised above the epidermis, treatment usually consists of shave excision.

Verrucae Vulgaris

Verrucae vulgaris (common warts) are usually seen in children and young adults, commonly on the fingers and hands. They appear as round or oval elevated lesions with rough surfaces composed of multiple rounded or filiform keratinized projections. They may be skin-colored or gray to brown.

Verrucae are caused by a virus and are autoinoculable, which can result in multiple lesions around the original growth or frequent recurrences following treatment if the virus is not completely eradicated. They may disappear spontaneously.

Treatment by electrodessication is effective but is frequently followed by slow healing. Repeated applications of bichloroacetic acid, liquid nitrogen, or liquid CO_2 are also effective. Surgical excision is not recommended, since the wound may become inoculated with the virus, leading to recurrences in and around the scar.

Because recurrences are common despite thorough treatment, it is reasonable to delay treatment of asymptomatic lesions for several months to determine if they will disappear spontaneously.

Cysts

A. Epidermoid Cyst: Although sebaceous cyst is the commonly used term, these lesions more properly should be called epidermal or keratinous cysts, since they are composed of thin layers of epidermal cells filled with epithelial debris. (True cysts arising from sebaceous epithelial cells are uncommon.)

Epidermoid cysts are soft to firm, usually elevated, and are filled with an odorous cheesy material. Their most common sites of occurrence are the scalp, face, ears, neck, and back. They are usually covered by normal skin, which may show dimpling at the site of skin attachment.

Treatment consists of surgical excision.

B. Piral and Dermoid Cysts: Pilar cysts are deeper than sebaceous cysts. They are not attached to the skin but frequently are attached to or extend through underlying bony structures. They may appear in many sites but are most common around the nose or the orbit, where they may extend to meningeal structures, necessitating CT scan for determination of extent.

Treatment is by surgical excision, which may necessitate sectioning of adjacent bony structures.

Pigmented Nevi

A. Junction Nevi: Junction nevi are well-defined pigmented lesions appearing in infancy. They are usually flat or slightly elevated and light to dark brown in color. They may appear on any part of the body, but most nevi seen on the palms, soles, and genitalia are of the junction type. Histologically, a proliferation of melanocytes is present in the epidermis at the epidermal-dermal junction. It was formerly thought that junction nevi give rise to malignant melanoma and that all junction nevi should be excised for prophylactic reasons. However, most investigators now feel that junction nevi are not precancerous. If there is no change in their appearance, treatment is unnecessary. Any change such as itching, inflammation, darkening in color, halo formation, increase in size, bleeding, or ulceration calls for immediate treatment.

B. Intradermal Nevi: Intradermal nevi are the typical dome-shaped, sometimes pedunculated, fleshy to brownish pigmented "moles" that are characteristically seen in adults. They frequently contain hairs and may occur anywhere on the body.

Microscopically, melanocytes are present entirely within the dermis and, in contrast to junction nevi, show little activity. They are rarely malignant and require no treatment except for aesthetic reasons.

Surgical excision is nearly always the treatment of choice. Pigmented nevi must never be treated without obtaining tissue for histologic examination.

C. Compound Nevi: Compound nevi exhibit the histologic features of both junction and intradermal nevi in that melanocytes lie both at the epidermal-dermal junction and within the dermis. They are usually elevated, dome-shaped, and ligth to dark brown in color.

Because of the presence of nevus cells at the epidermal-dermal junction, the indications for treatment are the same as for junction nevi. If treatment is indicated, surgical excision is the method of choice.

D. Spindle Cell-Epithelioma Cell Nevi: These nevi, formerly called benign juvenile melanomas, appear in children or adults. They vary markedly in vascularity, degree of pigmentation, and accompanying hyperkeratosis. Clinically, they simulate warts or hemangiomas rather than moles. They may increase in size rapidly, but the average lesion reaches only 6-8 mm in diameter, remaining entirely benign without invasion or metastases. Microscopically, the lesion can be confused with malignant melanoma by the inexperienced pathologist.

The usual treatment is excisional biopsy.

E. Blue Nevi: Blue nevi are small, sharply defined, round, dark blue or gray-blue lesions that may occur anywhere on the body but are most commonly seen on the face, neck, hands, and arms. They usually appear in childhood as slowly growing, well-defined nodules covered by a smooth, intact epidermis. Microscopically, the melanocytes that make up this lesion are limited to (but may be found in all layers of) the dermis. An intimate association with the fibroblasts of the dermis is seen, giving the lesion a fibrotic appearance not seen in other nevi. This, together with extension of melanocytes deep into the dermis, may account for the blue rather than brown color.

