

Principles and Practice of
PLASTIC SURGERY

S E C O N D E D I T I O N

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PRINCIPLES AND PRACTICE OF PLASTIC SURGERY

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Use of the Tube Pedicle in Early and Late Reconstruction of Facial Burns

1 to 7 Early use. 1. A severe facial burn as it appeared after debridement. 2. The face resurfaced by free skin grafts. 3. Beginning of the definitive reconstruction: a large tube pedicle prepared on the abdomen and attached to the wrist. 4. Migration of the tube pedicle to one side of the face. 5. The tube pedicle attached to cheek and neck. 6 and 7. Reconstruction completed.

8 to 13 Late reconstruction, ten years after injury. 8 and 9. Preoperative appearance. 10. A tube pedicle migrated to the cheek via the wrist. 11. The tube pedicle attached to cheek and neck. 12 and 13. Completed reconstruction. Note multiple Z-plasties to prevent traction on the lower eyelid when the mouth is open.

Preface

In preparing a book on plastic surgery, one is confronted with an immense amount of material, and the decision as to what to include or exclude is often difficult. Our guiding principle in this volume has been a clinical one, and we have selected primarily those aspects of plastic surgery with which we have had wide clinical experience. This is, therefore, a practical guide, not an armchair treatise; however, we have been able to include most of those conditions which can be corrected by plastic surgery. We have condensed our material into a single easily handled volume, and to this end we have been obliged to reduce the size of our drawings and also to eliminate most of the historical and research aspects of the specialty, however interesting these may be.

We have maintained the same arrangement of material as that used so successfully in the previous edition by the senior author and also in our teaching. The first eight chapters deal with fundamental principles of plastic surgery; these are followed by regional discussions of the applications of these basic principles.

This volume is not a collection of isolated articles by different authors but rather it reflects the experience of a closely integrated group. Practicing together, we have had the advantage of benefiting from one another's work, of comparing results, and refining our techniques. In effect, this has tripled the outlook of each of us. Although we have included most of the standard operations, we have not hesitated to express our preference for what we consider the best methods: those which have produced the optimum results in our hands.

We are grateful to our coworkers, Barbara Lipton, M.D., Aaron Bleiberg, Speech Pathologist, and I. Kenneth Adisman, D.D.S., for preparing respectively the sections on anesthesia, speech therapy, and prosthetics. Their contributions reflect our cooperative experience in these special fields.

We must express our appreciation to Natalie Raymond for her indefatigable efforts in the preparation of the manuscript, and to Paul Singh-Roy and Alfred Feinberg for their painstaking care with the drawings. Finally, warm thanks must be expressed to our publisher, the Blakiston Division of McGraw-Hill, for their cooperation.

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1

General Considerations

Definition

Plastic surgery is that specialty dealing with the correction of congenital or acquired defects. Its aim is to improve function and aesthetic effect. The term is not descriptive, nor is the definition accurate; yet it is customarily used. Although the boundary lines of the specialty are vague, it should be obvious that there are many congenital defects, such as hydrocephalus and clubfoot, that do not fall within its scope. Plastic surgery encroaches upon almost every other surgical specialty; just how far it should extend into allied fields is a matter for the individual surgeon to determine, being guided by his own inclination, training, and conscience.

The basis upon which this branch of surgery rests is the transplantation of tissue. With the advent of the antibiotics, transplantation of tissue was given a new impetus, and it is possible that even greater strides may be effected in the future through further development of tissue-culture techniques, use of plastics and other tissue substitutes, and similar technical advances.

Primary Principles

A primary principle of plastic surgery is the interpretation of the defect in terms of tissue loss or distortion and functional involvement. Application of this principle may be very simple, as in the case of an ordinary laceration, or very difficult, as in the case of a complicated injury. The latter will require a very thorough and careful exami-

nation to determine precisely which tissues are involved, as well as the extent of the loss or distortion and the degree of functional disability. The examiner should proceed in an orderly fashion to record the tissues involved, such as the skin covering, the lining (if the affected structure possesses one), the subcutaneous tissues, and the muscle or tendon damage and damage to the bony or cartilaginous support. Nerve injury, sensory, motor, or both, should be noted. The patient's occupation may be relevant, as in hand injuries.

The application of this principle of interpretation requires a good deal of thought. Let us consider it in relation to a common type of injury: avulsion of the palmar skin of the finger tip, with exposure of the bone of the terminal phalanx. The actual loss can readily be seen, and scarcely a moment's reflection reveals the functional importance of the palmar portion of the finger tip, for it is here that tactile stereognosis is developed to its greatest extent. How should this be repaired? An attempt might be made to resuture the avulsed portion, but this is usually not practicable. The problem poses the choice either of maintaining the length of the finger by applying a free skin graft or a flap or of shortening the finger. In the first instance, although the graft will develop ordinary sensation, it can never develop stereognosis, and hence this finger tip will not have the precise sensation often requisite in some occupations. In the second instance, if the finger is shortened, the finger tip will

have far better sensation than a grafted one, but length will be sacrificed. Thus the selection of the type of repair will be influenced by many factors, including the patient's occupation.

