Principles of minor electrosurgery; an authoritative treatise on the fundamentals and techniques of minor electrosurgery as applied to office practice, with bibliographical data.

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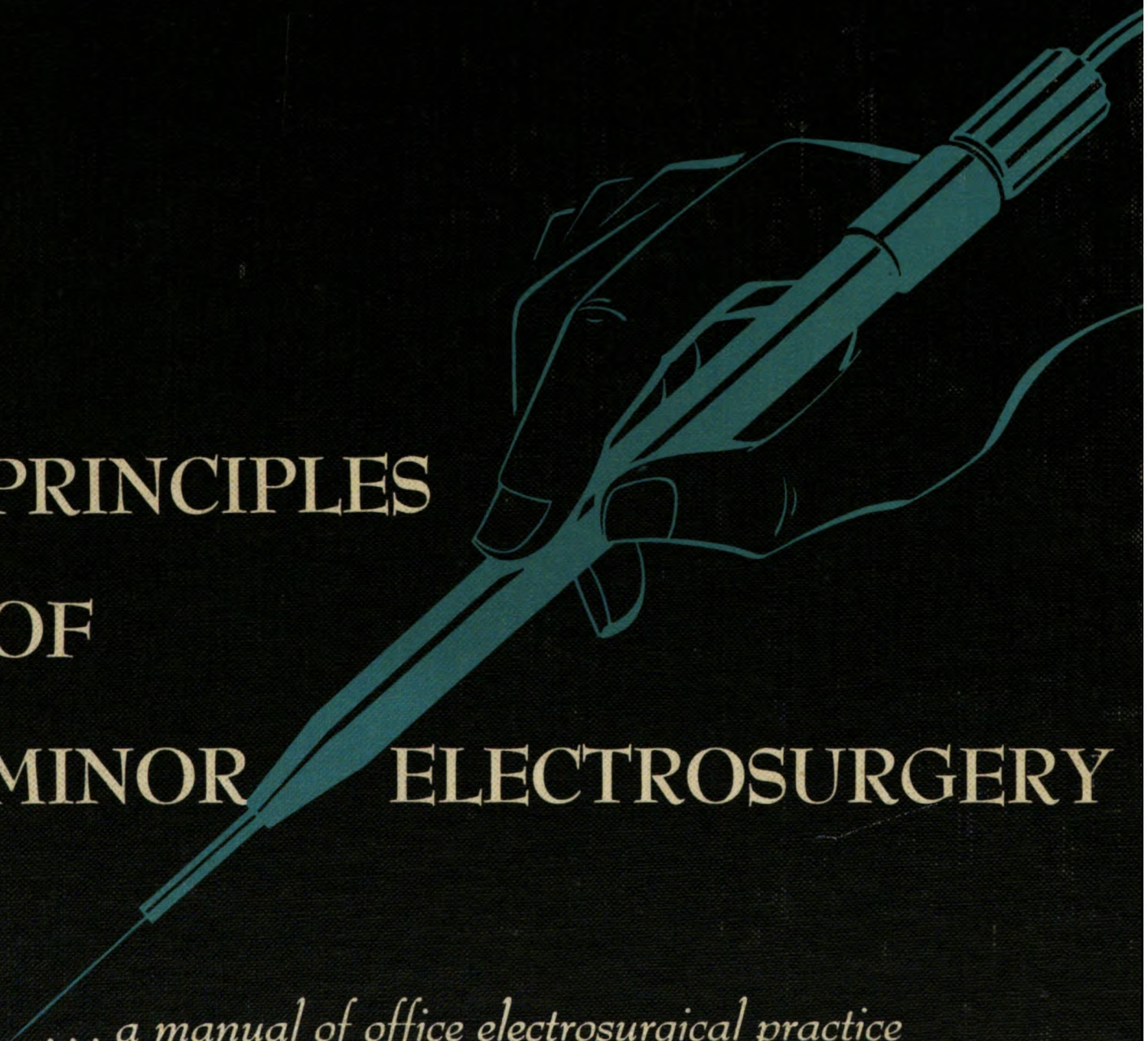


PRINCIPLES OF MINOR ELECTROSURGERY

. . . a manual of office electrosurgical practice

PRINCIPLES
of
MINOR
ELECTROSURGERY

An authoritative treatise on the Fundamentals and Techniques of Minor Electrosurgery as applied to office practice, with bibliographical data.

Compiled and Edited by

John F. Otto, Jr., M.D.

PUBLISHER'S *Preface*

We gratefully acknowledge the reception accorded our previous effort—1949—to provide a primer of minor electrosurgical practice.

In response to the suggestions of many interested physicians and the continuing need for such a text, we have encouraged Dr. Otto to revise and extend the original work which we are proud to present in this, its new form and content.

It is our sincere and confident hope that this manual will be of value to all physicians who use electrosurgery in office practice.

THE LIEBEL-FLARSHEIM COMPANY
E. M. FLARSHEIM,
President

EDITOR'S *Foreword*

This book is intended to serve the generalist, the specialist in those fields represented here, and particularly the resident in specialty training. Sound principles of surgical diathermy are emphasized, a number of helpful therapeutic hints are described, and the bibliographies provide abundant material for reference. The scope of this book is, of course, sharply limited: Major electrosurgery is a subject too vast for inclusion, and some surgical specialties have been neglected. Nevertheless, the techniques herein described constitute the bulk of electrosurgery applicable to the ambulatory patient.

Sincere appreciation is expressed to the many eminent physicians who offered invaluable criticism of various portions of the text. Advice in methods of dermatologic surgery was provided by Dr. P. M. Crossland, Santa Rosa, California; Dr. Leon Goldman, Cincinnati, Ohio; Dr. M. L. Niedelman, Philadelphia, Pennsylvania; Dr. C. E. Radcliffe, Iowa City, Iowa; Drs. H. J. Spoor and E. F. Traub, New York, New York; and Mr. D. Aiken, Doncaster, England. The gynecologic text was reviewed by Dr. B. Tenney, Boston, Massachusetts; Dr. K. J. Karnaky, Houston, Texas; and Dr. B. deF. Lambert, Lowell, Massachusetts. The otolaryngologic methods were reviewed by Dr. H. J. Burman and Dr. W. W. Morrison, New York, New York; Dr. J. R. Richardson, Boston, Massachusetts; Dr. Lee Shahinian, Los Altos, California; and Dr. F. L. Wahrer, Marshalltown, Iowa.

Illustrations were provided by Drs. Robert Gutierrez, Florence Karp and Eric L. Levy, New York; Dr. O. Zelezny-Baumrucher, Cicero, Illinois; Dr. C. E. Radcliffe, Iowa City, Iowa; Dr. M. L. Niedelman, Philadelphia, Pennsylvania and Mr. D. Aiken, Doncaster, England.

To these generous physicians, and to the many others whose work provides the basis for this compilation, the editor and publishers are deeply indebted.

JOHN F. OTTO, JR., M.D.

Contents

PART ONE
FUNDAMENTALS OF ELECTROSURGERY

Advantages and Uses of Electrosurgery

Electrosurgery is an important and versatile therapeutic modality of modern medical practice.

Apart from their value in major surgery, which will not be considered here, electrosurgical currents perform essential service in the office practice of dermatology, gynecology, otolaryngology, urology, proctology, oral surgery, and other surgical specialties. The chief reason for this diversification in use is the versatility of surgical diathermy. It can be used for incision (or excision), for destructive effects, or for a combination of these. The cutting current is often used instead of a scalpel or curet, because it has certain advantages that the latter instruments do not have. At other times, the coagulation current is used for effects similar but superior to radiation, thermal cautery, carbon dioxide snow, or sclerosing injections.

Although the *cutting* current can be used in the same manner as the cold scalpel, and can produce almost identical effects, it is *not* to be used as a mere substitute for that instrument. There are situations in which the scalpel should be used, and others in which the cutting current is preferable. The advantage of *hemostasis* provided by the cutting current is often the reason for its choice. This type of effect, which is dependent upon the sealing of small vessels, also accounts for its choice in some other situations: excision of neoplastic or infected lesions, in which the film of coagulated tissue (the depth of which can be regulated) may prevent spread of malignant cells or bacteria; the incision of abscesses bloodlessly and with inhibition of premature closure; or the retardation of recurrences of some growths of mucosal origin. In addition, the cutting electrodes can be used in some relatively inaccessible areas, they may obviate the need for undesirable manipulation of tumors or displacement of organs, and they may offer further advantages of precision, speed, and convenience. These advantages will become apparent when individual techniques are discussed.

The *coagulating* current of the same electrosurgical unit can also be used in a variety of ways, with many different electrodes, when primarily destructive effects are indicated. This current is responsible for the reputation of the electrosurgical unit in *cosmetic* surgery, and for its popularity in dermatology. It is widely recognized to be superior to other methods of tissue destruction, with some exceptions in certain situations to be mentioned later. Scars resulting from the proper use of this current are generally thin, soft, and noncontracting; and they can be expected to closely approximate the qualities of normal skin. Compared to the use of thermal cautery or caustics, this electrosurgical current can usually be applied with much

greater precision and versatility, with greater convenience, with faster healing, with fewer complications, and with superior cosmetic effects. It of course, has other advantages, depending upon the type and site of the lesion to be treated: hemostasis, sterilizing action, inhibition of recurrent growths, avoidance of manipulation, and speed or convenience in relatively inaccessible areas. These will be elucidated in the clinical sections of this manual.

Electrosurgery is not a substitute for all standard minor surgical practice; it is an adjunct with its own indications and values. It is not a new form of therapy; it has been increasingly employed for more than four decades. Certain of its applications have been standardized through long usage, and others have been modified to meet the needs of progress.

Optimal results with this therapeutic modality, as with any other, depend upon: 1) good, reliable equipment; and 2) the experience and judgment of the operator. The electrosurgical unit is not to be considered a gadget, but one requiring the respect and skill of its user. Sound surgical principles must not be neglected. Familiarity with this type of therapy will bring its rewards to any physician who performs minor surgery, and to his patients.

Principles of Surgical Diathermy

Alternating current, of sufficiently high frequency to avoid nervous and muscular response, can be passed through living tissue with no effect other than the production of heat. The heat produced is the direct result of the resistance offered to the passage of the current.

This is the principle involved in both medical and surgical diathermy (electrosurgery).

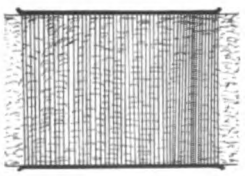
When electrodes of equal or near-equal size are used, the current density is quite evenly dispersed within the intervening tissue with a corresponding temperature rise adequate for medical diathermy and without concentration sufficient to cause cell destruction.

Exceptionally high frequencies can be successfully used in medical diathermy, (witness short and ultra-short wave diathermy using heavily insulated electrodes), but frequencies above ten million cycles (10 mc) per second are unsuitable for electrosurgery because energy is transferred to the operator through the electrode handle, making it virtually impossible to attain acceptably precise power control.

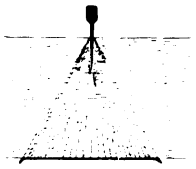
Note: This is *one* of the reasons why a short-wave diathermy generator is *not* satisfactory for dependable electrosurgery.

When one electrode is large, and the other one small enough, the current is no longer evenly dispersed, but attains sufficient density at the small electrode to cause actual destruction of the cells where the small electrode is applied. This is the application of surgical diathermy or electrosurgery. The small electrode is called the *active* electrode; the large one, the *indifferent* (or *dispersive)* electrode.

PRINCIPLE OF MEDICAL DIATHERMY



PRINCIPLE OF SURGICAL DIATHERMY



The cell-destructive, dehydrating effect of the high-frequency current concentrated, as shown above, at an active electrode (dispersed from an indifferent electrode), is known as *electrocoagulation* (or simply *coagulation*). Whenever the term, *electrocoagulation,* is employed, the use of an *indifferent* electrode is implied. In other words, all applications of electrocoagulation are *biterminal.*

A *monoterminal* application of high-frequency current (without indifferent electrode) is also used in electrosurgery. The current will flow from a pointed active electrode into the tissue because the patient represents sufficient capacitance to attract the current to "ground". If the electrode is held slightly away from the tissue surface, the superficial dehydrating effect caused by the resulting "sparking" is called *fulguration.* If the electrode point contacts the tissue or is inserted slightly into the tissue, the resulting dehydrative effect is termed, *desiccation.* Some authors use these two terms synonymously to indicate monoterminal application with or without tissue contact.

At this point, it is necessary to explain that there are differences in "wave form" of high-frequency currents and that these differences seem to be responsible for different effects on tissue.

The "wave form" of an alternating electrical current refers to its visual appearance as shown by an oscillograph or oscilloscope. Reversing its direction of flow from several times to millions of times per second, the current traces a wavy line which constitutes its wave form.