Treatment is not necessary unless the patient desires removal for aesthetic reasons or fear of malignancy. Surgical excision is the treatment of choice.

F. Giant Hairy Nevi: Unlike most nevi arising from melanocytes, giant hairy nevi are congenital. They may occur anywhere on the body and may cover large areas. They may be large enough to cover the entire trunk (bathing trunk nevi). They are of special significance for severalreasons: (1) Their large size is especially deforming from an aesthetic standpoint; (2) they show a definite predisposition for developing malignant melanoma; and (3) they may be associated with neurofibroma or melanocytic involvement of the leptomeninges and other neurologic abnormalities.

Microscopically, a varied picture is present. All of the characteristics of intradermal and compound nevi may be seen. Neurofibromas may also be present within the lesion. Malignant melanoma may arise anywhere within the large lesion; the reported rate of occurrence ranges from 1% to as high as 13.7% in one study. Malignant melanoma with metastases can arise in childhood and even in infancy.

The only treatment is complete excision and skin grafting. Large lesions may require excision and grafting in stages. Some lesions are so large that excision is not possible. Split thickness excision or dermabrasion has been successful when done in infancy.

Hemangioma

It is confusing to attempt to classify hemangiomas on the basis of their histology. For example, the histologic term capillary hemangioma is used for both the common involuting hemangioma of childhood that disappears by age 7 and the port wine stain that persists into adulthood. The term cavernous is used to designate several types of hemangiomas that behave quite differently. Some hemangiomas are true neoplasms arising from endothelial cells and other vascular elements (such as involuting hemangiomas of childhood, endotheliomas, and pericytomas). Others are not true neoplasms but rather malformations of normal vascular strucutres (eg, port wine stains, cavernous hemangiomas, and arteriovenous fistulas).

A. Involuting Hemangioma: Involuting hemangiomas are the most common tumors that occur in childhood and comprise at least 95% of all the hemangiomas that are seen in infancy and childhood. They are true neoplasms of endothelial cells but are unique among neoplasms in that they undergo complete spontaneous involution.

Typically, they are present at birth or appear during the first 2-3 weeks of life. They grow at a rather rapid rate for 406 months, when growth ceases and spontaneous involution beings. Involution progresses slowly but is complete by 5-7 years of age.

Involuting hemangiomas appear on all body surfaces but are seen more often on the head and neck. They are seen twice as often in girls as in boys and show a predisposition for fair-skinned individuals.

Three forms of involuting hemangioma are seen - superficial, combined superficial and deep, and deep. Superficial involuting hemangiomas appear as sharply demarcated, bright red, slightly raised lesions with an irregular surface that has been described as resembling a strawberry. Combined superficial and deep involuting hemangiomas have the same surface characteristics, but beneath the surface a firm bluish tumor is present that may extend deeply into the subcutaneous tissues. Deep involuting hemangiomas present as deep blue tumors covered by normal-appearing skin.

The histologic findings in involuting hemangiomas are quite different from those seen in other types of hemangiomas. There is a constant correlation between the histologic picture and the clinical course. During the growth phase, the lesion is composed of solid fields of closely packed round or oval endothelial cells. As would be expected during the growth phase, cellular division with mitotic figures is seen, so that the lesion is sometimes called a hemangioendothelioma by the pathologist. This term must not be used, however, since it is commonly used to denote the highly malignant angiosarcoma that is seen in adults.

As the phase of involution progresses, the histologic picture changes, with the solid fields of endothelial cells breaking up into closely packed, capillary-sized, vessellike structures composed of several layers of soft endothelial cells supported by a sparse fibrous stroma. These vascular structures gradually become fewer in number and spaced more widely apart

in a loose, edematous fibrous stroma. The endothelial cells continue to disappear, so that by the time involution is complete the histologic picture is entirely normal with no trace of endothelial cells.

Treatment is not usually indicated, since the appearance following spontaneous regression is nearly always superior to the scars that follow surgical excision. Complete surgical excision of lesions that involve important structures such as the eyelids, nose, or lips results in the unnecessary destruction of these important structures that are difficult to repair.

Partial resection of a portion of a hemangioma of the brow or eyelid is indicated when the lesion is large enough to prevent light from entering the eye - a condition that will lead to blindness or amblyopia. The same type of treatment may be necessary for lesions of the mucosal surfaces of the lips when they project into the mouth and are traumatized by the teeth. In these cases, surgery should be very conservative - resecting only enough of the lesion to alleviate the problem and leaving the remaining portions to involute spontaneously.