It is not always possible, at the time of injury, to determine the exact amount of tissue lost. Some tissues that are badly damaged may ultimately recover, while some that appear viable may subsequently slough. In injuries about the head, swelling frequently obscures damage to the bony structures. Distortion of tissue following injury often complicates the diagnosis. Sometimes only at the operating table, when distortion and contracture have been released surgically, can the exact amount of loss be determined. The operative plan, therefore, should anticipate the restoration of the *maximum* loss. In some cases, interpretation is facilitated by making a plaster cast, which permits one to contrast the normal and abnormal regions, thus clarifying operative planning.

Functional involvement must be studied thoroughly. Since function so often involves motion, the elements that bring about motion must be analyzed. Thus, the bony structure, with its joints and ligaments, should be investigated, as well as muscle action, nerve continuity, and (in members such as the hand) tendon damage or adherence. This particular phase will be considered in more detail when specific local areas are discussed.

In contemplating the repair of a structure, it is important to restore all the architectural elements. A structure that normally has a lining should have such a lining replaced; if the structure requires supporting tissue, this, too, must be provided. In a total rhinoplasty or jaw restoration, for example, one must provide a skin covering, a lining, and a supporting tissue for the nose or jaw. When restoring a through-and-through loss of the cheek, lip, or nose, one must provide a lining as well as a covering. To fail to line a structure requiring a lining is to court disaster, for such an unlined flap will contract and

shrivel even if it does not become infected. Nature demands faithful imitation.

The interrelation of form and function should always be the goal of the surgeon. It is necessary to achieve both. Unfortunately, restoration of function alone does not necessarily restore form. The transplanted tissue should be as close as possible morphologically to the tissue it replaces. It is obvious that fascia should not be used as a cavity lining, but in instances where morphologically similar tissues are present, they may be utilized. Thus, to build up a depressed bridge of the nose, cartilage may be substituted for bone; or if sufficient mucous membrane is not available to line an eye socket or to restore the buccal sulcus, skin may be used.

When skin is to be transplanted, it should be selected from a donor area that resembles the original as nearly as possible in color, texture, thickness, and hair distribution.

In planning the repair, many factors must be borne in mind. The general physical condition of the patient must be considered, as well as the presence of an active local lesion. The patient's age, sex, occupation, and economic status often intrude upon the surgical problem. Some patients cannot afford the time required for surgery, and thus one may be obliged reluctantly to recommend the use of a prosthesis.

Another principle, paradoxical as it may seem, is that the repair of the defect must not produce another visible defect equally great. This sounds naïvely simple; yet in the hands of the uninitiated, many attempts at repair have resulted in disfigurement far greater than the original. To repair an extensive loss of the nose, one would not take a large flap from the cheek; rather, in a man, one might select tissue from a nonhairy portion of the neck, where the subsequent scar would ordinarily be covered; in a woman, the forehead skin might be used, since the hair could be dressed to conceal the scar in the donor area. To follow this principle requires not only a knowledge of the applicability of plastic surgery, but also an acute

awareness of its limitations. Though these outlined procedures may be the preferred ones, they are not always practicable, in which case we must seek the happiest compromise.

Above all, the surgeon must have a knowledge of tissue behavior. Will the transplanted tissue contract after grafting? Will it impede muscle action? Will it swell? Will it be absorbed or remain permanently? Will it withstand pressure, if necessary? What *not* to do is often as important as what *to* do. In making transfers from one region of the body to another, future anatomic changes must be taken into consideration. In a little girl, for instance, flaps should never be taken from the region of the breast, for this tissue will retain its breast-forming characteristics. One should remember that low abdominal flaps taken from children may in later years develop pubic hair. These examples may seem foolishly obvious, but such mistakes have been made in the past and will continue to be made by surgeons who fail to anticipate even the most minute details.

A word about final results. One is often inclined to compare the final result with the original disfigurement, and on this basis to say that a result is good or bad. This viewpoint is misleading. The surgeon should seek to achieve a possible *perfect surgical result* and measure his final result against it. The concept of what can and what cannot be accomplished requires keen surgical judgment and experience. The beginner cannot be expected to have this experience, but thought, care, study, and reflection will aid in its development.