The earliest and simplest high-frequency, alternating-current generators employed the principle of condenser discharge across a spark-gap. This type of oscillator produces what is known as damped wave form; that is, with each condenser discharge a series of oscillations are set up, the voltage peak of the first being highest and then each subsequent oscillation of the series disminishing in voltage down to zero.

HIGHLY DAMPED WAVEFORM

Each series of oscillations in this sort of a wave-form picture is called a "wave train" and you will notice that there are distinct no-voltage separations between the wave trains.

Note: The highly-damped, high frequency current is ideal for coagulation, desiccation, and fulguration. It produces the most dependable hemostasis, the greatest precision in application, the surest results. It is *not* available from a short-wave diathermy apparatus or other vacuum-tube units.

With the invention of the vacuum-tube oscillator by DeForest, a new high-frequency current of different wave form was demonstrated. The vacuum-tube oscillator was capable of producing *continuous wave* oscillations—i.e., with equal voltage and *without interruption.*

UNDAMPED WAVEFORM

This current produced an entirely new effect on tissue—it would *cut*. Concentrated at the active electrode, these continuous wave oscillations produce such intense heat so very quickly that the cells are volatilized (exploded), producing a hole if the electrode is held stationary or an incision if the electrode is moved. It is almost completely devoid of dehydrating or hemostatic effect and its usefulness is confined, therefore, to cutting only in non-vascular areas or where keen, fast cutting is the only requirement and hemostasis unwanted. (As is the case in some major operative situations, but *never* with an office technique.)

Note: This is the *only* current available from a short-wave diathermy unit or a vacuum-tube surgical unit, which is the second reason why these machines are not satisfactory for dependable electrosurgery.

DeForest's invention of the vacuum tube made him the "father of radio" and his demonstration of the cutting characteristic of the undamped high-frequency current stimulated experimental endeavor to produce a cutting current which would also have hemostatic effect and be generally safe to use. It was the determination and encouragement of Dr. Harvey Cushing that maintained the interest and cooperative effort of Dr. W. T. Bovie of Harvard University's Department of Physics and The Liebel-Flarsheim Company of Cincinnati, which eventually resulted in the perfection of the first Bovie electrosurgical unit.

Dr. Bovie, the physicist, and Messrs. G. H. Liebel and E. S. Flarsheim, two engineers, succeeded in generating a *moderately damped* oscillating current in which wave trains were packed closely enough together for effective cutting, but with sufficient damping to retain the desired dehydrating or hemostatic effect. It is this current, refined over the years, which is still the typical cutting current of all Bovie units.

From the foregoing, it will be obvious that two distinct types of high frequency current are essential to successful electrosurgery. Both of these currents are provided by the Bovie electrosurgical units. The three surgical effects resulting from the use of these currents are:

1. Electrodesiccation or fulguration
2. Electrocoagulation

} Coagulation Current

3. Electrosection or cutting } Cutting Current

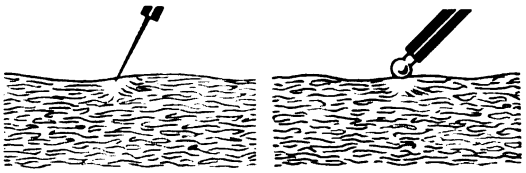
The Electrosurgical Currents

I. Electrodesiccation or Fulguration

The effects of fulguration and desiccation are quite superficial and for that reason, these applications are preferred when best cosmetic results are important —i.e., they are commonly used for most skin lesions.

Desiccation is always a monoterminal technic; that is, no indifferent plate is used. This, of course, limits its effective-

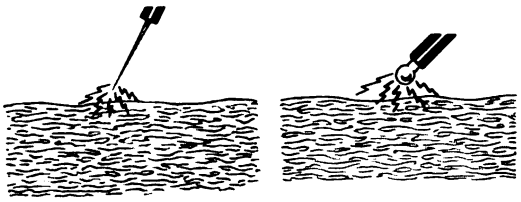
ness in elevated or deep growths. Fulguration is commonly a monoterminal technic with most superficial effect, but is sometimes used biterminally for convenience in connection with application of electrocoagulation or to produce somewhat more penetrating dehydration.



Desiccation

For desiccation, use the coagulating circuit of the Bovie unit with active electrode connected to one of the active terminals of the machine and with no indifferent electrode. The needle is held in contact with the tissue or the point inserted.

For fulguration, do not contact the tissue. Hold the needle one or two millimeters away from the tissue, allowing the current to spark to the surface being treated.



Fulguration

Average Bovie power settings for monoterminal desiccation or fulguration are as follows:

Fine (.0175 in.) needle..15 to 25
Coarse
(.0275 in.) needle....20 to 35
Small (⅛ in.) ball.....30 to 45
Larger (3/16 in.) ball....40 to 60

For biterminal fulguration, the power should be reduced about one-half for comparable effect.

The greyish white, dry coagulum resulting from superficial desiccation or fulguration will slough in several hours to several days, depending on the mass. Applying more power will produce very little more slough because the surface will dehydrate and carbonize quickly, forming an effective layer of insulation against penetration of the current to the underlying structure.

II. Electrocoagulation

The technic of electrocoagulation is always biterminal — i.e., an indifferent plate is used (or a special biterminal electrode which eliminates the need of an indifferent plate). Coagulation tends to produce more necrosis of tissue than desiccation, and its destructive effects are not as quickly limited by a zone of dehydration. This current is often advantageous or necessary in the treatment of relatively large or deep growths; although its proper use may require more care and experience than do monoterminal applications.

Active electrodes, such as needles, pointed rods, or small sized balls, are always used in contact with the tissue— either firmly pressed against the surface to be coagulated or inserted into it.

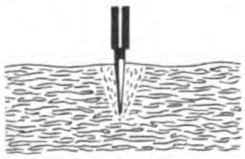
With a constant area of contact with the tissue, the amount of coagulation around the electrode is dependent on: 1) the amount of current, and 2) the length of time it is applied. Of these two, the time factor is the more important. When the current is applied for an extremely short time, the coagulation for practical purposes will take place only around the tip of the electrode because of

NOTE: The terms monoterminal and monopolar are synonymous; so are the terms biterminal and bipolar.

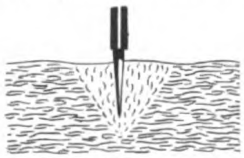
the greater current density at this point. This fact is of importance, for example, in the technique of epilation.

When the needle is inserted for any depth into the tissue, coagulation takes place around the tip before it becomes obvious at the surface of the skin. As the current is left on, the area of coagulum ascends to the surface and broadens as it ascends. When the electrode merely contacts or is inserted very slightly into the tissue, the coagulation is, of course, more shallow and almost immediately becomes apparent at the surface.

Contrary to what one would expect, a heavy current for a short time will not coagulate as great a mass of tissue as will a lesser power over a longer period of time. This is illustrated as follows:



Coagulum around electrode when heavy current is applied for short time.



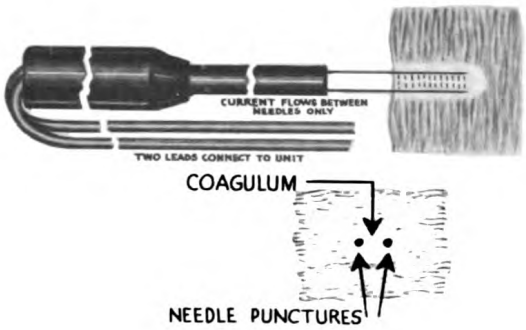
More extensive coagulum when moderate current is applied for longer time.

The reason for this is that with the lower current, the tissues in contact with the active electrode are not as rapidly dried out. The interstitial fluids maintain good electrical conduction between the tissues and the electrode for a longer period of time, permitting the current to be applied longer and coagulation carried to a greater depth. With a greater current, however, dehydration of the tissues occurs so fast that a high resistance to current flow is introduced, thereby reducing the current strength and limiting the depth to which coagulation can be carried.

For these reasons, the results of coagulation depend largely on the experience and judgment of the operator. There are no simple rules to determine what takes place at the active electrode. The operator soon learns, from careful observation, how much power to apply and for how long, to achieve the desired results. If the time that the current is applied remains constant, the depth of coagulation can be varied by regulating the power setting; and, of course, a higher power setting will be required for large electrodes than small, or for deeper insertions of the active electrode into the tissue. Average power settings for coagulation with the Bovie are as follows:

Fine (.0175 in.) needle..10 to 20
Coarse
(.0275 in.) needle....15 to 25
Pointed rod .....20 to 30
⅛ in. ball.....30 to 40
3/16 in. ball.....35 to 45

Biterminal (Biactive) electrodes can also be used with the coagulating current. In these instruments there are two needles or points, one connected to the indifferent (PATIENT) terminal, the



other to one of the active terminals of the machine. Coagulation takes place only between and around the two needles. Only a *small* amount of power is required with biterminal electrodes as the current penetrates only the thin strip of tissue between the points. Avoid an excess of power so that arcing between the points or a breakdown within the handle will not occur. The tonsil, turbinate, and cervical (Cherry) biterminal electrodes are the ones most extensively employed, and their uses will be described later.

Electrocoagulation of tissue results in destruction of the cells to which the current is applied. They will not regenerate. The greyish-white coagulum will slough in a few days or several days, depending on the mass. When the slough has completely separated, healthy granulation tissue appears beneath.

III. Cutting Current (Electrosection)

As explained under "Principles of Surgical Diathermy," the wave form of the cutting current is distinctly different from that of the coagulating current. Its effect is to explode the cells in the path of the electrode with parting of the tissues as if actually cut with a razor-sharp cutting edge. The heat of the arc also creates a shallow zone of dehydration on the severed edges which seals off the minute vessels and prevents vascular "oozing" from these surfaces.

The indifferent electrode is *always* used with the cutting current.

The indications for the use of electrocutting in office electrosurgery include: Taking of biopsy specimens; removing of some types of skin growths; incising abscesses or infected cysts; and cervical conization. The techniques for these procedures are outlined later.

Approximate Bovie power settings for electrodes used in the common techniques range as follows:

	Power Setting:
Blade Electrode	15—25
Needle Electrode	20—30
Small Loop Electrode....	25—35
Conization Electrode	40—50

It must be remembered that power is a variable factor depending on the electrode used, speed of cut, area of electrode in contact with tissue, and the desires of the operator.

The degree of hemostasis with the cut is directly proportional to the depth of dehydration and is variable with speed of cut, thickness of electrode edge and amount of power used. The slower the cut, the greater the dehydration of the wound edges. With speed constant, dehydration (and hemostasis) increases with heavier electrodes or higher power.

Preliminary Experimental Work

Before attempting actual electrosurgery, it is advisable to experiment with use of the machine on a piece of meat. This is an excellent way for the physician to acquaint himself with the action of the different currents, the control settings, manipulation of the footswitch and use of the various electrodes.

A generous-sized piece of veal, or a heart, are the most satisfactory for the purpose. The meat should be allowed to attain room temperature and should be

fresh and moist. If necessary, it may be moistened by injection of a moderate amount of physiologic saline solution. The moisture content is important in order to simulate living tissue as closely as possible though the dead meat, in any case, cannot be entirely comparable.

Experiments with Coagulation

Lay the piece of meat directly on an indifferent plate connected by means of the clip and connecting cord to the "patient" terminal of the Bovie unit. The active electrode handle is connected to one of the active terminals. Connect the footswitch and place it for convenient accessibility, turn the selector switch to "Coagulation" and proceed as follows.

For the first experiment, use the straight-point coagulation electrode. Using a fairly heavy power setting (about 40 percent of total), insert the electrode into the meat to a depth of about a quarter of an inch. Step on the footswitch and maintain the flow of current until a distinct ring of bleached tissue appears on the surface of the meat surrounding the point of insertion. With this power setting, blanching will occur in two or three seconds. Do not allow the current to remain on until sparking occurs at the active electrode.

Turn off the current by releasing the footswitch and withdraw the electrode. Cut a section through the blanched circle and observe the tissue change which has taken place. You will find that you have produced an inverted cone of coagulum surrounding and extending beyond the depth of electrode insertion.

Next, try applying low power for a longer time. Set the power control for about 20 percent of the output, insert the electrode to the same depth and apply the current until blanching is obvious. With this low power, this will probably require fifteen seconds or more. On sectioning the meat this time, you will see a more extensive mass of coagulum extending farther away from the electrode and penetrating more deeply.

You have now demonstrated two methods of electrocoagulation; first, the application of high power for a short time to produce limited, accurately controlled tissue destruction and, second, the application of low power for a longer time to produce more massive coagulation with a single insertion of the electrode. Obviously, the first method is generally preferable in the interest of conservatism, accuracy and time saving. For coagulation of massive areas, multiple punctures at high power are considered usually more desirable than a single or fewer punctures at low power and the longer time required.