In approximately 8% of cases, ulceration will occur. This may be accompanied by infection, which is treated by the use of compresses of warm saline or potassium permanganate and by the application of antibiotic powders and lotions. Bleeding from the ulcer is not common, and when it does occur it is easily controlled by the application of pressure.

After involution of large lesions, superficial scarring may be present or the involved skin may be thin, wrinkled, or redundant. These conditions may require conservative plastic surgery procedures.

The application of local agents such as dry ice to the surface of these lesions has been popular. This type of treatment has no effect on the deep portions of the hemangioma. It will destroy superficial lesions but results in severe scarring. Injections of sclerosing agents (eg, sodium morrhuate) have minimal effect. There is no place for radiation therapy in the treatment of these benign lesions.

B. Noninvoluting Hemangioma: Most noninvoluting hemangiomas are present at birth. In contrast to involuting hemangiomas, they do not undergo rapid growth during the first 4-6 months of life but grow in proportion to the growth of the child. They persist into adulthood, when they may cause severe aesthetic and functional problems. Some, such as arteriovenous fistulas, may cause death due to cardiac failure.

Unfortunately, treatment of noninvoluting hemangiomas is difficult and usually far from satisfactory.

Port wine stains are by far the most common of the noninvoluting hemangiomas. They may involve any portion of the body but most commonly appear on the face as flat patchy lesions that are reddish to purple in color. The light red lesions may fade to a varying degree but persist into adulthood. Some of the deep red or purplish lesions that have a stippled appearance show a propensity for growth later in life, in which case they become raised and thickened, with nodules appearing on the surface.

Microscopically, port wine stains are made up of thin-walled capillaries that are arranged throughout the dermis. The capillaries are lined with mature flat endothelial cells. In the lesions that produce surface growth, groups of round proliferating endothelial cells and large venous sinuses are seen.

Results following treatment of the port wine stain are uniformly disappointing. Since most lesions occur on the face or neck, patients seek treatment for the aesthetic problem they present. The simplest and still the most effective method of treatment is camouflaging. Unfortunately, this is difficult because the port wine stain is darker than the surrounding lighter skin.

Tattooing with skin-colored pigments may offer some measure of disguise in the lighter lesions but generally is unsatisfactory because the pigment deposited in the skin looks artificial and tends to be absorbed unevenly, producing a mottled appearance.

Superficial methods of treatment such as dry ice, liquid nitrogen, electrocoagulation, and dermabrasion are ineffective unless they destroy the upper layers of the skin, which produces severe scarring.

Radiation therapy, including the use of x-rays, radium, thorium-X, and grenz x-rays, is to be condemned. If it is administered in doses high enough to destroy the vessels involved, it also destroys the surrounding tissues and the overlying skin. Experience with the laser beam seems encouraging, but the results have not been dramatic.

If the lesion is small, surgical excision with primary closure may be indicated. Unfortunately, most lesions are large, and surgical excision requires split thickness skin grafting. Because of the scar present around the edge of the graft and the loss of normal skin texture - along with the inability to obtain a good color match between the graft and the facial skin - the results are far less than ideal.

Most port wine stains should be left alone.

C. Cavernous Hemangioma: Cavernous hemangiomas are bluish or purplish lesions that are usually elevated. They may occur anywhere on the body but, like other hemangiomas, are more common on the head and neck. They are composed of mature, fully formed venous structures that are present in tortuous masses which have been described as feeling like "a bag of worms".

Cavernous hemangiomas are usually present at birth but do not usually grow except to keep pace with normal body growth. In many cases, growth occurs later in life and may interfere with normal function.

Microscopically, cavernous hemangiomas are made up of large dilated, closely packed vascular sinuses that are engorged with blood. They are lined by flat endothelial cells and may have muscular walls like normal veins.

Treatment is difficult. In only a few cases is the lesion small enough or superficial enough to permit complete surgical excision. Most lesions involve deeper structures -

including muscle and bone - so that complete excision is impossible without radical surgery. Since most lesions are aesthetic problems, radical surgery is rarely indicated.

Other forms of treatment such as x-ray and radium therapy are of no value, since the mature vessels are not sensitive to radiation. Suture ligation of surrounding vessels, multiple intralesional ligations, and injections of sclerosing solutions usually have no effect upon the lesions and have been discarded. Superselective embolization under fluoroscopic angiographic control has been used with some success in the treatment of noninvoluting angiomas and arteriovenous malformations.