No other specialty demands more precise attention to detail. No other specialty requires more patience. Complicated cases may necessitate many operations, some taking hours to complete, followed by exacting postoperative care. Constructive imagination is essential, for the plastic surgeon at the outset must be able to visualize the end result, as well as every step leading to it. One should always have an alternative operative plan in reserve. Courage is needed when,

after a series of long and difficult operations, unforeseen disaster makes it necessary to start all over again. From the surgical point of view alone, no two cases are precisely alike. It is this infinite variety that contributes to unending fascination and unflagging interest.

Psychological Aspects

The plastic surgeon who contemplates the operative treatment of a patient suffering from a real or fancied disfigurement must make every effort to comprehend the patient's mental attitude. While he cannot be expected to be a psychiatrist, the surgeon must never restrict his point of view to the mere consideration of the actual physical repair. He must adopt a broader outlook and treat the patient, not merely the local condition.

Surgical treatment of a disfigurement is only part of the problem in plastic surgery, the other part being the psychological treatment. Two approaches to the patient are equally essential and equally indispensable: (1) an objective evaluation of the defect and the practicability of remedying it; (2) an appraisal of the patient himself and the possibility of achieving a result that will prove satisfying to him. Careful thought must be given to the patient's anxieties, needs, or motives, the relationship of the total distress to the actual disfigurement, and the role of that disfigurement in the patient's general psychological make-up. To direct all one's energy toward one phase of the patient's illness and to disregard the other is comparable to eradicating a malignancy but neglecting the metastasis, or to treating the metastasis and ignoring the malignancy.

The patient's mental attitude is of crucial importance. It explains his ready submission to extensive surgery. A patient undergoing plastic surgery differs from the ordinary surgical patient: the former comes to the surgeon in the hope that he will be subjected to operation, whereas a patient coming to the general surgeon hopes that he will be told no surgery is necessary. The one courts

surgery; the other dreads it. This desire for plastic surgery renders the patient peculiarly vulnerable, since those whose commercial interests far exceed their professional skills may take advantage of his eagerness.

Moreover, the patient may be inclined to expect too much from the surgeon. His expectation may be beyond the surgeon's ability to fulfill, either because there is no actual surgical solution for the physical problem, or because surgical repair, even if feasible, cannot solve the person's psychological problem. As regards the first factor—the possibility of physical repair—the surgeon's approach must be cautious. When the general question of repair is discussed, the prognosis should be scrupulously presented. If grafting of tissue is indicated, the possibility of disfigurement in the donor area should be pointed out. Hospitalization, post-operative discomfort, both from the operation itself and from possible immobilization, should be considered. The final result should be described. Possible adverse factors should be presented to the patient as simply and clearly as possible, without minimizing them.

Certain practical considerations should be taken into account: the patient's age, occupation, social position, and economic and marital status. From a purely objective point of view, repair might seem to be more important to a young person who has his life before him than to an old person whose life is largely behind him and, given our social order, more important to a woman than to a man. From this point of view it might also seem that surgical repair of a defect is more urgent in certain occupations than in others—let us say, more essential to an actress or a person in public life than to a laborer or a housewife. Yet from a subjective point of view, this may not be true.

Some general observations with regard to age and sex are quite consistent. In the performance of a cosmetic operation—let us say a nasal plastic—on a young woman between the ages of eighteen and twenty-two, we find that the patient is usually more satisfied with the result of her operation than is

an older, single woman. The younger patient seems to make a better social adjustment, with the happy result that in the great majority of cases she becomes engaged and marries. An improved appearance may well help a young woman to achieve the employment or career she has in mind, whereas for the older woman such opportunities are sharply limited, no matter what improvement in appearance may be achieved. The older, single woman places too much reliance on her operation and may expect that by this means she will, among other things, gain a husband and security. It is pathetic but understandable that the less attractive the older single woman is, the greater her expectations may be.

It is readily recognized that a disfigurement will engender anxiety in the individual, but what is not so readily recognized is that an individual may be basically unstable and *also* possess a disfigurement.

A patient with a physical disfigurement has an accompanying anxiety, a mental distress, for it is because of his mental reaction to the disfigurement that he seeks plastic repair in the first place. The terms "anxiety" and "distress" are used here in a broad sense to include such mental and emotional attitudes and mechanisms as inferiority, shame, and overcompensation and such personality aspects as an antisocial tendency, social insecurity, and general maladjustment. One might be inclined to assume that the anxiety ought to bear a definite proportional relationship to the disfigurement. Strangely enough, this is not always the case; there is no definite or predictable relationship between a disfigurement and the mental attitude it engenders.

No hard and fast rule can be set down as to what constitutes a genuine disfigurement. In contrast to large and obvious defects, there are others so slight that one's attention must literally be called to them. Between these two extremes lie all possible gradations. The dividing line between a genuine defect and a fancied one is often vague. A condition which to the surgeon

may seem of slight import may be of tremendous significance to the patient; also, the reverse situation is frequently encountered: that of a patient whose marked disfigurement causes him little or no mental distress.