Insert different sizes of needles to different depths, varying the amount of power and noting the time required to produce a ring of blanched tissue around the electrode. With attentive examination of the sections, you will soon gain an understanding of the amount of coagulation to be expected from various amounts of power with different depths of insertion of heavier or finer electrodes for varied periods of time.

To achieve controlled superficial destruction, try "brushing" the surface of the meat with a ball electrode over a predetermined area. Section and note the depth of penetration as evidenced by the blanching. Vary the amount of power and

speed of moving the ball, noting on sections, how the depth of destruction can be varied from a few thousandths of an inch to any moderate depth required.

The destruction of small particles of tissue may be demonstrated by hooking a curved electrode into a small tab of meat. With a moderate power setting, the current is turned on in short flashes until the entire tab is dehydrated as indicated by the blanching.

If you expect to use special biterminal electrodes, try them after disconnecting the indifferent electrode connection from the Bovie. The biterminal electrodes have two connecting cords or a bifurcated cord. Connect one cord to the "patient" terminal; the other to one of the active terminals of the unit. Apply the electrode to the meat, turn on the current (using very low power) and note the blanching between the two points. Experiment with various power settings (keeping them as low as possible for desired effect) to determine the proper technic for the electrode you are using. Beware of too high a power setting because too much power will arc across the points or may break down the insulation of the electrode.

Experiments with Fulguration and Desiccation

Using a pointed electrode (preferably the heavy skin needle), allow a stream of sparks one or two mm. long to play from the point to the meat. Try this with and without the indifferent plate and when the indifferent electrode is *not* used, hold the meat in your left hand to add the capacitance of your body which will simulate actual treatment conditions. The spray of sparks will dehydrate the superficial layers of tissue quite rapidly and you will find that the depth of destruction is self-limiting because complete surface dehydration will insulate the current against further penetration. Some variation in depth of penetration can be accomplished by varying the power and you will note that you will use about one-half the power setting for biterminal fulguration that will be required for monoterminal applications.

Now, continue to hold the meat and try monoterminal desiccation by touching the needle point to the meat and then by inserting it slightly. You will see that desiccation will produce deeper penetration than fulguration but that it, too, by virtue of its monoterminal character is quite superficial and self-limiting.

Your experience with these two applications of high-frequency dehydration will demonstrate their particular usefulness in skin conditions.

Experiments with Electro-cutting

The cutting current will prove to be a very useful modality in minor electrosurgical procedures, but the successful use of this current requires more understanding and skill than the purely dehydrating currents. The physician will wisely familiarize himself with the "feel" of the cutting current, the synchronization of hand and foot in the manipulation of the electrode and footswitch, the proper selection and application of electrodes, and the selection of power settings suitable to the technic being employed.

Application of the cutting current is always biterminal. In preparation for cutting experiments, therefore, the indifferent electrode is again connected to the "patient" terminal of the Bovie and the meat placed upon it. Set the selector switch on "cutting" and insert the electrode into the chuck handle which should be connected to one of the active terminals of the machine.

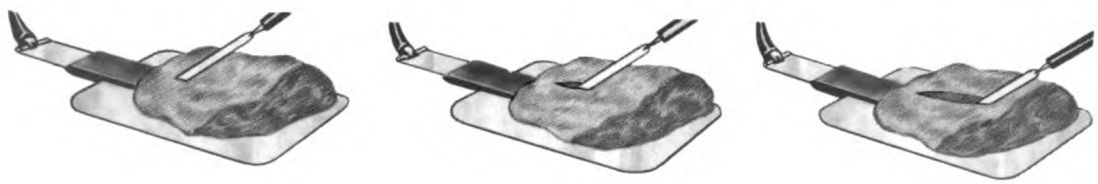
For the first experiment, use a flat blade electrode. The flat blade should always be used for a "clean" incision which will heal by primary union if you do not cut too slowly. Set the power control at about one-third of the total. Place the tip of the electrode lightly in contact with the meat and as you step on the footswitch, draw the electrode through the tissue at about the same speed you would use for cutting with a scalpel. Note that the current does the cutting, carrying the electrode through the tissue with almost complete lack of the resistance "feel" of the cold scalpel.

Lift your foot at the exact moment you complete the cut and lift the electrode from the tissue. This synchronization is important. If the current is turned off too soon, the cut will be incomplete; if too late, electrical arcing will follow the electrode from the tissue, causing extra dehydration at that point. Similarly, unless the electrode starts to move immediately after the current is turned on, there will be a wider depth of dehydration at the start of the incision.

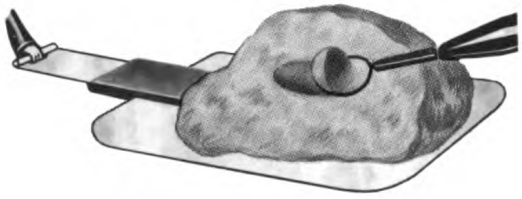
Vary the depth of cut—increasing the power setting for deepest cutting, using less power for shallow incisions—and try stopping and starting to practice hand and foot synchronization.

Now, repeat the above experiments, substituting a needle electrode for the flat blade. The needle, presenting a thicker cutting edge, will produce greater dehydration on the edges of the incision, with more resistance and, consequently, slower cutting at the same power setting. A needle electrode is preferred for incising abscesses or cysts where drainage is desirable and healing by first intention is to be prevented by choice. Try short cross incisions, a type of incision used particularly for abscess or cyst.

Next, try "scalloping" out bits of tissue or looping off simulated neoplasms with

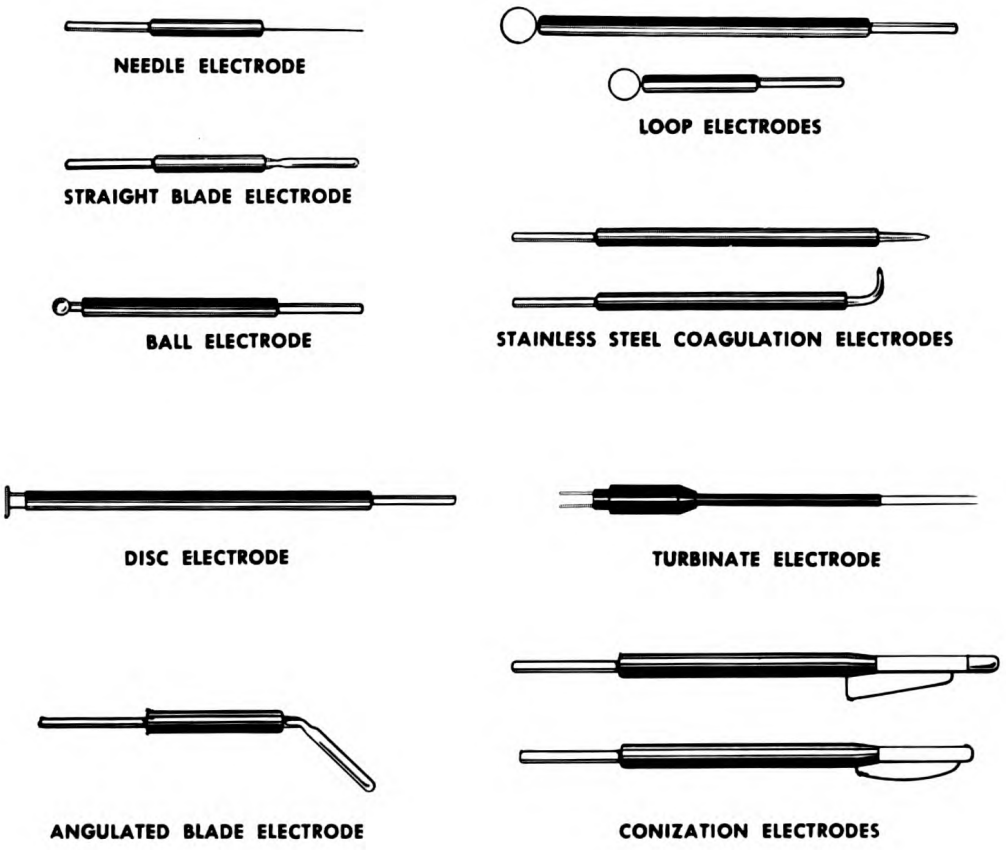


a loop electrode. Use about 40 percent of power output to begin with. Contact the tissue lightly with a small section of the loop before turning on the current. Step on the footswitch and start movement of the loop immediately. If too much of the loop contacts the tissue or if you wait too long with current on before moving the loop, coagulation will retard or prevent cutting. Cut into, through, and out of the tissue. It is quite an art to bring the loop away from the tissue with the piece completely excised. The final thin tab of tissue will resist severance unless the loop is handled just right. Practice makes perfect.



The wire loop of the electrodes will permit shaping to desired shapes other than round, or bending to various angles; so there is no need to be equipped with loops of varied shapes or angulation.

Types of Electrodes



PART TWO

MINOR ELECTROSURGERY OF THE SKIN

Electrosurgery is an essential part of the dermatologist's armamentarium. With its aid, he is able to accomplish many procedures that could not be done, or which could be performed less adequately with the cold scalpel or other methods. The treatment of many common skin disorders described in this manual are procedures which any trained physician can do in his office. Electrosurgical techniques are not necessarily simple, and experience and care are essential for optimal results. Sound dermatologic and surgical principles must be applied, as they are with any type of therapy.

Selection of Treatment:

When cosmetic effect is paramount, the choice between scalpel excision and electrodesiccation is usually resolved by a consideration of the size and depth of the lesion, its location, and the operator's experience with one or the other methods of removal. For example, most dermatologists prefer the cosmetic results of desiccation for small and reasonably superficial blemishes, whereas a linear excisional scar may be preferable for large (over 1 square centimeter) or deeply situated lesions (184). Concerning the location, Cipollaro (37) states that the cosmetic result following electrosurgical treatment of lesions about the eyelids, ears, or nose is usually superior to that following scalpel surgery.

At times the physician must choose between radiation and electrosurgery, with particular respect to certain neoplastic or angiomatous lesions. The selection here will depend on such factors as the age of the patient, the radiosensitiveness of the tumor, and the location and size of the lesion. Many times, a combination of electrosurgery and radiation will be indicated. This will be discussed further when the individual lesions are considered.

Types of Skin Electrosurgery:

Most dermatologic electrosurgery involves *desiccation* or *coagulation* because of the ease, precision, and good cosmetic effects usually achieved with these currents. An elaborate surgical setup is not needed, the equipment is immediately ready for use, and the current has a sterilizing action upon the destroyed tissue (185).

The *electric cutting current* is used less frequently in dermatologic office practice. As will be described in future sections, however, this current can be advantageously employed for the removal of a variety of benign growths, for the excisional biopsy of potentially or actually malignant lesions, and for the treatment of plantar warts and rhinophyma.

The power settings used depend upon the type of electrosurgical current (coagulation or cutting), the type of electrode, and the technique. Commonly used settings for the Bovie are given in the discussion of electrosurgical currents on pages 9 to 11.

Results of Skin Electrosurgery:

The matter of scarring is important on exposed skin surfaces. Cannon (27) has said that whatever defect results from the operation with electrosurgery, it is at least much less noticeable than the original blemish. He cites cases in which neither the patient nor the physician could find the site of the operation several months after the removal of a nevus. Fulguration or desiccation have the advantage that any scar occurring at the treated site is usually soft and noncontracting; repetition of treatment, when necessary, does not make the scar hard (45). Thermal cautery, which is used less frequently in present dermatologic practice, is more likely to be followed by slow healing, a depressed scar, or a keloid (167).

The amount of residual scarring from electrosurgery is dependent on the skill of the operator and his technique. The best cosmetic effects are usually obtained by using the lowest current which will give the desired result (27, 172, 209). Carbonization (charring) is undesirable. Saunders (169) states that rapid, intense destruction of a lesion with a very hot spark is apt to be followed by an elevated scar; whereas the use of the smallest "coldest" spark possible, with interruptions to allow dissipation of heat, almost always results in a flat scar of good cosmetic appearance. Of course, the deeper the skin destruction must be in order to abolish the lesion, the more scarring there will be. Any resulting scar is pink at first, but subsequently fades so that it is usually difficult to distinguish from the surrounding skin (47).

The tendency of the beginning operator is to overtreat the lesion (139, 180). Overzealous treatment may produce a depressed or pitted scar (139). Except in the case of potentially or actually malignant lesions, it is better to do too little than too much. A second treatment can always be given later, if necessary.

Preoperative Preparation of the Skin:

The area of skin to be treated is commonly cleansed with soap and water. A 3-percent solution of hexachlorophen in pHisoderm (pHisoHex) has been demonstrated to be an excellent cleansing and bactericidal agent; this may be used alone or in combination with 1:1000 aqueous Zephiran (187). Inflammable fluids or solvents such as alcohol and ether may also be used; *but* it is important to remember that there is a possibility of igniting any residual liquid by a spark from the electrode, especially on the scalp or other hairy regions. Allow sufficient time for *complete* evaporation before proceeding.