Premalignant Skin Lesions

Actinic (Solar) Keratoses

Actinic keratoses are the most common of the precancerous skin lesions. They usually appear as small, single or multiple, slightly elevated, scaly or warty lesions ranging in color from red to yellow, brown, or black. Since they are related to sun exposure, they occur most frequently on the face and the backs of the hands in fair-skinned Caucasians whose skin show evidence of actinic elastosis.

Microscopically, actinic keratoses consist of well-defined areas of abnormal epithelial cells limited to the epidermis. Approximately 15-20% of all lesions become malignant, in which case invasion of the dermis as squamous cell carcinoma occurs.

Since the lesions are limited to the epidermis, superficial treatment in the form of curettement and electrodesiccation or the application of chemical agents such as liquid nitrogen, phenol, bi- or trichloroacetic acid, or fluorouracil is curative. The application of fluorouracil (5-FU) cream is of particular benefit in preventive treatment in that it will destroy lesions of microscopic size - before they can be detected clinically - without causing damage to uninvolved skin.

Chronic Radiation Dermatitis & Ulceration

There are 2 distinct types of radiation dermatitis. The first and most common follows the acute administration of relatively high dosages of ionizing radiation over relatively short periods of time - almost always for the treatment of malignancy. It is characterized by an acute reaction that begins near the third week of therapy, when erythema, blistering, and sloughing of the epidermis start to occur. Burning and hyperesthesia are commonly present.

This initial reaction is followed by scarring characterized by atrophy of the epidermis and dermis along with loss of skin appendages (sweat glands, sebaceous glands, and hair follicles). Marked fibrosis of the dermis occurs, with gradual endarteritis and occlusion of the dermal and subdermal vessels, Telangiectasia of the surface vessels is seen, and areas of both hypo- and hyperpigmentation occur.

The second type of radiation dermatitis follows chronic exposure to low doses of ionizing radiation over prolonged periods of time. It is usually seen in professional personnel who handle radioactive materials or administer x-rays or in patients who have been treated

for dermatologic conditions such as acne or excessive facial hair. Therefore, the face and hands are most commonly involved. The acute reaction described above does not usually occur, but the same process of atrophy, scarring, and loss of dermal elements occurs. Drying of the skin becomes more pronounced, and deepening of the skin furrows is typically present.

In both types of radiation dermatitis, late changes may occur such as the following: (1) the appearance of hyperkeratotic growths on the skin surface, (2) chronic ulceration, and (3) the development of either basal cell or squamous cell carcinoma. Ulceration and malignancy, however, are seen much less commonly in the first type of chronic radiation dermatitis than in the second. When malignant growths appear, basal cell carcinomas are seen more frequently on the face and neck and squamous cell carcinomas more frequently on the hands and body.

Treatment of chronic radiation dermatitis or ulceration or the malignant lesions that develop is complicated by the marked scarring that is present and by the avascularity of the involved tissues secondary to endarterities.

Surgical excision is the treatment of choice. Excision should include all of the irradiated tissue including the area of telangiectasia, whenever possible, and the defect should be covered with an appropriate axial or musculocutaneous flap.

Primary wound closure is feasible for only the smallest lesions, and even so at some risk. Free skin grafting is usually unsuccessful because of the damage to the vascular supply of the subcutaneous structures. Adjacent and random flaps are unsuccessful because they cannot pick up blood supply from the surrounding irradiated area.

The extensive use of radiotherapy for the treatment of malignancies of the breast may result in radionecrosis of the chest wall. For head and neck malignancy radiotherapy may produce radionecrosis of the mandible, and when used for carcinoma of the cervix or prostate it may result in radionecrosis of the pubis or sacrum.

Radiation necrosis of the chest is best treated by excision of as much involved tissue as possible, at times including the chest wall, and one-stage coverage of the defect with a Prolene mesh to stabilize the chest wall and a flap of omentum which in turn is covered with a split thickness skin graft. Radiation ulcers in the region of the pubis are treated by wide excision and coverage with a tensor fascia lata musculocutaneous flap. Ulcers over the sacrum can be covered with a transverse back flap or a gluteus maximus musculocutaneous flap.

Radiation necrosis of the mandible can be managed by debridement of all infected irradiated tissue and coverage of the remaining bone and neck structures with a well-vascularized muscle or musculocutaneous flap, such as the pectoralis major, trapezius, or latissimus dorsi. Free flaps anastomosed to neck vessels may also be used for coverage.

Intraepidermal Carcinoma

Intraepidermal carcinoma includes Bowen's disease and erythroplasia of Queyrat.