Just as an objective evaluation of the physical extent or severity of a disfigurement bears no inevitable relationship to a person's mental suffering, so the other objective social factors that we mentioned above—age, sex, occupation, socioeconomic position—cannot be assumed to bear definite and predictable relationships to the degree of distress felt by the patient. The actress may be less troubled than the housewife, the public figure less than the laborer. We can say only that to stand apart from the accepted physical pattern *may* be the cause of great anxiety.

There is in most of us a very human desire to conform to the standards of our society. We are not concerned here with the question of what factors mold our concept of desirable "looks"; that would involve a discussion of fashion, the arts, the dominant social group, and so on. Whatever the genesis of the standard physical pattern, both from the general social standpoint and from that of the individual, failure to conform to the accepted norm sets one apart in one's own estimation and is often the basis for feelings of acute anxiety.

Frequently a patient's anxiety seems so deep-seated that we classify him as neurotic, as indeed he may be. However, an effort must be made to distinguish between the basic neurotic and the situational neurotic. In the latter type, the personality itself is undistorted, but a neurosis develops in response to a definite external situation pregnant with conflict. There is no real neurotic personality here, merely a temporary lack of adaptation to a particular, trying situation. In this type of patient (i.e., with distress or anxiety limited to the disfigurement), the psychological state has arisen from a definite physical defect, and surgical repair will relieve the anxiety just as it will repair the defect.

On the other hand, the result of surgery will be quite different if one is dealing with a basic neurotic personality. Here the patient (for whom the disfigurement may be only a focus for some more basic maladjustment), will, after surgery, quickly find another symptom through which to channel his anxiety. The surgeon who disregards caution and operates upon the basic neurotic will soon find reason to regret having done so. The general surgeon is guided by physical signs; but physical signs alone are not sufficient for the plastic surgeon, who must consider a psychic as well as a physical outcome. He must be prepared to deal with a basically neurotic person at each stage of treatment: (1) by taking time and attention to diagnose the case, (2) by calling a psychiatrist into consultation in borderline or dubious cases, (3) by preparing to meet the situation, should he have operated upon this type of patient. In our experience, it may be stated categorically that surgery on the basic neurotic is not effective therapeutically and should not be performed.

Surgical responsibility with the borderline type lying midway between the clearly basic and the situational neurotic is not to be ignored or treated lightly. Just as we do not hesitate to analyze the patient's blood or take an x-ray, so we must not be reluctant to investigate his psychological state. In general, the patient's history will serve as background for diagnosis, and the specific case may be illuminated by such sample considerations as the following: Is there general emotional instability? Is there lack of social and occupational adjustment? Did the early family environment account for lack of early security? What effect has the disfigurement had on the development of the patient's present personality? If the defect was acquired and not congenital, what was the patient's emotional state prior to the disfigurement?

Finally, in cases where the patient cannot be completely restored by physical repair, guidance and encouragement leading him toward social rehabilitation and toward

a normal place in the social world are as essential as is the strictly physical solution.

Plastic Surgery in Children

Plastic surgery in the child brings its own attendant problems, applicable only to the child patient. It is surprising how early in life distress over a disfigurement, either congenital or acquired, may manifest itself. In this connection it should be pointed out that awareness of the defect occurs as soon as the child is capable of realizing a physical distinction between itself and other children, a "difference" that is, of course, accentuated by the attention focused upon it by parents, relatives, and playmates.

However, awareness of disfigurement may emerge even before the child is capable of comprehending the spoken word, and may have its origins in the undue attention given by others to the disfigurement—often a non-verbal attention that may take the form of excessive handling of the deformed part, or of facial expression by parent, visitor, or nurse. Comprehension outruns speech, and it is not uncommon to see children who are still too young to talk but who will present a burned or webbed hand for examination without actually being requested to do so.

It might be said that the best treatment is prophylactic—the child should not be exposed to dangers. Here the problem is bound up, in large measure, with the socioeconomic setting. The socially underprivileged child must play in unguarded streets rather than in supervised areas. Furthermore, such a child is also exposed to many hazards indoors as well as outdoors, for he has less general supervision than the more privileged child.