The matter of *local anesthesia* is an individual problem, since it is dependent on the method of treatment and the age and sensitiveness of the patient. It is often unnecessary in the treatment of very small and superficial lesions in the adult, such as in the destruction of multiple filiform warts. When anesthesia is desirable, the injection of a small amount of 1 or 2 percent procaine or xylocaine solution into the skin about the lesion will suffice in most cases (27). Epinephrine, in its usual *safe* concentrations, can be used in the procaine solution, but prolongation of anesthetic effect is seldom necessary for electrosurgical techniques. It is better to

inject the anesthetic solution at the circumference or below, rather than directly into the lesion to be treated, since the excess fluid may interfere with proper desiccation or coagulation. If the patient objects to the injections, preliminary freezing of the skin is helpful. Freezing alone may provide sufficient anesthesia for small lesions. If ethyl chloride is used, extreme care should be taken to be sure that all the fluid has evaporated before applying the spark. "Frigiderm" (freon) is just as effective, and is safer since it is not flammable. Goldman (80) uses liquid nitrogen, which is applied with a cotton swab just before coagulation.

Postoperative Care:

The after-care is aimed simply at the prevention of trauma and infection. The crust remaining after desiccation is sterile, and the postoperative application of an antiseptic solution is not necessary. Nor is a dressing required when the destruction has been superficial, although a sterile gauze bandage may be used to protect the treated area from trauma. When the site is over a joint, splinting may facilitate healing. A few authors, (24, 27, 61) have advised repeated cleansings and antiseptic dressings until the slough has separated and the wound has epithelialized. Such dressings usually are not necessary when the amount of coagulum is small; and they may be inadvisable, since keeping the postoperative crust *in situ* and in a dry state protects the regenerating tissue underneath.

Most physicians remove the greater part of the desiccated or coagulated tissue, when this is relatively large. The advantages of removing the destroyed tissue are: 1) It makes the base more accessible to redesiccation, thus reducing recurrences; and 2) the removal of dead tissue prevents subsequent infection (153). Following careful curettage, with a sharp curet or small scissors, the base of the lesion is usually lightly fulgurated or desiccated in order to seal oozing capillaries and lymph channels and to provide a sterile protective crust. The depth of such redesiccation is of course dependent on the type of lesion treated and the cosmetic considerations. If the destruction has been very superficial, curettage and redesiccation are not required (8), and the best cosmetic result will be assured by allowing the coagulum to fall off (61).

The patient should be seen at regular intervals, as after any surgical procedure. Areas previously treated insufficiently can thus receive more treatment, and subsequent infection or new growths can be recognized early (110). Any superfluous granulations can be removed by light desiccation, or by application of x-ray, silver nitrate, or trichloracetic acid (27). When the patient is known to have a keloidal tendency, Goldman (80) recommends early postoperative roentgen therapy of the scar.

Warts

All types of warts (verruca vulgaris, verruca filiformis, verruca plana juvenilis, etc.) are treated effectively by electrosurgery (9, 76, 95, 139, 170, 184). Their local destruction by monoterminal desiccation is probably the most common

Verruca vulgaris, before and after treatment by desiccation.

method of therapy. Local anesthesia is advisable for most common warts, and is accomplished by infiltration of the base and circumferential skin with 1 or 2 percent procaine. Anesthesia usually is not necessary for the removal of multiple minute digitate or flat warts. The treatment of multiple warts in children sometimes is accomplished under a general nonflammable anesthetic, so that they may all be removed in one session.

Verruca Vulgaris:

Common warts may be treated by either fulguration or desiccation although the latter is preferable. It should be remembered that the dry keratin cells are poor conductors, and current applied only to the surface may pass to the surrounding skin, causing blistering while the growth center of the wart is not destroyed.

A technique used by many dermatologists (9, 142, 184) is as follows: A monoterminal needle electrode is introduced into the center of the wart, and the current is applied until there is a sudden luminescence and lightening in color of the wart, indicating thorough desiccation of the keratotic substance and its separation from underlying tissue. The current must be stopped at this point to avoid unwarranted destruction of normal tissue. The wart is then raised with a mouse-tooth forceps, and is cut off level with the skin with small pointed scissors. Any rough edges are trimmed, and the base of the lesion is then lightly fulgurated to form a dry sterile crust. If the site is over a joint, splinting will facilitate healing. Healing should occur within two weeks.

For large warts, desiccation at several points may be necessary; and for unusually bulky lesions biterminal coagulation, or successive steps of desiccation and curettage, may be employed. If coagulation is used for warts on the dorsum of the hand, the patient can rest his palm on the indifferent plate.

Common warts have also been treated by a fractional method of superficial fulguration, applied at biweekly intervals until removal is complete (183). This technique seems unnecessarily prolonged for routine use. Fractional fulguration or desiccation, with curettage, are more commonly performed in one therapeutic session.

The treatment of *periungual warts* may require partial removal of the nail. The incidence of recurrence in this area is high (142), and desiccation should be thorough. The patient should be warned in advance that some deformity of the nail may result because of involvement of the matrix (80).

Scalp warts also have a high rate of recurrence, and Niedelman (142) recommends the bidaily application of a 5 percent sulfur-5 percent salicylic acid ointment to the treated areas. Five percent ammoniated mercury may also be used on the treated sites, and on any suspicious early lesions (80). Hollander (95) believes that the administration of vitamin A, and infrequent combing may also reduce recurrences in this area.

Verrucae also occur on the *lips* and *tongue,* appearing most often as small round pinkish nodules in children and young adults. These are also easily destroyed by monoterminal desiccation (95). Usually, topical anesthesia suffices for the treatment of small lesions (80).

Flat, Digitate, and Filiform Warts:

Multiple warts of these varieties are easily removed by superficial desiccation or fulguration to skin level, but their autoinoculable tendency is high and complete eradication is often tedious. Anesthesia is not necessary in the adult, since the brief stinging sensation is usually well tolerated. Warts with narrow attachments to the skin can be readily treated by desiccating merely the bases of their pedicles, and clipping them off through the dehydrated portion at skin level (76). For numerous filiform warts, the instantaneous application of a mild desiccating current to the base of each growth is sufficient; they drop off in about a week and no scar remains (127).

Treatment of multiple warts can often be rendered more complete by marking the small lesions with an indelible pencil under a magnifying glass, prior to desiccation (142). It is advisable, particularly in treating the persistent verrucae barbae, to perform desiccation of new lesions at weekly intervals (95).

Suggested methods to reduce recurrences of warts in the bearded area, in addition to their local destruction, include: infrequent shaving, sterilization of shaving instruments, light x-ray therapy (75r to each side of the face), weekly intramuscular injections of bismuth sodium tartrate, local applications of antiseptics in alcoholic vehicles, antiseptics added to shaving cream, and the use of autogenous vaccines (80, 95, 142).

Multiple flat warts on the faces of children *must* be treated with extreme care, to avoid scarring. Goldman (80)

prefers a ball-tipped electrode for this purpose. The use of double strength lotio alba, or the careful application of 10 percent trichloracetic acid at weekly intervals may be tried prior to desiccation (146).

Seborrheic Warts (Verruca Senilis):

These are actually varieties of seborrheic keratoses (see page 30). They can readily and permanently be removed by monoterminal desiccation, followed by curettage and light fulguration of the base.

Condyloma Acuminata (Verruca acuminata, venereal warts):

These lesions usually respond well to topical podophyllin, but electrosurgical measures are also effective (12, 22, 54, 61, 69, 127). Considerable time may be saved in the treatment of large conglomerate masses with successive steps of coagulation (or desiccation) and curettage (12, 61, 139), or more simply with the cutting current and a loop electrode (22). Local anesthesia is necessary, unless electrosurgical removal is limited to superficial insensitive layers. When there is extensive involvement of the vaginal vault and cervix, general anesthesia is required (80). Removal of the bulk of the growth is followed by the use of monoterminal desiccation, or topical podophyllin in the usual manner.

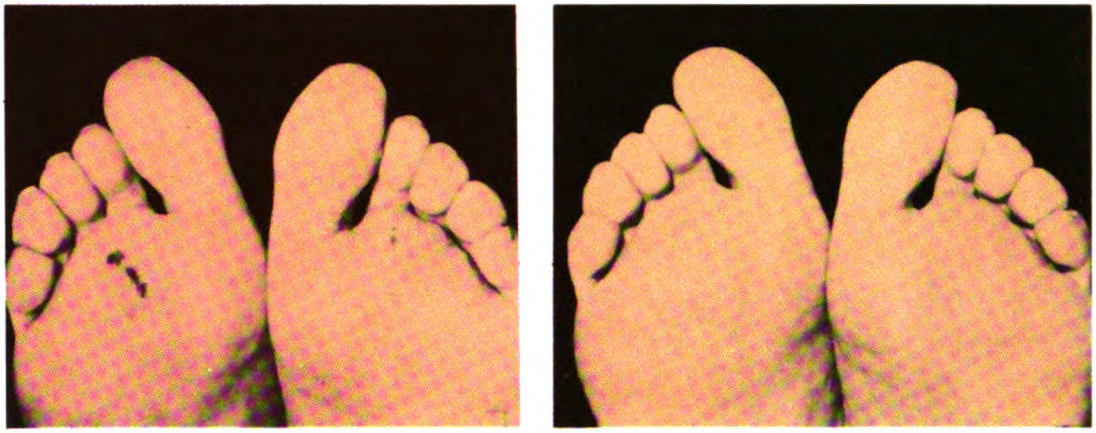
The small, soggy type may be removed simply with a sharp curet, followed by light desiccation of the base (69). MacKee and Cipollaro (127) state that very small discreet warts may be destroyed by superficial desiccation without local anesthesia. Harrison (88) applies 10 or 20 percent cocaine solution to the penile wart for several minutes, inserts a fine needle electrode to the base of the growth, and applies a mild monoterminal current. Dodson and Frohbose (54) remove penile verrucae by fulguration, after infiltrating the base of each wart with 1 percent procaine.

Any method of removal must be combined with hygienic measures to prevent recurrence. Dilute potassium permanganate compresses or penile soaks, and astringent dusting powders, are commonly used. Chronic discharges from the vagina, rectum, or urethra must be treated. The treatment of *interdigital warts* of the feet include the wearing of shoes of adequate width, and the treatment of hyperhidrosis and tinea pedis if present (142).

Plantar Warts

Electrosurgery and x-radiation are frequently used in the treatment of common (non-mosaic) plantar warts. Each procedure is effective in experienced hands but requires judgment in its application. Of the electrosurgical methods, electrodesiccation, electrocoagulation, and electrocutting have all been reported to produce good results (8, 9, 53, 77, 79, 102, 117, 139, 170). It should be remembered that orthopedic measures to correct faulty foot balance are often essential to prevent recurrence.

Local Anesthesia is usually considered necessary for any electrosurgical method, and can be achieved, with or without preliminary freezing, by two or three injections of 2 per cent procaine into the tissue



Plantar warts, before and after removal by Karp method.

around and beneath the wart (9). Of the many procedures described, one of the most effective is the "loop treatment" of Karp and Frank (101, 102):

Electrocutting (loop) Technique:

The active electrode for this technique is made by twisting a stock 8 mm. steel wire loop so that the remaining loop is 2 mm. in diameter. The twisted stem with the loop gives the electrode a length of 1 cm.

The patient lies face down on the treatment table with the leg elevated and extended over the edge of the table. The indifferent electrode must be used, and can be conveniently bandaged to the leg, if there is not too much hair; or it can be applied to the back or beneath the abdomen. The electrode is sterilized, and the area to be treated is cleansed and anesthetized in the usual manner.

This technique will require a power setting of about 25-35 on the Bovie. The desired intensity is one which will allow the loop to penetrate easily without producing excessive coagulation.

The electrode handle is held perpendicular to the surface of the wart, and—with the current on—the loop is thrust into the center of the wart to a depth of 6 to 10 mm. depending on the size of the lesion. Holding the chuck handle in the same position, the loop is rotated 180° (a half turn) in a continuous motion, and then is withdrawn from the same linear opening that was made when the loop entered the tissue. By this rotating movement the essential part of the wart is destroyed. No bleeding occurs because of the slight coagulating effect, and only a linear incision is observed after the loop has been removed.

The wound may then be painted with an antiseptic solution, followed by alcohol, and the application of a dry dressing. The patient is advised to keep the foot dry for two weeks, and dressings are changed on alternate days. At the end of two weeks, the patient is instructed to soak the foot in warm water for 20 minutes immediately before coming to the office; the physi-

cian then removes the superficial crust.

Complete healing, with disappearance of the wart and all evidence of treatment takes place in three to four weeks. The patient can continue working from the beginning of treatment without discomfort.