A. Bowen's Disease: Bowen's disease is characterized by single or multiple, brownish or reddish plaques that may appear anywhere on the skin surface but often on covered surfaces. The typical plaque is sharply defined, slightly raised, scaly, and slightly thickened. The surface is often keratotis, and crusting and fissuring may be present. Ulceration is not common but when present suggests malignant degeneration with dermal invasion.

Histologically, hyperplasia of the epidermis is seen, with pleomorphic malpighian cells, giant cells, and atypical epithelial cells which are limited to the epidermis.

Treatment of small or superficial lesions consists of total destruction by curettement and electrodesiccation or by any of the other superficially destructive methods (cryotherapy, cytotoxic agents). Excision and skin grafting is preferred for larger lesions and for those that have undergone early malignant degeneration and invasion of the dermis.

B. Erythroplasia of Queyrat: Erythroplasia of Queyrat is almost identical to Bowen's disease both clinically and histologically but is confined to the glans penis and the vulva, where the lesions appear as red, velvety, irregular, slightly raised plaques. Treatment is as described for Bowen's disease.

Malignant Skin Tumors

1. Basal Cell Carcinoma

Basal cell carcinoma is the most common skin cancer. The lesions usually appear on the face and are more common in men than women. Since exposure to ultraviolet rays of the sun is a causative factor, basal cell carcinoma is most commonly seen in geographic areas where there is significant sun exposure and in people whose skins are most susceptible to damage from exposure, ie, fair-skinned individuals with blue eyes and blond hair. It may occur at any age but is not common before age 40.

The growth rate of basal cell carcinoma is usually slow but nearly always steady and insidious. Several months or years may pass before the patient becomes concerned. Without treatment, widespread invasion and destruction of adjacent tissues may occur, producing massive ulceration. Penetration into the bones of the facial skeleton and the skull is reported. Basal cell carcinomas rarely metastasize, but death can occur because of direct intracranial extension or because of erosion of major blood vessels.

Typical individual lesions appear as small, translucent or shiny ("pearly") elevated nodules with central umbilication and rolled, pearly edges. Telangiectatic vessels are commonly present over the surface, and pigmentation is sometimes present. Superficial ulceration occurs early. When invasion of the dermis and subcutaneous tissues occurs along with deeper ulceration, the lesion is termed a rodent ulcer.

A less common type of basal cell carcinoma is the sclerosing or morphea carcinoma, consisting of elongated strands of basal cell cancer that infiltrate the dermis, with the intervening coriumbeing unusually compact. These lesions are usually flat and whitish or waxy in appearance and firm to palpation - similar in appearance to localized scleroderma.

The superficial erythematous basal cell cancer ("body basal") occurs most frequently on the trunk. It appears as reddish plaques with atrophic centers and smooth, slightly raised borders. These lesions are capable of peripheral growth and wide extension but do not become invasive until late.

Pigmented basal cell carcinomas may be mistaken for melanomas, because of the large number of melanocytes present within the tumor. They may also be confused with seborrheic keratoses.

Treatment

There are several methods of treating basal cell carcinoma. Alll may be curative in some lesions, but no one method is applicable to all. The special features of each basal cell cancer must be considered individually before proper treatment can be selected.

Since most lesions occur on the face, aesthetic and functional results of treatment are important. However, the most important consideration is whether or not therapy is curative. If the basal cell carcinoma is not eradicated by initial treatment, continued growth and invasion of adjacent tissues will occur. This will result not only in additional tissue destruction but also in invasion of the tumor into deeper structures, making cure impossible.

The principal methods of treatment are curettage and electrodesiccation, surgical excision, and radiation therapy. Chemosurgery, topical chemotherapy, and cryosurgery are not often used but may have value in selected cases.

A. Curettage and Electrodesiccation: Curettage and electrodesiccation is the usual method of treatment for small lesions. After infiltration with suitable local anesthetic, the lesion and a 2- or 3-mm margin of normal-appearing skin around it are thoroughly curetted with a small skin curet. The resultant wound is then completely desiccated with an electrosurgical unit to destroy any tumor cells that may not have been removed by the curet. The process is then repeated once or twice if necessary. The wound is left open and allowed to heal secondarily.

When used as treatment for superficial basal cell carcinoma, curettage and electrodesiccation is a simple, quick, and inexpensive procedure that will cure nearly all superficial lesions. However, this method of treatment should not be used in the deeper infiltrative and morphea type lesions. These should be treated by surgical excision, x-ray therapy, or chemosurgery.