There are, then, considerations relevant to the child patient and not to an adult, as well as elements in the treatment of children that are perhaps of less significance to an adult. A child who has suffered a serious burn or who is injured in a street accident has undergone a terrifying as well as a mutilating experience. He is immediately faced with a series of further terrors in a course

of treatment that is painful, incomprehensible, and bewildering. He is taken to a hospital where he is in the hands of strangers, in an unfamiliar setting. Loneliness and fear are added to his actual physical pain. He probably will not understand what is being done for him, or why it is being done. His inner security is assailed and shaken. It is natural, therefore, that he should act in a defensive manner, fighting back at the doctor or nurse with any weapons at his disposal. He may find that by screaming and struggling he can evade painful treatment, at least for a time. His belligerence and uncooperativeness may result in either conscious or unconscious neglect by attendants, or the application of forcible methods to accomplish the treatment. Here again, pain, loneliness, and terror enter into the picture. From the moment of injury, a psychic trauma has been superimposed upon the physical trauma, and the course of treatment and place of treatment may accentuate both these initial traumas.

In dealing with an injured child, the surgeon must take all possible precautions to avoid causing or increasing a psychic trauma, the effects of which may persist throughout a lifetime. His approach must be carefully considered. His first efforts should be to relieve the pain and quiet the terror. Thus he will convey to the child too young to be reasoned with, a sense of security, calm, and relaxation, precisely the reverse of the anxiety or fear that parents so often communicate to their children. With a child old enough to understand, the surgeon may adopt an attitude of reason. It has been our experience that in general children are reasonable beings. If, from the very outset, before any additional pain has been inflicted, the surgeon explains in some way what has to be done, the child will usually cooperate.

The surgeon must approach his task with tact and sympathy. Patient understanding, absolute honesty, firmness, and great gentleness are essential at all times, and in a surprising number of cases these will elicit the child's helpful cooperation. Along with such

general guides to the surgeon's behavior, certain specific techniques are helpful. When removing sutures or applying a dressing that might cause pain if the patient were to move, the offer of a small reward of one kind or another will sometimes accomplish wonders. At such times, an obviously playful or absurd remark may change a state of apprehension into one of half-amused tolerance of the surgeon's whims and, in any event, will provide needed diversion. Similarly, engaging the child in some playful argument may serve to distract his attention.

In the course of explanation and of treatment, deceit must never be practiced by the surgeon or by any others with whom the child comes in contact. On this score the surgeon must have the cooperation of all who deal with his patient. Of what avail is truthfulness on the surgeon's part if, when a child is to be sent to the operating room, someone else tells him that he is merely going to have an x-ray picture taken? The child finds, instead, that he is taken to the operating room, an ether mask is placed over his face, and an anesthetic is given. Is it surprising that the child will struggle and fight with all his strength against those who, his own reason tells him, are enemies? Or that he will remain resentful, hostile, and recalcitrant throughout the course of surgical treatment? The surgeon urgently needs the cooperation of all who deal with the child and should be quick to enlist the aid of anyone—nurse, intern, maid, porter—to whom the child may take a fancy, as children often do.

Another complicating factor specific to the treatment of children is the attitude of the parents. All too often the parents' deep anxiety is so readily displayed that a child otherwise unable to realize his own situation quickly perceives his parents' reactions and becomes frightened. We mentioned earlier that comprehension outruns speech, and it is surprising how quickly the emotions of a parent will be communicated to a child. Even a baby scarcely able to understand the spoken word will comprehend the fear in

his mother's face and attitude and detect her mood. There is even a language of muscle tension that conveys a mother's anxiety to the child she is holding.

Inevitably, parents are constantly in the picture where a child patient is concerned. By their oversolicitude or undersolicitude, by their own fears and half-formed knowledge of what the surgeon is trying to accomplish, by their unconscious feelings of guilt toward a child congenitally deformed, or by conscious guilt toward one injured through their carelessness, in short, by their attitudes toward both the patient and the surgeon, they may do incalculable harm to the morale of the child and render a difficult task immeasurably more difficult. And yet, cooperation on the part of the parents is vital in many ways. For example, if it is advisable to delay a reparative operation for some reason, the parents must be impressed with the importance of not directing attention to the disfigurement.

It cannot be stressed too emphatically that the important twofold problem created by psychic as well as physical trauma must involve the utmost cooperation of surgeon, parents, and attendants—and, hopefully, of the child himself—if the outcome is to be successful.

SURGICAL INSTRUMENTS AND TECHNIQUES

Gentleness in handling tissue is of paramount importance; therefore all instruments should be designed with this requisite in view. In fact, not only the armamentarium itself but the surgical procedure, the actual use of the instruments, should help to carry out the basic precepts of plastic surgery: atraumatic technique, asepsis, accurate wound approximation, and the avoidance of tension, dead spaces, and raw surfaces. To achieve these ends, not only must the proper instruments be selected, but they must be utilized correctly. To traumatize tissue is to invite failure.