Reporting on a 16-year experience with this method, Karp (102) has claimed the following advantages for it: The technique is simple, there is little postoperative discomfort, the patient is not incapacitated, there is little or no scar tissue to serve later as a source of pain, and there are no sequelae such as may occur after excessive doses of radium or roentgen rays. In one series of 127 cases, a cure was obtained in 95.5 per cent (102).

Techniques of Fulguration and Desiccation:

The technique of Andrews (9) is representative, and is reported to be rapid and effective without causing disability: A strong monoterminal current is applied to the wart, and the lesion rapidly assumes a grayish color. Soon the heat causes a puffing of the grayish area, which then suddenly becomes luminescent. The current is continued for just a few moments until the whole lesion is aglow, signifying that the dry horny thickening has separated from the plantar fascia. The grayish area is then lifted with a mouse-tooth forceps and trimmed with small, curved, pointed scissors. This exposes, on the plantar fascia, a small, whitish papillomatous growth which is removed with a curet. A rounded fibrous cavity forms its base and this is lightly fulgurated, but the plantar fascia is left intact. The skin edges about the wound are removed to avoid any "dead space." The cavity is filled with 5 percent iodoform tape, and dressings are changed daily until the wound is healed in three or four weeks.

A similar but simpler method has been used by Delherm and Marchand (53) for 40 years: These authors state that anesthesia is neither necessary nor advisable. The surface of the wart is first fulgurated, and then the needle electrode is inserted into the center of the wart and desiccation is continued. Treatment is immediately stopped when illumination of the wart occurs and when pain is experienced by the patient. The patient is able to walk immediately and no dressing is required. The wart is allowed to slough spontaneously, or it can be easily curetted on the eighth postoperative day. Although one session generally suffices, very large warts can be treated more than once at weekly intervals.

McLaughlin (135), in a plea for rational therapy of plantar warts, reports a simple method of combined curettage and desiccation: Under local anesthesia, the wart is pared and then shelled out with a Volkmann spoon. The hyperkeratinized collar is then trimmed and saucerized with scissors. The base of the wound is desiccated to prevent recurrence and to control bleeding. A small gauze wick is inserted into the cavity, and the wound dressed with gauze and Elastoplast. The patient can walk with care immediately, and after removal of the plug in 48 hours there is little discomfort. Healing is usually complete in seven to ten days.

Moles (Nonvascular Nevi)

Moles show great variation in size, shape, color, and location; but they may be classified into several groups which are microscopically, and usually clinically distinct. Their most common histologic classification is based upon the layer of the integument from which the nevus cells arise, and this will be discussed later. The type of therapy selected depends upon the type of mole being treated, the reason for its removal, and the experience and preference of the operator. Many authorities believe that *any* nevus, removed for any reason, should be widely excised and the specimen thus obtained submitted for biopsy. Most dermatologists believe that benign nevi can usually be recognized by their clinical appearance, and that certain types may be safely treated by destructive measures with a superior cosmetic result. Certainly these nevi which are considered potentially malignant, or those in which the diagnosis of melanoma cannot be reasonably excluded, should be completely excised. (See Moles and Melanomas, page 27.)

Preparation:

The skin is prepared in the same manner as for any minor surgical procedure. Procaine anesthesia is usually advisable, although it is not essential for the very small and superficial lesions, and it is not necessary for the method of fractional fulguration (37). One author prefers to avoid anesthesia for small and cosmetically important lesions, because he can thereby resist the temptation to treat too vigorously (200). When local anesthesia is used, it is well to inject rather deeply under the lesion, so as not to balloon or partially conceal the nevus. In the interest of an excellent cosmetic result, it is not advisable to make an intracutaneous injection into the nevus itself, since heating of the fluid by desiccation may result in more tissue destruction than necessary (75).

Techniques of Electrosurgical Treatment:

The Hairy Mole:

Most physicians prefer to remove the hairs before further treatment is undertaken (61, 76, 81, 118, 139, 167, 170, 200). The technique of electrosurgical epilation is described on page 46. In the case of a very small or lightly pigmented nevus, removal of the hairs may suffice to make it inconspicuous (200). If further treatment is needed, it may be done immediately following epilation, as described in the following sections.

A few authors prefer to destroy the nevus and hair follicles in one operation by electrodesiccation, especially if the nevus is small and the hairs numerous (16, 108, 139). Those hairs which recur are then subjected to epilation, although some (80) advise that the initial destruction be sufficiently deep in the dermis to prevent such recurrence.

Flat and Slightly Elevated Moles:

Monoterminal fulguration or very light desiccation will give the best cosmetic result (13, 37, 139). For fulguration, the power should be set at the lowest point which will produce a "cold" spark about one-sixteenth of an inch long. Charring is to be avoided. The spark is applied inter-

Elevated mole of upper lip. (1) Before treatment; (2) Immediately after desiccation; (3) Healed.

mittently in very short flashes until the entire patch has been covered. The depth of current penetration can be increased by contacting the tissue with the electrode. The treatment is completed when the whole patch has a blanched and dried-out appearance.

Some therapists carefully curette away the desiccated area, and then mildly refulgurate the base. This, however, is not necessary when the destruction has been quite superficial, and may be inadvisable when cosmetic appearance is the primary consideration (37). The layer of dehydrated tissue forms a crust, beneath which healthy granulation tissue grows, and which spontaneously separates upon completion of healing. If some pigment persists, the procedure may be carefully repeated, after the reaction from the first treatment has completely subsided (37, 139).

Many authorities prefer to excise the smooth flat hairless mole, especially if deeply pigmented, since this is likely to be a junction-type nevus which is considered potentially malignant (52, 55, 205). Others employ desiccation for these lesions, but insist that *all* pigment cells must be destroyed when the mole is first treated. The Blue Nevus, which may be blue-gray or blue-black in color, while not considered premalignant by most authorities, usually is better treated by excision because of the depth of the pigment (197).

Elevated Moles:

The tissue destruction must be deeper than for the flat nevus, although prac-

tically all nevi can be treated by monoterminal desiccation. When there is no suspicion of malignancy, and when the cosmetic result is paramount, it is better to treat too superficially than too deeply at first (37, 139, 180). When the reaction from the desiccation has completely subsided, a second treatment can be given. Cipollaro (37) achieves the best cosmetic results with a series of fractional treatments, as follows: Without anesthesia, the surface of the lesion is lightly fulgurated. After the reaction from the treatment completely subsides, in about 20 days, a second treatment is administered. Three such treatments are normally sufficient to reduce a mole to the level of the skin. When cosmetic appearance is not the primary consideration, the mole can and should be destroyed at one sitting.

Most dermatologists feel that an excellent cosmetic result can be achieved by careful treatment of a mole in one stage. Following fulguration or desiccation, the dehydrated tissue is carefully pared away with a curette, scalpel, or curved scissors (27, 139, 171, 200). Successive steps of desiccation and curettage may then be followed, if necessary, until the level of the skin is reached and the last particles of the nevus are apparently removed.

Biterminal coagulation has also been used when deeper destruction is desired, as in the treatment of large warty nevi; but it is not always easy to accurately gauge the depth of destruction, and it is generaly advisable to use the monoterminal current when working near the normal skin level. *Conservative* and careful desiccation to skin level is the most common "cosmetic" method of removing a mole of the warty or intradermal types (see later). Deeply pigmented nevi, if treated by desiccation, usually receive more thorough destruction, a policy which tends to counteract the cosmetic advantage of desiccation over scalpel excision.

Many dermatologists believe that a specimen for biopsy should be obtained at the time of treating any elevated nevus. This can be accomplished by snipping off the most superficial portion with a small scissors, after which the remainder is immediately destroyed by desiccation (7, 13, 16). A sterile razor blade or scalpel can also be used to plane the lesion off at or just above skin level, followed by fulguration of the base (43, 160). With such techniques, the removed tisue can be submitted for histologic examination, and excellent cosmetic effects can be achieved. (It must be remembered that these techniques are applicable only to clinically benign nevi, and to those considered not premalignant. When a mole is removed for diagnostic, rather than cosmetic purposes, total excision is the only logical procedure.) Very extensive nevi are often best treated by excision and full-thickness skin graft.

Stalked or Pedunculated Moles:

These may be removed by applying the desiccating current intermittently to the base of the growth, until the pedicle is thoroughly dried out. The entire growth will subequently slough away. A small pedunculated lesion may be merely clipped off with a scissors, and its base lightly fulgurated (13).

Kovacs (110) has used the following method: The base of the pedunculated growth is grasped with a fine forceps and the desiccating current is applied to the

Pedunculated moles, removed by desiccation.

top of the growth. The forceps grounds the surplus current through the operator, the growth shrivels up without any painful sensation, and can be removed without bleeding.

Moles and Melanomas

The subject of the malignant or potentially malignant mole is somewhat complex and controversial. Yet the matter cannot be ignored, since the decision to treat or not to treat (aside from cosmetic considerations), and the choice of the method of therapy, are to a large extent dependent on an evaluation of the mole's malignant capabilities. For this reason, a few principles compatible with present dermatologic opinion and practice will be stated.

Classification:

Although its use is not universal (14), the histologic classification described by Traub and Keil (190) in 1940 is very widely employed, and has contributed order and understanding to a difficult subject. Nevi can be classified into the following groups:

1. Intraepidermal Nevus
2. Junctional Nevus
3. Intradermal Nevus (Common Mole)
4. Blue Nevus
5. Compound (Mixed) Nevus

To this list, some would add juvenile (prepubertal) Melanoma, which has histologic characteristics of a melanoma but

acts like an intradermal nevus (4). Intraepidermal (warty) moles are often omitted from the classification since they are not true cellular nevi. The classification above depends upon the origin of the nevus cells within the layers of the integument. The pathologic criteria will not be described here, but certain clinical features will be briefly reviewed:

Clinical Types:

The *intraepidermal* moles include the hard warty nevi, and the linear warty type, which are invariably benign and are well treated by destructive measures (190).

The *intradermal* mole is the common or ordinary type, often becomes conspicuous at puberty or later in life, is usually only lightly pigmented or flesh-colored, frequently contains hair, and commonly appears on the face and is therefore removed for cosmetic reasons (4, 58, 99, 190-197). This is a benign lesion, essentially without malignant potentialities, which can be removed with excellent cosmetic effect by desiccation to skin level (194). Although it arises in the dermis, destruction to skin level is sufficient. It shows no tendency to recur, but hairs if present may have to be epilated.

The *junctional* nevus is believed by most authorities to be potentially malignant and a precursor of melanoma, although such transformation rarely occurs (194). These moles are smooth, soft, flat or only slightly elevated, usually deeply pigmented (brown or brown-black), and may be present from birth although more frequently they gradually appear during adult life. They are never warty or pedunculated, and do not contain hair (4, 58, 99, 118, 194, 206). They occur on any part of the body; nevi of palms, soles or genitalia are practically always of this type (4). Junctional nevi, if treated, should be completely excised, either with scalpel or electrocutting current (195); and the excised tissue should be submitted for histologic examination.

The *blue* nevus is blue, blue-gray, or blue-black in color; it is smooth, hairless, round or oval, sharply circumscribed, and flat or only slightly raised (4, 58, 99, 197). It usually occurs as an isolated lesion on the face, dorsum of hands and feet, or buttocks. Its pigment is located deeply in the cutis, and the blue color is the result of refraction through upper dermis and epidermis. This lesion is usually considered to be harmless, although it may be confused with a melanoma or junction nevus. Although local therapy is probably innocuous (4), because of the depth of the pigment as well as for reasons of diagnostic difficulty, excision is the treatment of choice (13, 118, 197).

The *compound* mole is a mixture of two of the preceding types. Intradermal moles may be associated with junctional change in about 12 per cent of cases (4), a fact which is used to support the practice of routine excision.

Incidence of Melanoma:

Malignant melanoma is, fortunately, an uncommon disorder, its incidence having been estimated to be 9 in every 500,000 persons (122). The average person has, on the other hand, 15 or 20 benign pigmented nevi (150, 152). Despite the low incidence of melanoma, the conscientious physician must be alert to its early diagnostic signs so that more cases can be cured by radical excision.

The proportion of melanomas which arise from pre-existing benign junctional

nevi is not precisely known, since various estimates range between 18 and 80 per cent (14, 52, 55, 152, 205, 207).