C. Surgical Excision: Surgical excision, following the principles outlined earlier in this chapter, offers many advantages in the treatment of basal cell carcinoma: (1) Most lesions can be quickly excised in one procedure. (2) Following excision, the entire lesion can be examined by the pathologist, who can determine if the tumor has been completely removed. (3) Deep infiltrative lesions can be completely excised, and cartilage or bone can be removed if they have been invaded. (4) Lesions that occur in dense scar tissue or in other poorly vascularized tissues cannot be treated by curettage and desiccation, radiation therapy, or chemosurgery, since healing is poor. Excision and flap coverage may be the only method of

treatment in these conditions. (5) Recurrent lesions in tissues that have been exposed to maximum safe amounts of radiation can be excised and covered.

Small to moderate-size lesions can be excised in one stage under local anesthesia. The visible and palpable margins of the tumor are marked on the skin with marking ink. The width of excision is then marked 3-5 mm beyond these margins. If the margins of the basal cell carcinoma are vague, the width of excision will have to be wider to ensure complete removal of the lesion. The lines of incision are drawn around the lesion as a circle. This tissue is excised, taking care to leave a margin of normal-appearing subcutaneous tissue around the deep margins of the tumor. Frozen sections may be obtained at the time of excision to aid in determining whether tumor-free margins have been obtained. This is minimized with experience. It is better to err on the side of removing more normal tissue than necessary rather than to run the risk of including tumor at the margins. Closure of the wound is accomplished in the direction of minimal skin tension, usually along the skin lines. The dog-ears are removed appropriately.

Wounds resulting from the excision of some moderate-sized tumors and nearly all large tumors may necessitate closure by a free skin graft or a flap. Larger lesions may require excision and wound closure by free skin grafts or flaps. This can nearly always be performed in one stage.

The disadvantages of surgical excision are as follows: (1) Specialized training and experience are necessary to master the surgical technics. (2) Whereas curettage and desiccation may be performed in the office, surgical excision requires specialized facilities. (3) In lesions with vague margins, an excessive amount of normal tissue may have to be excised to ensure complete removal. (4) Structures that are difficult to reconstruct such as the eyelids, nasal tips, and lips have to be sacrificed when they are extensively infiltrated.

C. X-Ray Therapy: This modality is as effective as any other in the treatment of basal cell carcinoma. Its advantages are as follows: (1) Structures that are difficult to reconstruct such as the eyelids, tear ducts, and nasal tips can be preserved when they are invaded by but not destroyed by tumor. (2) A wide margin of tissue can be treated around lesions with poorly defined margins to ensure destruction of nondiscernible extensions of tumor. (3) It may be less traumatic than surgical excision to elderly patients with advanced lesions. (4) Hospitalization is not necessary.

The disadvantages are as follows: (1) Only well-trained, experienced physicians can obtain good results. (2) Expensive facilities are necessary. (3) Improperly administered radiation therapy may produce severe sequelae, including scarring, radiation dermatitis, ulceration, and malignant degeneration. (4) In hair-bearing areas, baldness will result. (5) It may be difficult to treat areas of irregular contour, ie, the ear and the auditory canal. (6) Repeated treatments over a period of 2-4 weeks may be necessary. This modality should not be used in patients under age 40 except in unusual circumstances.

2. Squamous Cell Carcinoma

Squamous cell carcinoma is the second most common cancer of the skin and is even more common than basal cell carcinoma in darkly pigmented racial groups. As with basal cell

carcinoma, sunlight is the most common causative factor in Caucasians, and most lesions occur in fair-skinned individuals. The most common sites of occurrence are the ears, the cheeks, the lower lip, and the backs of the hands. Other causative factors are chemical and thermal burns, scars, chronic ulcers, chronic granulomas (tuberculosis of the skin, syphilis), draining sinuses, contact with tars and hydrocarbons, and exposure to ionizing radiation. When a squamous cell carcinoma occurs in a burn scar it is called a **Marjolin ulcer.** This lesion may appear many years after the original burn. It tends to be aggressive, and the prognosis is poor.

Since exposure to the sun is the greatest stimulus for the production of squamous cell carcinoma, most of these lesions are preceded by actinic keratosis on areas of the skin showing chronic solar damage. They may also arise from other premalignant skin lesions and from normal-appearing skin.

The natural history of squamous cell carcinoma may be quite variable. It may present as a slowly growing, locally invasive lesion with metastases or as a rapidly growing, widely invasive tumor with early metastatic spread. In general, squamous cell carcinomas that develop from actinic keratoses are of the slowly growing type, whereas those that develop from Bowen's disease, erythroplasia of Queyrat, chronic radiation dermatitis, scars, and chronic ulcers tend to be more aggressive in nature. Lesions that arise from normal-appearing skin and from the lip, genitalia, and anal regions also tend to be aggressive.