We have found that the simplest system

of arranging instruments is to organize them in a number of different kits. First, there is a basic surgical or dissecting kit (Fig. 1-1). This consists of various scalpels; several sizes of thumb forceps without teeth; a Mayo type of straight scissors with somewhat finer points than the original; three small pairs of scissors, one straight sharp-pointed, one curved sharp-pointed, and one curved blunt; a number of hemostats; two sharp hooks; small retractors; and a flexible ribbon retractor. This set of instruments is used at every operation and is laid out on the instrument tray in the same order for every operation. Supplementary sets of instruments are added to this basic set, according to the type of operation to be performed. For instance, if a split thickness skin graft is to

be done, the Blair-Brown type of knife or other skin graft knife, a suction box, and a dermatome are added. When a nasal plastic operation is to be performed, a supplementary set of nasal instruments is added. These additional groups of instruments will be described and illustrated in the appropriate sections.

A cutting instrument should have a sharp, keen edge, preferably one that is replaceable or that can be sharpened easily. A useful addition to every surgical kit is a hard Arkansas sharpening stone. Time spent in learning the actual mechanics of sharpening instruments will be time well spent, for a few strokes on the stone will often suffice to transform a dull instrument into one that will cut sharply and cleanly.

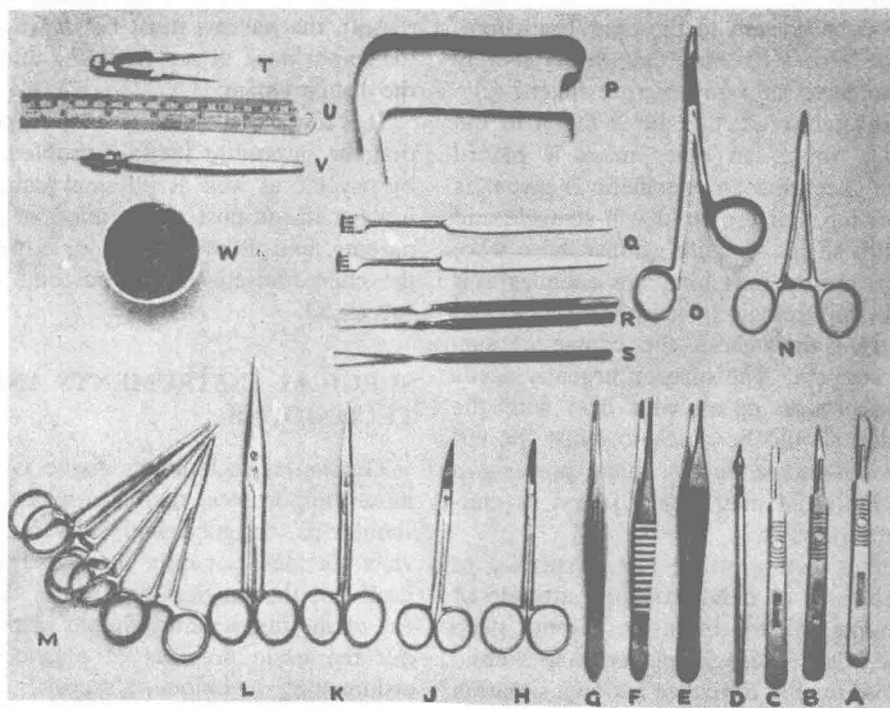


Fig. 1-1. Basic operating set: A, B, C, Bard-Parker knives Nos. 10, 11, 15; D, razor-blade knife; E, F, G, thumb forceps; H, small, curved, blunt-pointed scissors; J, small, curved, sharp-pointed scissors; K, small, straight, sharp-pointed scissors; L, Barsky's pattern, straight Mayo scissors; M, hemostats; N, small, locking needle holder; O, Gillies' suture needle holder; P, two sizes of flexible ribbon retractors; Q, small rake retractors; R, fine hooks (replaceable) on Kilner handle; S, Barsky's double hook (replaceable) on Kilner handle; T, stainless-steel dividers; U, ruler; V, marking pen; W, small container with skin-marking solution.

For making incisions, the razor-blade knife is particularly useful. It consists of a thin sliver of the edge of a razor blade, held in a very small pin-vise type of handle. Other knives are generally of the Bard-Parker type. Blades Nos. 10, 11, 15, and 22 are the most useful.

We are obliged to handle thumb forceps so much that the instrument should be designed to lessen finger fatigue as well as to avoid bruising delicate tissues. Thumb forceps should not be thick, heavy, rigid instruments. Rather, they should be delicate, comfortable to handle, and have a light, easy spring. We prefer thumb forceps without teeth or those with very small, fine teeth. We have found that an ideal arrangement is to have three different thumb forceps, the grasping ends varying in size from 2 to 5 mm. The instruments are made of stainless steel to prevent rusting and flaking of plating. The grasping ends are serrated, and the handles are of different designs so that each instrument may be identified readily at a distance.