The Role of Trauma:

There is actually no evidence that trauma causes malignant transformation of a benign junctional nevus, although such an intuitive belief is understandable (4, 149, 152, 167, 190). For example, it might be thought that daily shaving over such a nevus would result in a higher incidence of facial melanoma in men, but such is not the case (152). Although acute trauma is implicated by history in as many as one-fifth of the cases, it seems to serve in most instances to focus the patient's attention to a nevus which was already beginning to show malignant change (149, 152). This problem of cause-and-effect may be illustrated by the fact that scratching of a mole could be held responsible for the production of a melanoma, yet the pruritis or pain which prompted such action on the part of the patient may well have been symptoms of its prior malignant change. It should also be remembered that a benign nevus is quite a hardy structure; whereas a melanoma tends to be fragile, vascular and subject to easy iritation (152). It is open to question whether incomplete removal of a junctional nevus by any method can stimulate malignant transformation; such reported occurrences seem usually to represent treatment of a lesion which is already malignant (4, 7, 37, 152, 167, 177). One authority with extensive experience in skin neoplasia has never seen malignant transformation of a mole treated by desiccation in one or more stages (37). Most physicians feel, however, that a nevus of the junctional type should either be excised or completely destroyed in one stage (13, 52, 55).

Prophylactic Removal:

This is related to the subject of trauma. Chronic irritation, as opposed to acute trauma probably deserves serious consideration as a possible stimulant to malignant change (149). Even here it is not clear whether the higher incidence of melanoma on the palms and soles is a result of chronic irritation, or a result of the fact that nevi in this area are almost exclusively junctional in type. Since they are exceedingly common, it is manifestly impossible to prophylactically remove all junctional nevi. Most authorities, however, recommend the removal of moles subject to chronic irritation, such as those in the collar or beltline; and the statistics also justify the excision of any nevus located on the palms, soles, or genitalia (4, 5, 14, 78, 149, 206). Since melanoma rarely appears before puberity, it follows that childhood is the time most ideally suited to such prophylactic endeavors (4, 13, 152, 177).

Clinical Signs of Melanoma:

In general, *any change* whatsoever in a pigmented nevus must be regarded with suspicion, and any such suspicious lesion should be widely excised and submitted for histologic examination. Such changes include: Sudden appearance of a nevus or an increase in size of one already present, increased pigmentation, vascularity, bleeding, itching, pain, inflammation, weeping, or ulceration (13, 32, 52, 177, 206).

Choice of Therapy:

The two most common methods of treatment of clinically benign nevi are excision and electrodesiccation. Surgeons generally prefer the former, and dermatologists the

latter. Of 50 dermatologists of professorial rank polled in 1951, 40 used electrosurgical methods with or without curettage exclusively; seven used surgical excision alone; and three used both methods (173). Another survey revealed that two-thirds of 1,625,000 nevi removed by dermatologists were treated by desiccation or fulguration; 5 per cent were excised with the electric cutting current, and most of the remainder were removed by scalpel (175).

The most cogent argument for the use of routine wide excision is the clinician's inability to recognize melanoma by gross inspection (21, 32). This is indeed difficult at times, and most authorities would resolve a diagnostic problem by excision, followed by histologic examination of the suspicious lesion. Nevertheless, the majority of dermatologists feel competent to judge the malignant potentiality of most moles by clinical criteria (118, 175); and it has even been suggested that the clinical judgment of a good dermatologist is at least as good as the pathologic diagnosis of the non-dermal pathologist (75).

General principles which would seem to satisfy the majority of authorities on dermal neoplasia are as follows: Common intradermal moles, particularly if lightly pigmented, are safely and effectively removed by desiccation to skin level. The presence of hair in a nevus is evidence in favor of its benignity; and warty or pedunculated nevi have little or no malignant potentialities. Most nevi of the junctional type, especially if darkly pigmented, should be excised; and the same is true of blue or blue-black nevi. Any mole which suddenly appears in adult life, or which shows any change in its appearance, may represent melanoma and must be widely excised.

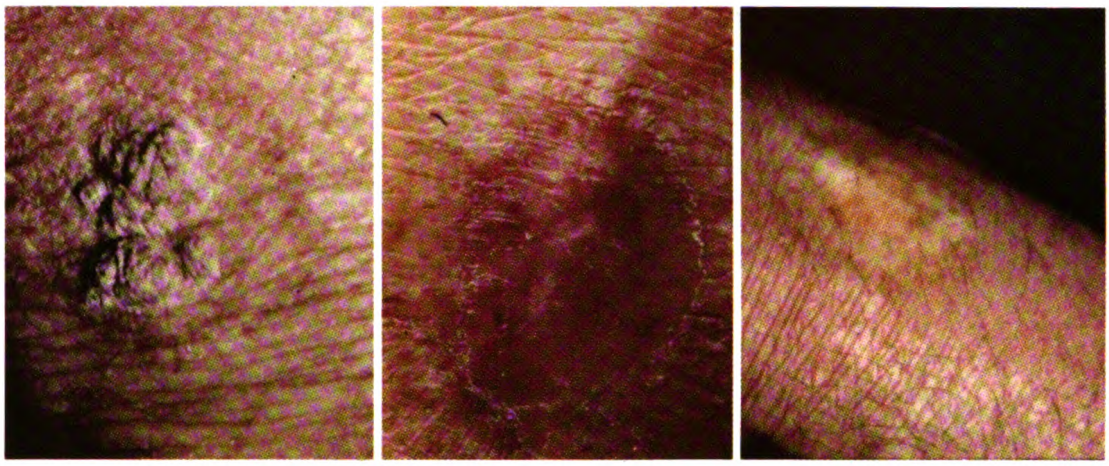
Keratoses and Precancerous Dermatoses

Seborrheic Keratoses (Verruca Senilis):

These lesions are most common in the elderly, and most frequently occur on the trunk and seborrheic areas of the face. Early seborrheic keratoses are only slightly elevated and are flesh-colored or yellowish. As they enlarge the scale becomes thicker and more greasy, the lesion becomes dome-shaped or warty, and the color becomes darker brown or almost black (30, 168, 174). Although basal cell carcinoma may rarely develop in these lesions, most authorities consider seborrheic keratoses to have little malignant potentiality (30, 127, 168, 174). For this reason, electrosurgical destruction can be conservative, permitting an optimal cosmetic result. The most frequent reasons for removal are cosmetic, or because of pruritis or irritation at points of pressure or friction.

The simplest method of treatment is the initial removal of the keratosis with a sharp curet, leaving a granular surface which is then lightly desiccated or fulgurated with a monoterminal current. Local anesthesia is optional for small lesions, but is advisable for most. The application of liquid nitrogen is considered by Goldman (80) to be especially effective.

Many physicians prefer to desiccate a keratosis prior to gentle curettage, as well as afterward (12, 27, 30, 125, 139). Caro and Szymanski (30) state that large keratoses are prepared for curettage by sur-



Senile keratoses of the wrist, removed by desiccation and curettage.

face desiccation, which makes the lesion more friable and promotes its separation from the underlying base. Following curettage, the base is lightly fulgurated, a measure which serves to prevent recurrence by destruction of underlying papillary projections, and provides a sterile crust. A dressing is seldom necessary. Healing occurs in about one week.

Senile Keratoses:

These lesions are also most common in the elderly, usually occurring on exposed skin surfaces, and often accompanying other manifestations of senile skin ("farmer's skin" or "sailor's skin") such as dryness, atrophy, senile freckles, and telangiectasia (30, 31, 96, 174). These keratoses are rough, dry, usually brown or yellowish, and have a tightly adherent horny scale. They are definitely precancerous, the incidence of malignant change, either basal cell or squamous cell, having been estimated to be 15 percent (12). For this reason, complete destruction is essential, and the cosmetic effect is of secondary importance.

The *electrosurgical techniques* vary in minor details, but generally involve a combination of desiccation and curettage. Procaine anesthesia is required. Most often, the keratosis is thoroughly desiccated, the destroyed tissue is removed with a curet or small scissors, and the base is thoroughly redesiccated (9, 27, 127, 170). The desiccated area heals in one or two weeks, leaving a pink spot which fades and eventually leaves little scar.

Some dermatologists (31, 37) first remove the lesion with a sharp curet. At the same time, an experienced observer can often detect any signs of malignant change. If, as is the usual case, no epitheliomatous nests are discovered, the surface is desiccated; whereas if evidence of malignant change is discovered, more radical therapy such as that described under Skin Cancer is indicated (37). Regardless of the technique, adequate follow-up is advisable, to insure adequate removal and to detect any early cancerous process (30). Certain clinical signs suggest that carcinomatous

transformation has already occurred in a keratosis: These include a rapid increase in size or elevation, signs of inflammation, replacement of scale by crust, erosion or ulceration, increasing telangiectasia, or the appearance of a pearly border (31, 174). Tissue should be obtained for biopsy, and the lesion treated as cancer. Keratoses or small cancers on the lip are often excised *in toto* with the *cutting* current and a loop electrode.

Many authorities post the reminder that the senile skin, upon which these keratoses so often develop, also deserves therapy (30, 31, 96, 174). Shielding from sun and wind by brimmed hats and gloves or protective ointments, avoidance of detergents and other irritants, and the use of bland skin lubricants are indicated.

Miscellaneous Keratoses:

Other keratoses may be divided into several groups: (1) *Radiodermatitis.* Keratoses resulting from overexposure to radiation are usually destroyed by electrodesiccation, if the involved skin does not require excision and plastic repair (96). (2) *Arsenical keratoses,* which have a predilection for palms and soles, have in the past resulted from therapy with Fowler's solution but also occur from industrial contact with arsenic. Furriers, tanners, sprayers, taxidermists, and those who make or handle wallpaper may be afflicted (96). (3) *Industrial keratoses,* aside from the former, may result from exposure to various carcinogenic hydracarbons such as soot, pitch, paraffin, petroleum, lanolin, asphalt, mineral oil, and tars. (4) *Xeroderma pigmentosum,* a rare hereditary degenerative skin disorder in which there is marked sensitivity to light, is associated with the production of precancerous keratoses and other evidences of premature degeneration.

All of these keratoses are similar to the senile type in structure and in carcinogenic properties, and the same therapeutic principles apply (31, 37, 96, 127).

Cutaneous Horns (Senile hyperkeratoses):

These lesions have histologic and clinical similarities to senile keratoses, and their malignant propensities and treatment are the same (12, 96, 125). Most commonly, the mass of cornified material is clipped away, the base is destroyed by thorough desiccation, and the site is inspected at a suitable interval to confirm complete removal and healing. Since the base of the horn may show malignant change, Crossland (43) prefers to excise the entire lesion with the cutting current so that an adequate histologic examination can be made. (See section on Skin Cancer.)

Leukoplakia:

This disorder of the mucosae or muccocutaneous junctions is followed by squamous cell carcinoma in about 30 percent of cases, and every case should be kept under close observation (36, 127). The methods of treatment include the destruction or excision of the leukoplakic patches, and the removal of all possible predisposing factors.

In the case of oral leukoplakia, dental treatment to prevent injury from jagged teeth or poorly fitting dentures, treatment of pyorrhea, avoidence of biting of tongue or buccal mucosa, discontinuance of tobacco or other irritants, the use of mouth washes and the maintenance of

scrupulous oral hygiene are necessary (36, 96). The etiological role of syphilis has been overestimated in the past, but it should be treated if present.

For local removal, many authorities consider monoterminal fulguration or desiccation the treatment of choice (36, 45, 136, 170, 180, 189, 200, 209). Chemical caustics or radiation are generally not advised. The patches are first anesthetized with a topical anesthetic if superficial, or with local procaine if relatively deep destruction is necessary. A specimen for biopsy is usually obtained from the most suspicious area. The fulgurating spark is applied intermittently over the plaque until it is entirely dehydrated, desiccating slightly beyond the periphery of the patch. Although this type of treatment is especially applicable to small patches, rather extensive areas on the tongue or buccal mucosa have been desiccated in one sitting. The resultant dehydrated mass may be peeled off in a uniform membranous sheet with the aid of a forceps, leaving a surface which undergoes rather prompt healing.

Very hypertrophic or warty patches can be thoroughly removed with biterminal electrocoagulation, or they may be curetted with a loop electrode and the cutting current (33, 76). Some operators (97, 211) recommend superficial biterminal coagulation of the leukoplakic area with a ball-tip electrode; the patch is destroyed in a manner similar to the coagulation of erosions of the uterine cervix.

If leukoplakia is so widespread as to make complete removal impractical, and/or if conservative therapeutic measures are first being employed, it is advisable to inspect the lesions at intervals of three months. If any portion of the leukoplakia shows persistent activity-erosion, fissure, ulceration, or warty excrescenses — that area should be destroyed (127).

Kraurosis Vulvae (leukoplakic vulvitis):

Various precancerous dermatoses (leukoplakia, keratotic or verrucous lesions, ulcers etc.) associated with the earlier stages of this syndrome may be destroyed by desiccation, or excised with the cutting current (33, 76, 125). When the disease is extensive, complete vulvectomy is advisable.