Early squamous cell carcinoma usually appears as a small, firm, erythematous plaque or nodule with indistinct margins. The surface may be flat and smooth or may be verrucous. As the tumor grows, it becomes raised, and, because of progressive invasion, becomes fixed to surrounding tissues. Ulceration may occur early or late but tends to appear earlier in the more rapidly growing lesions.

Histologically, malignant epithelial cells are seen extending down into the dermis as broad, rounded masses or slender strands. In squamous cell carcinomas of low malignancy, the individual cells may be quite well differentiated, resembling uniform mature squamous cells having intercellular bridges. Keratinization may be present, and layers of keratinizing squamous cells may produce typical round "horn pearls". In highly malignant lesions, the epithelial cells may be extremely atypical, abnormal mitotic figures are common, and intercellular bridges are not present and keratinization does not occur, so that "horn pearls" are absent.

As with basal cell carcinomas, the method of treatment that will eradicate squamous cell carcinomas and produce the best aesthetic and functional results varies with the characteristics of the individual lesion. Factors that determine the optimal method of treatment include the size, shape, and location of the tumor as well as the histologic pattern that determines its aggressiveness. The most common form of squamous cell carcinoma - that arising from actinic keratosis - is the least aggressive and requires less vigorous therapy than the more malignant types arising from Bowen's disease, scars, ulcers, chronic radiation dermatitis, and apparently normal skin.

Treatment consists of surgery or radiation. The advantages and disadvantages of each type of therapy are discussed above. Since basal cell carcinomas are relatively nonaggressive

lesions that very rarely metastasize, failure to eradicate the lesion will result only in local recurrence. Although this may result in extensive local tissue destruction, there is rarely a threat to life. Aggressive squamous cell carcinomas, on the other hand, may metastasize to any part of the body, and failure of treatment may have fatal consequences. For this reason, total eradication of each lesion is the imperative goal of treatment.

Because the overall incidence of lymph node metastasis is relatively low, most authorities agree that node resection is not indicated in the absence of palpable regional lymph nodes except in the case of very aggressive carcinomas of the genitalia and anal regions.

Aesthetic Surgery

Aesthetic plastic surgery has an application in all age groups. Procedures include corrective otoplasty for the lop-eared child, rhinoplasty for the teenage boy or girl, or a blepharoplasty or facelift for the aging man or woman.

Otoplasty

Young children with protruding ears due to the absence of the conchoscaphal angle are frequently teased unmercifully by other children. Re-creation of the cartilage fold through a postauricular incision can be performed with a brief hospitalization and convalescence. Preschool age is probably the ideal time for operation, as the child's ears have reached nearly their full potential growth by age 6. The surgical technic is fairly standard with minor variations, and postoperative complications are rare.

Rhinoplasty

Variations in the appearance of the nose from aesthetically desirable standards may be a result of ethnic developmental deformities or secondary to an injury. Nasal fractures are frequently recognized in a young child, and the resulting deformity may only become manifest at a much later age. The large humped nose with bulbous or drooping tip is often a tragedy to the sensitive teenage boy or girl with an emerging awareness of social competition. Aesthetic nasal reconstruction is usually recommended after puberty, since the nose develops as a secondary sexual characteristic. This may be as early as age 15 in girls but usually averages somewhere between 16 and 17 years. Boys are generally operated on at a slightly later age than girls. The operation is done through intranasal incisions, usually under local anesthesia, and requires only a brief period of hospitalization. Postoperative swelling and periorbital ecchymosis are associated with a convalescence of 10-14 days following operation.

Proper selection of the candidate for surgery is important both from a psychologic and anatomic point of view. Certain patients may present with other profile problems associated with a receding chin. In selected cases, a complementary chin augmentation with a silicone implant may enhance the surgical result. Rhinoplasty has proved to be a very satisfactory procedure, as attested by the fact that it is one of the most widely performed aesthetic surgical operations.

Mammoplasty

Aesthetic breast surgery, particularly the augmentation mammoplasty, has become a frequently requested operation. The general surgeon who operates for breast malignancy can attest to the tremendous psychological significance of the breasts to the average woman. The development of the silicone breast prosthesis for augmentation mammoplasty has made this procedure a safe operation with excellent long-term results. An appropriately sized implant containing silicone gel in a sealed silicone bag is placed in a prepared retromammary pocket through a small incision inthe inferior submammary fold. The scars are usually quite inconspicuous after a few months. The improvement in contour is predictably good, and the breast is authentic to palpation unless too large an implant has been placed, resulting in overly tight skin coverage, or a tight capsule develops around the implant (capsular contracture).