Small, sharp hooks can be used to handle tissue with a minimum of damage. The Kilner hook with a replaceable end is especially valuable, in that it is necessary to replace only the hook portion when the instrument loses its edge or becomes damaged. A double-pronged hook is ideal for handling small skin flaps.

In addition to the ordinary retractors, small four-pronged rakes are practical. Flexible ribbons that can be bent to any angle will be found very useful. These can be made easily from sheet Monel metal, cut to the desired size. The material is sufficiently flexible for the purpose and does not rust or corrode.

Various scissors are used. Wherever possible, straight scissors are employed, since they are more easily sharpened. Scissors of the Mayo type, with somewhat narrower points, are well adapted to our work. These scissors should have a good balance and should not be clumsy or top-heavy. Figure 1-1L shows an ideal pair of scissors. Smaller

scissors approximately $5\frac{1}{2}$ in. long should be straight-pointed, curved-pointed, and curved blunt. Double-edged scissors (Fig. 10-5), cutting on both opening and closing of the blades, can be used to undermine the skin and accomplish clean-cut, gentle dissection. Though complicated, unusual types of scissors may be useful occasionally, the necessity and difficulty of constant resharp-ening outweigh whatever advantages they may have.

Care should be given to the selection of a good needle holder. It must be remembered that plastic operations involve a good deal of suturing. The instrument should be comfortable to hold and should grip the needle firmly, without cracking or bending it. A locking or nonlocking type of holder may be used. We have found the Gillies suture needle holder and cutter the most convenient type, for it fits the hand easily, cuts the suture, and does not require the constant finger manipulation necessitated by the locking type of instrument. In cavities such as the mouth, the locking type of needle holder is more useful. It is well to have several sizes of needle holders, and if one intends to tie knots with this instrument, one should be sure that the grasping portion will hold the suture material without slipping. The holders must be made of stainless steel, for the serrations of a plated instrument will flake off, and rusting will destroy the grasping portion of the instrument.

Suture needles should be of the sharp cutting type in a variety of sizes, three-eighths curved, full half-curved, and straight. For suturing the skin, the three-eighths curved type of needle is recommended, since its use necessitates less supination and pronation than does the half-curved needle, and thus reduces fatigue if a great deal of suturing must be done. The atraumatic type of needle is recommended, but its cost must be considered. As a substitute, a double-eye needle does away with the annoying loss of the suture from the needle.

For suturing skin (Fig. 1-2), the thinnest possible nonabsorbable suture material is

recommended. Braided, treated silk is excellent. A number of satisfactory proprietary skin sutures are also obtainable. Fine stainless steel is an excellent material but is somewhat difficult to use. Multifilament stainless-steel wire is an ideal material for the intradermic or subcuticular suture. It is inert and causes no reaction. Ordinary single-filament tantalum has the disadvantage of lacking tensile strength, but multiple-filament tantalum wire overcomes this disadvantage. For the ligation of vessels, our preference is for plain fine catgut (No. 4-0). However, there is no objection to the use of silk, provided, of course, that the material is fine.

Several sizes of hemostats are essential, and it is always best to use the size that will

take the smallest bite of tissue. We have found the medium-sized, nontoothed instrument to be the most practical for all-round use.

Simple measuring instruments, such as a 6-in. stainless-steel ruler and a pair of dividers, should be on the sterile instrument tray as part of the basic set.

For skin marking at the operating table, a hypodermic needle dipped in one of the antiseptic dyes, such as gentian violet, brilliant green, or Bonney's blue, is satisfactory. In the office, any ordinary skin-marking pencil is adequate.

For making patterns of flaps and skin grafts, sheet tinfoil is an excellent material. It is easily cut, can be sterilized with the