Skin Cancer

The curability of skin cancer appears to be about the same with the skillful application of any modality, whether it be surgical, electrosurgical, chemosurgical, radiological, or a combination of these (91). Any series of skin cancers treated by one method is to some degree selective, since no single therapeutic technique is applicable to all neoplastic lesions. Electrosurgical methods, either alone or in conjunction with radiotherapy, are very commonly used; the five year rate of cure in several large series of small basal cell or squamous cell cancers treated by these modalities is 97 to 99 percent (50, 62, 157, 185). Certain fundamental principles apply, regardless of the type of therapy: (1) obtaining a tissue specimen to establish or confirm the diagnosis; (2) complete destruction or removal of the neo-

Basal cell carcinoma before treatment, immediately after electrosurgical excision, and 6 months later.

plastic cells; and (3) follow-up to insure adequate treatment and proper healing. The physician undertaking therapy of neoplasia must have the experience necessary for proper selection and application of treatment (37, 172).

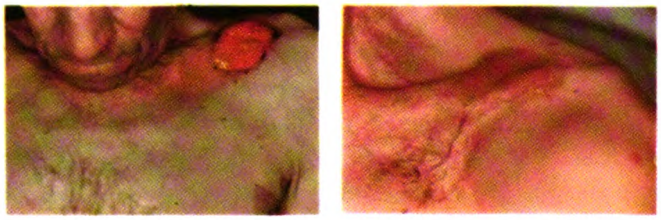
Technique of Desiccation or Coagulation:

Local anesthesia is obtained by procaine injection around and beneath the growth, but not into malignant tissue. A specimen for biopsy is obtained, usually with a punch or scalpel. Some operators prefer to first curet away most or all of the friable malignant tissue, which is used for biopsy, and then desiccate or coagulate the new surface (62, 179). Monoterminal desiccation is the current most commonly used for small neoplasms. For larger tumors, biterminal electrocoagulation will permit more rapid and deeper destruction; the technique is similar to desiccation except that the indifferent electrode and a lower power setting are used.

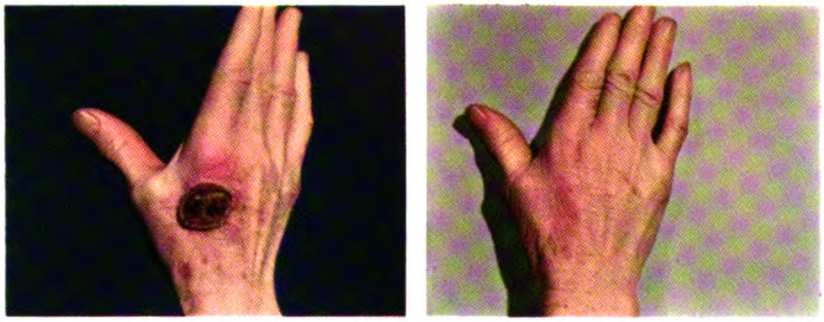
The desiccating current is first applied to the healthy tissue beyond the visible or palpable margin of the tumor, thus cutting the neoplasm off from the normal tissue and sealing the blood and lymph spaces (172, 185). After circumvallation, the remainder of the growth is systematically and thoroughly destroyed in a centripital direction. The needle electrode can be inserted to varying depths into the tissue to obtain the required depth of destruction. After complete desiccation, a curet is used to remove the destroyed tissue. This ordinarily leaves a dry base, although any bleeding vessel can be sealed by desiccation. The final step is redesiccation of the base, with particular attention being paid to the edges and any suspicious areas. A bland or antibiotic ointment, and a sterile dressing may be applied if desired. The crust separates in about one week; and if the neoplasm has been properly destroyed, a healthy granulating base appears which will be epithelialized in about three weeks (172). Although of secondary importance in cancer therapy, the cosmetic result is usually excellent (37). After complete healing, follow-up every three to six months for two years or longer is recommended (91, 185).

The technique described above has usually been applied to basal cell carcinomas, and to a lesser extent to *early* squamous cell lesions. If the size and location of the lesion permit complete and safe excision, this is often preferred (see page 36).

Some cancer therapists believe that proper electrosurgical destruction of small *basal cell* carcinomas is sufficient treat-



Left: Basal cell carcinoma treated by electrosurgical excision ("discing").
Below: Squamous cell carcinoma treated by electrosurgical excision and coagulation.



ment, and reserve radiation for those so located that complete removal is difficult or uncertain (36, 114, 172). Many others use some x-ray therapy following electrosurgical treatment, regardless of the type of cancer (28, 62, 193, 200). Some therapists apply postoperative x-ray, directed to the tumor bed and routes of spread, only when the biopsy indicates a *mixed* or *squamous cell* origin (114). Cancerous or precancerous lesions recurring in a previously irradiated area is a special situation in which desiccation alone is usually preferred (140, 189).

Combined Electrosurgery and X-Radiation:

A review of the literature suggests that the majority of skin cancers treated by dermatologists receive a combination of electrosurgery and radiation (91). Many physicians believe that the permanent rate of cure and cosmetic effects achieved by the combined method are superior to either one alone. The growth is removed by the technique previously described, and the site is then given x-ray therapy. The dose and area of radiation, of course, depend on such factors as the type of tumor, its size, location, and the evidence for complete removal. Representative doses following electrosurgical removal of small cancers are 1800 to 3000 r, in three or more divided doses (28, 62).

The chief advantage of electrosurgical removal prior to radiation is stated to be the resultant lowered roentgen dose required for cure (62, 192). Many basal cell carcinomas, particularly those of cystic, cicatrizing, morphea-like, or infiltrating types, are relatively resistant to radiation; and x-ray as the sole curative agent may have unpleasant sequelae on the skin and adjacent tissues (193, 200). The factor of radiation sequelae is especially important in the younger patients (179).

Aside from the cosmetic effect of radiodermatitis, this lesion itself may have delayed carcinogenic effects (192), and will make further therapy more difficult in the event of recurrence (39). Certain areas may not tolerate heavy radiotherapy well, particularly where the amount of subcutaneous tissue is small, and where the skin overlies cartilage or bone (188, 200). If the lesion is large or deeply infiltrating, the therapist may remove the major portion of the growth, by coagulation and curettage, or with the electrocutting current, and will then depend on radiation to complete the cure (130).

Electrosurgical Excision and Biopsy:

It is often possible to completely excise skin cancers, under local or field block anesthesia, especially if they are small and suitably situated. A margin of normal tissue must be included, and the entire specimen is submitted for histologic study. Many therapists consider excision to be the treatment of choice for early squamous cell cancers (124, 193), and others routinely excise basal cell carcinomas with the cutting current (160, 161). The choice between the electric cutting current and the cold scalpel for excision may depend on the characteristics of the tumor, its size and location, the desire for primary union, and the preference of the operator. Certain possible advantages of electrosurgical excision will be mentioned below. Postoperative radiation may be employed after excision, as it is following other electrosurgical methods, particularly for certain squamous cell lesions or if complete removal is uncertain. The cutting current, of course, requires the application of the indifferent electrode.

For electrosurgical excision any type of cutting electrode may be employed, and each has its value. A *needle* electrode is most often used, and is generally the most suitable for excision of tumors by the "discing" method, although a small blade can be used for this purpose. Radcliffe (160, 161) and his associates electrosurgically excise about 90 percent of their cases of basal cell and epidermoid carcinoma by the following technique: After a circumferential intradermal injection of 1 percent procaine or xylocaine, 2 or 3 cc. of the anesthetic are injected directly under the lesion to "float" it away from underlying structures. The cutting current and a needle electrode are used to make a circular cut entirely around the tumor at a 1 or 2 mm. distance from its margin. The incision extends into the subcutaneous fat. Then, using a small mouse-tooth forceps to raise one margin, the entire disc of skin is excised by cutting through the layer of fat. The current is switched to coagulation, and the base is desiccated only as required to secure hemostasis; no postoperative radiation is given. The wound, which is left open, may be treated once or twice daily with 2 percent aqueous gentian violet or 0.5 percent neomycin cream. Depending on the size of the lesion, healing is complete in three to six weeks.

In general, electrocutting electrodes should *not* be used to produce elliptical excisions with the expectation of suturing the edges and obtaining primary union. A small flat blade electrode, and a rapid cut, have been used for this purpose but the cold scalpel is preferable when a linear scar is desired. The round defect, left after the usual type of electrosurgical excision, heals in and leaves a scar which is cosmetically very acceptable (43).

The *blade* electrode is reported to be convenient for excision of cancers involving the rim of the ear (188): The cancer and cartilagenous margin are easily and bloodlessly amputated under local anesthesia, with no need for sutures. A *loop* electrode can also be used to excise small tumors and an adequate margin of normal skin, although the greater current required by this type of electrode may have a cosmetic disadvantage, and experience is necessary for optimal results. A small fine loop, somewhat larger than the neoplasm, is touched to the skin at one side of the tumor; when the cutting current is applied, the loop is immediately and quickly moved below and out the opposite side of the lesion so as to completely excise it. Lesions of the lip are often excised in this manner.

Many surgeons and dermatologists have used electrosurgical excisional biopsy for a variety of cancerous or suspicious lesions not only because of its convenience and the hemostasis obtained, but because of theoretical advantage that dissemination of malignant cells might be prevented by non-manipulation of the tumor and because the blood and lymph vessels are sealed by coagulation (76, 86, 107, 137, 172, 178, 203). It has been claimed by some physicians that the electric cutting produces less distortion of the tissues than do the scalpel or biopsy punch (86, 103, 178). This method is chiefly applicable to *excisional* biopsy, or to fractional biopsy of large lesions, in which a thin film of coagulated tissue does not interfere with histologic study. Biopsy specimens from small lesions, unless the lesion is excised *in toto*, are better obtained with scalpel or punch.

Vascular Nevi (Angiomas)

Inspection of the literature on the subject of hemangiomas is likely to prove confusing, since different authors may consider the same lesion to be of capillary, venous, or arteriolar construction (104, 151, 208). Actually, classifications based on vascular pattern are often inaccurate. In any one case, a combination of non-canalized tissue, irregular spaces lined by endothelial cells, capillaries, and mature arteries and veins may be found (98). Such vascular tumors are believed to arise from vasoformative (hamartomatous) tissue misplaced or unused during fetal development, and such tissue may produce lesions recognizable at birth or later in life. Their enlargement is probably due to canalization and establishment of blood flow in fresh parts of an existant malformation, or to changes caused by hemorrhage, inflammation, or cystic degeneration (98).

The common *intradermal* (superficial) hemangiomas are usually called "strawberry marks", "port wine stains", and "spider nevi." The *subcutaneous* (deep) lesions are called "cavernous hemangiomas." These are useful clinical terms which are recognized by all physicians. It should be remembered that strawberry marks may have subcutaneous extensions.

During the past two decades there has been much controversy concerning the indications for treating vascular nevi in infancy and childhood. Hemangiomas commonly occur during the first few months of life, continue to enlarge for some months,

and then stabilize for a period of months or years until thrombosis and the process of gradual involution begins. There is no doubt that a majority of infantile hemangiomas spontaneously regress and disappear during early childhood, and it is on this basis that many physicians have preferred to delay treatment until after the fifth or seventh year (6, 29, 119, 202). Some physicians employ expectant therapy only if the angioma is kept under close observation, and if the size, location and parents' cooperation justify such a course. A recent survey of over 400 infantile angiomas reveal that 95 per cent of strawberry nevi and 77 per cent of cavernous lesions showed spontaneous involution (202). Some physicians imply that cavernous angiomas less often disappear (42, 133).

A few hemangiomas of childhood continue to grow alarmingly, some involute incompletely; and a significant number of others never retrogress except as the result of trauma, infection, cystic degeneration or ulceration—which can lead to serious scarring and deformity. Although the latter are in the minority, it is impossible to accurately predict the course infantile angiomas may take, and it is for this reason that many authorities advise immediate treatment (11, 23, 42, 115, 133, 143, 151, 196).

Methods and Principles of Therapy:

Radiation, electrosurgical methods, and surgical excision seem to have the widest acceptance, and a combination of these methods are used in many clinics. Injections of sclerosing solutions have also been successful in some cavernous lesions. Pulsating cavernous angiomas should be first treated by ligation of afferent and efferent vessels supplying the tumor, if this is possible, prior to the use of other therapeutic measures (70). Thermocautery, carbon dioxide snow or liquid nitrogen are sometimes used for very superficial lesions, but have important disadvantages in terms of maximal surface destruction, with resultant scarring, and poor penetration of vascular spaces. In general, none of these methods of therapy are suited to port wine stains, and most of the comments to follow apply to angiomas of the strawberry-mark or cavernous type.

Excellent cosmetic results can be obtained with either radiation (11, 133, 165) or electrosurgery (2, 70, 90, 131); although proper equipment, patience, and experience are essential for optimal results by either method. *Radiation,* whether by radium plaques or contact x-ray, is generally applicable only in children, in whom the lesions are radiosensitive; the treatments are commonly applied at intervals of three months or more over a six to eighteen month period (11, 155). The serious late effects of radiation have been emphasized by many therapists (151, 202, 208), and it is essential that such treatment be applied with proper equipment by a physician experienced in pediatric radiotherapy.