Direct injection of silicone fluid into the breast is not only illegal at the present time but is strongly contraindicated, since it has been demonstrated experimentally that significant volumes of the injected fluid are gradually lost from the local site, and local reactions to the silicone fluid injection have been recorded. In addition, localized collections of fluid may simulate carcinoma.

Recent advances in the manufacture of the silicone breast prosthesis have provided a thin-walled soft gel prosthesis that produces an augmented breast with a remarkably natural feel in most cases. Capsular scar contracture with resultant excessive firmness of the breast occurs less frequently. Additional camouflage of the operation has been provided by use of the periareolar incision, which leaves a very inconspicuous scar.

Reduction mammoplasty, while it has significant aesthetic implications, is in fact a reconstructive surgical procedure. The chronic symptoms associated with carrying greatly enlarged breasts are well recognized, and the operation is indicated to relieve back and neck pain as well as posture problems. It is one of the most gratifying operations for the patient and surgeon.

The most common procedures used are those in which the nipple is displaced upward on a pedicle of breast tissue around which the reduced skin brassiere is tailored following excision of the excess breast tissue and skin. Nursing ability can be preserved with this technic, although nipple sensation may be lost. Small but ptotic breasts can be aesthetically improved utilizing this technic.

Another method of reduction mammoplasty that is suitable for the older patient with massively enlarged breasts employs the technic of transplantation of the nipple as a free graft. This is combined with a simpler plan of skin and breast tissue excision, and wound healing is usually free of complications.

Reconstruction of the breast is being performed with increasing frequency even in patients who have undergone radical mastectomies with loss of skin, glandular breast mass, and underlying pectoral muscles. The reconstructive procedure of choice consists of the use of a latissimus dorsi musculocutaneous flap that restores the lost muscle and skin. The breast mound is simulated by the insertion of a Silastic gel implant - all done in a single operation. In a subsequent procedure (or, rarely, at the same time), the nipple and areola can be

recreated by use of the contralateral nipple and areola or by using a free graft from the junction of the pubic and inguinal region, with or without a composite graft from the ear lobe and some auricular cartilage, or skin from the elbow.

Blepharoplasty

Removal of redundant drooping eyelid skin and eyelid "bags" can correct the evidence of aging around the eyes. The procedure is often performed at the same time as a facelift. The scars are placed so as to blend into normal skin creases. "Bags" of bulging orbital fat are removed after dissection from beneath the orbicularis oculi muscles.

Facelift

The facelift, or rhytidectomy, is a very satisfactory operation in properly selected patients. The procedure is usually performed under local or general anesthesia and can be accomplished with a brief hospitalization and convalescence of 2-3 weeks. The operation is designed primarily to correct the sagging of redundant skin beneath the chin and along the neck and jawline that develops with advancing age. The lines of expression, such as the nasolabial folds and the so-called laugh lines around the lateral canthi of the eyes, are only minimally affected. The surgery is of value in the patient with sufficient laxity of the face and neck skin so that significant correction can be achieved. In such a patient, a worthwhile interval will pass before the sagging gradually occurs again. It is not uncommon for a patient to have a second facelift or even, occasionally, a third.

Abdominoplasty & Body Contouring

A. Abdominoplasty: Looseness of the abdominal skin, separation of the rectus abdominis muscles (diastasis recti), and loss of the waist contour - usually as a result of multiple pregnancies - can be corrected by an abdominoplasty. Through a transverse suprapubic incision that can be concealed by the batging suit, the abdominal panniculus is elevated at the fascial level to the xiphoid centrally and the costal margins laterally. The underlying fascia is plicated in the midline and at times at the flanks. The umbilicus is circumscribed and left in place. Traction is placed on the abdominal skin, and the excess is resected. The navel is exteriorized through a small transverse incision in the flap.

The procedure is effective and the complications few. The long transverse scar tends to widen or hypertrophy in a good number of cases.

B. Body Contouring: Patients who have lost considerable weight (70-120 kg) following intestinal or gastric bypass, have considerable excess skin on the abdomen, arms, chest, breast, and thighs. The excess skin and subcutaneous tissues from the arms and chest can be excised as an ellipse from the midaxillary line to the elbow, leaving a linear incision on the medial aspect of the arm, extending down the midaxillary line of the chest. This may be combined with reduction mammoplasty. The thighs may also be tightened by an incision on the medial aspect of the thigh which extends along the inguinal region. The buttocks may be raised by an incision above the gluteal crease. A similar procedure has been proposed for the correction of trochanteric lipodystrophy (riding britches deformity).