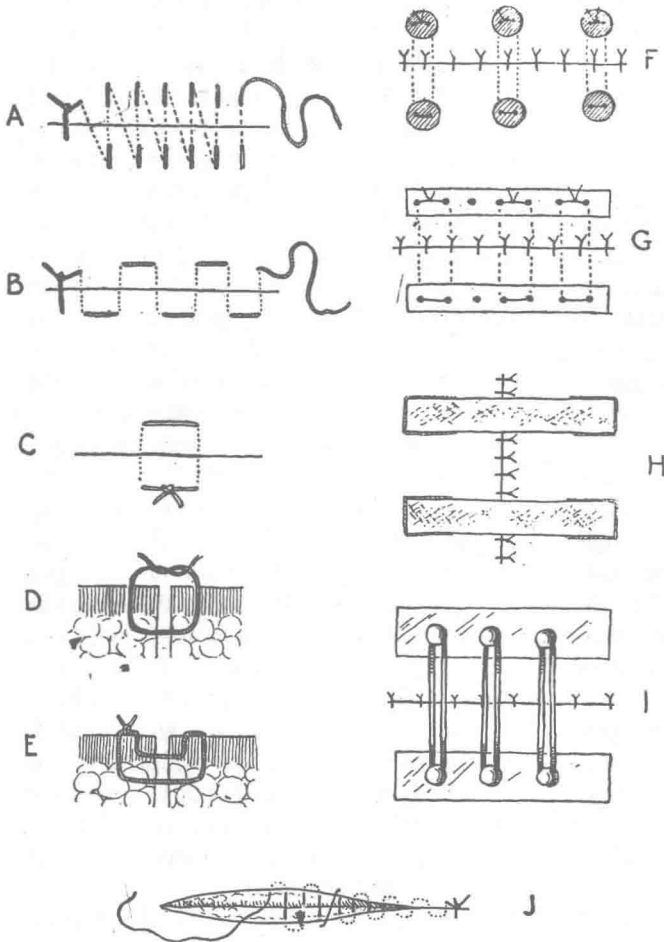


Fig. 1-2. Types of sutures: *A*, continuous on-end or vertical mattress suture; *B*, continuous mattress suture; *C*, interrupted mattress suture; *D*, path of the simple interrupted suture through the tissues; *E*, interrupted on-end or vertical mattress suture.

Methods of relieving tension on wound edges: *F*, buttons; *G*, perforated lead strips; *H*, gauze bandage strips glued vertically across the wound with collodion; *I*, strips of sterile adhesive tape with hooks; rubber elastic bands cross the wound vertically and make traction; *J*, subcuticular suture.

instruments, and can be marked by scratching or perforating with a pin. Its only disadvantage is that it has no elasticity and therefore will not drape itself neatly over irregular surfaces. Pliofilm and the newer transparent plastic sheet materials may be used for making patterns. Although they are not so durable as tinfoil and require more careful handling, they have an advantage in that they are transparent. All these materials should also be kept sterile and readily available in the operating room.

Sheet lead approximately $\frac{1}{32}$ in. in thickness can easily be cut to form small buttons or plates over which to tie sutures. Lead splints are also used in nasal plastic surgery. An ordinary straight suture needle can perforate the lead. Split lead shot, such as is used on fishlines, can be fastened to the ends of intradermic sutures.

Stent, or dental modeling compound, is used as a mold in cavity grafting. The material in this country is called "dental modeling compound," and the similar material in England is called "stent." Since it was first used in England and popularized there, a mold of this kind is often called a stent. It comes in flat cakes, generally dark red in color. When it is heated, it becomes soft and pliable and can be molded into almost any shape. When the material is chilled, it sets and retains its shape. Stent may be sterilized by placing several cakes in a small basin approximately 6 in. in diameter and covering the top of the bowl with several layers of gauze tied securely around the rim. The bowl is then placed in an autoclave and sterilized. The bowl should be placed upright in the sterilizer to prevent the contents from spilling over.

NUTRITION AND WATER BALANCE

The individual with a normal gastrointestinal tract can ingest sufficient food to supply all required nutrients. Though the majority of patients undergoing plastic and reconstructive surgery belong to this cate-

gory, some patients are not normal from the nutritional viewpoint. Their deficiencies may be caused by faulty eating habits; by disease that has prevented adequate food intake, absorption, or utilization; by loss of nutritive elements from the blood stream, the gastrointestinal tract, or a large open wound. The severely traumatized patient suffering from extensive soft-tissue and skeletal injuries or from a major burn is likely to fall into this group.

The rate of wound healing, the "take" of grafts, and the patient's susceptibility to infection are known to be related to the nutritional state of the body; to its water, nitrogen, and vitamin balances; and to the hemoglobin, red cell, and protein content of the blood. There is indication that vitamins A, C, and riboflavin are related to wound healing. In clinical or experimental scurvy, there is definite delay in wound healing as well as a lowering of the tensile strength of the scar; i.e., collagen formation is inhibited, tensile strength develops late, and wound infection is frequent.

Hypoproteinemia and anemia are now known to be the most important factors in delaying the healing of wounds and trophic ulcers, in slowing the formation of callus after fractures and bone operations, and in lowering resistance to infection. The elements essential for the proliferative phase of wound healing, particularly proteins, are simply in short supply at the wound edges. The experienced plastic surgeon will not attempt extensive skin grafting or major reconstructive surgery until major nutritional defects are either corrected or treated actively. Furthermore, the development of acquired immunity and resistance to surgical infection depends ultimately upon the intake of foods yielding a high type of amino acids, from which the gamma-globulin fraction, with its contained antibodies, is synthesized. Nearly all severely burned patients are in negative nitrogen balance, evidenced during the first 10 days and followed by progressively lower plasma protein levels, anemia,