Electrosurgical therapy is preferable for *adult* angiomas, which are radioresistant (70). Its use in *children* is usually limited to certain areas where the hazards or difficulties of radiation are great, i.e. over cartilages of nose and ears; on the scalp, breasts, or genitalia; on thin skin overlying sternum and vertebrae; or in situations where the angioma is small and the cosmetic effect is not paramount. Although most dermatologists prefer radium therapy for infantile angiomas, Aiken (2) claims

that his technique of electrocoagulation produces cosmetic results equal or superior to any other method of therapy either in children or adults. Electrosurgical methods have often been used in conjunction with other types of treatment: Thus, residual vascular tissue or telangiectases following radiotherapy or injection may be treated by desiccation; and rapidly growing or diffuse cavernous lesions can be controlled or reduced in size by electrocoagulation to simplify future excisional surgery (104, 132). An electrosurgical unit with spark-gap generated current is preferred (2).

Electrosurgical Therapy:

As with radiation, the best cosmetic results from electrosurgery will be achieved by conservative factional therapy. The principle is that of endothelial injury and coagulation of blood leading to thrombosis, organization, fibrosis, and contraction —simulating spontaneous involution. The beneficial effects accrue *gradually,* and retreatment at too short an interval may produce a hypertrophic scar (131). It is better to undertreat at first, and to evaluate the need for further therapy after one or two months (2, 121, 131). It is usually necessary to give more than one treatment, and it is better to treat a segment of a large angioma rather than to attempt its complete destruction in one session.

Although fulguration has been used for tiny superficial lesions, it is generally much preferable to insert the needle directly *into* the tumor *before* turning on the current; thus uniform heat is delivered to the depth of the lesion and surface destruction is minimized. Monoterminal desiccation is often adequate for small strawberry nevi, but biterminal coagulation is needed for deeper lesions.

A number of operators have specified their preference for needle electrodes which are *insulated* except for 2 or 3 mm. at the tip, particularly for the treatment of cavernous lesions, so that surface effect and scarring are further reduced (1, 2, 70, 90). A method of preparing such an electrode has been described by Aiken (2). A disadvantage lies in the fact that insulation thick enough to be effective may also increase the difficulty of insertion, although sterile lubricant or a minute stab wound can be used to facilitate placement. In treating deep angiomas, it may be preferable to insert the electrode through normal skin adjacent to the tumor, in order to avoid the bleeding which follows direct puncture of the lesion (2), and to reduce the danger of slough of thin overlying skin (70).

Electrosurgical therapy usually requires circular block anesthesia: The injection of 2 percent procaine around the growth at a distance of 1 to 2 cm. A general anesthetic of nonflammable type is preferable for young children.

Strawberry Mark (Superficial or noncavernous hemangioma; hemangioma simplex; hemangioma hypertrophicum):

This angioma is the elevated, dusky to bright-red tumor which is soft and compressible, often having an irregular tufted surface. Radium therapy is the preferred treatment at a number of medical centers, particularly for facial lesions in young children. A number of operators have achieved good cosmetic effects with the use of monoterminal desiccation (2, 19, 106, 108, 209). Some physicians prefer to limit its

use to elevated lesions which have a base less than 0.5 cm. in diameter (204). Although fulguration has been used for small and very superficial lesions, it is almost always preferable to insert the needle electrode directly into the angioma *before* applying the current. In some of the larger strawberry angiomas, and in those with subcutaneous extensions, biterminal coagulation may be needed. A needle electrode which is insulated except at its tip, may be used if the size or the depth of the lesion justifies its use.

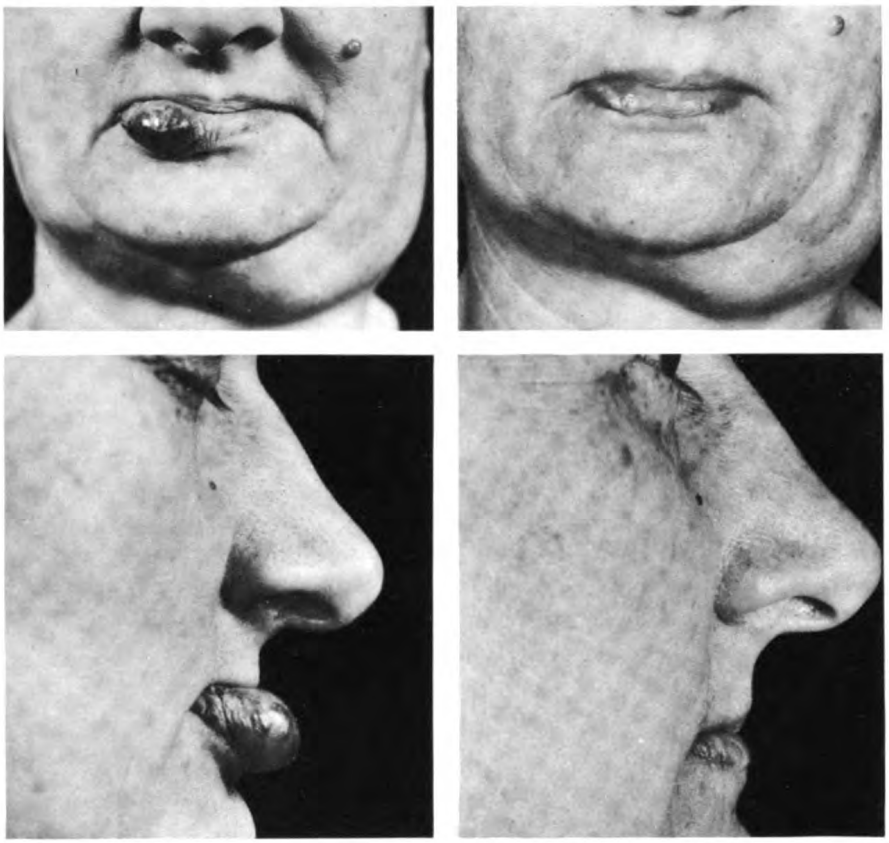
Multiple punctures of the lesion with a needle electrode are usually recommended, and the point is placed about midway between the base and external surface. After the electrode is placed, the current is applied, keeping in mind that the area of skin destruction about each puncture should be small. Multiple punctures are used, leaving small pieces of intervening skin undamaged by the desiccating current (132). In this way the area heals in much the same way as a donor site after cutting a thin free graft and with no greater residual blemish. Remember to clean the electrode point of coagulated blood after each puncture. In general, angiomas should *not* be curetted after desiccation. According to Matthews (131, 132), it is usually necessary to administer a second treatment, which should be delayed for two months.

Aiken (2, 3) claims cosmetic advantages from the use of insulated needle electrodes for capillary as well as for cavernous angiomas, and his method of treating the deep lesions (following) often can be applied to the superficial variety: The needle is inserted at a distance from the lesion, and then is advanced beneath the area to be treated. Care is taken to avoid approaching the superficial aspect too closely, and a swab dipped in iced water is used to cool the skin during treatment to avoid overheating and subsequent sloughing.

Cavernous (Deep) Hemangioma:

This lesion is deep-seated, soft, often nodular and lobulated, and usually has a blue or purplish color. *Biterminal coagulation,* using the indifferent electrode, is necessary. Most authorities prefer to use a needle electrode which has an insulated shaft, to protect the normal skin or mucosa through which it passes (1, 2, 70). More intensive coagulation is necessary than might be anticipated, since the heat is diffused rapidly by the blood and carbon forming on the electrode tends to insulate the current (72). However, it is essential that destruction of overlying skin be minimized, since sloughing will produce excessive scarring.

The point of the electrode should rest within the body of the angioma, and should neither be placed too deeply nor too close to the skin surface. It is sometimes possible to feel the firmer underlying sound tissue with the needle point; this is a valuable warning as to depth (93). The electrode upon insertion may render the tissue bloodless so that coagulation is simulated, but this effect is negated by drawing the needle back slightly to equalize the tension. The point of the needle should never be allowed to come too near the surface during the treatment in order to avoid sloughing; this risk can be avoided by careful palpation of the needle point before turning on the current. Aiken (2) also gauges the depth of the electrode by using



Cavernous hemangioma of the lip treated by electrocoagulation.

a semi-darkened room, since the radiating sparks give an indication of the proximity of the needle point to the surface.

The electrode may be inserted directly into the overlying skin or through normal skin adjacent to the angioma; bleeding is avoided by the latter procedure (2). It is also of advantage to introduce the needle through adjacent normal skin when the skin covering the tumor is so thin that it is difficult to avoid destroying it as the deeper portion of the tumor is coagulated (70). One needle puncture may be sufficient for small angiomas, whereas a large one will require treatment at multiple points 1 to 3 cm. apart. It is preferable to treat just a segment of a large angioma at any one session (2). The current is not applied until the electrode is properly placed.

A *mild* coagulating current is applied at each point for 2 to 5 seconds (2, 204). The current should be discontinued if there is any lightening in color of the skin or mucosa overlying the electrode (70). It is wise to use the bare finger over the electrode tip, not only as a guide in placement, but also to guard against overheating dur-

ing application of the current; the surface heat should be just perceptible to the finger (2). If overheating should occur, the skin should be cooled by a swab dipped in cold water.

The treated part becomes swollen within a few hours, but except in young children, no dressing is required unless the skin is blistered (2). Angiomas in the mouth require no after-care other than routine oral hygiene. Repeat treatments are best carried out at intervals of one to three months (2, 70, 90, 121).

Port-Wine Stains (Nevus flammeus, nevus vinosus):

This nevus is the flat purplish-red or violet capillary angioma, usually seen on the face. It is included here only in the interest of completeness, since electrosurgery has very little place in the treatment of these lesions. According to Traub (196), light desiccation may improve the cosmetic appearance if the lesion is very small, and if it is superficial enough to blanch under pressure. Fulguration is also used for the treatment of papillary angiomatous projections, which may arise upon these large nevi in later years (160). X-ray and radium are contraindicated (42, 151, 204). Cosmetic camouflage with "Covermark" is helpful in female patients. The tattoo method of Conway (40) is often quite successful for those nevi which are deep enough to permit pigment injection into the upper dermis. Excision and full-thickness grafting are successful in selected cases (104, 204). Thorium X and abrasive techniques have also been used.

Spider Nevus (Nevus araneus, spider angioma):

This nevus appears as a solitary or multiple pinhead-sized lesion with a central vessel from which smaller ones radiate, resembling the body and legs of a spider. These lesions are treated locally very well with monoterminal desiccation or fulguration. The most common technique is to insert the point of a small needle electrode just under the skin so that it enters the central vessel, followed by the application of a mild current for not more than one second (42, 45, 143, 209). Brief fulguration may also be used, applying the spark in short flashes to the central vessel (33, 199). In either event, obliteration of the peripheral vessels automatically occurs and healing takes place without scar. The results of this procedure can be checked with the glass slide test, by pressing a slide over the lesion and releasing it; if therapy has been successful the blood will not reappear.

Telangiectases:

These vascular dilations have a varied etiology, and may be due to heredity, metabolic or nutritional disturbances, roentgen dermatitis, intracutaneous or subcutaneous tumors, infection, exposure to sun and wind, or aging. This group includes the dilated vessels of rosacea, the lesions of hereditary telangiectasia, the common senile angiomas ("cayenne pepper spots"), and the spider nevi which were previously considered. The local treatment of such permanently dilated vessels is effectively accomplished using either the intermittent fulgurating spark, or the desiccating needle inserted directly into the vessel. In either case, a mild monoterminal current is applied until the vessel is obliterated (29, 151, 170, 174).

Lymphangioma:

Lymphangioma circumscriptum (lymphangiectodes, lymphangioma simplex) consists of small discrete, translucent lesions which have the appearance of thick-walled vesicles, are colorless or pinkish, and have been likened to frog spawn. Destruction of the lesions is quickly and effectively accomplished with monoterminal desiccation or fulguration (25, 108, 196). The current is applied intermittently to each lesion until it is thoroughly dehydrated. Healing occurs with a good cosmetic result. Deeper varieties of lymphangioma, whether of the "capillary" or "cavernous" type, involving the skin or tongue, have also been effectively treated by electrocoagulation in a manner similar to that described for cavernous hemangiomas (2, 57, 196). These lesions are usually radioresistant.

Sebaceous Cysts

Sebaceous cysts have long been treated by electrosurgical techniques, which have the advantage that definite therapy can be undertaken during the stage of infection—the time when these lesions become symptomatic and are brought to the physician's attention. The most common method has been as follows: The cyst is opened with the electric cutting current, its contents are expressed, and the cyst wall epithelium is then destroyed by electrocoagulation or desiccation, usually with a small ball-tipped electrode (12, 25, 33, 61, 123). The principle of this method is similar to the use of liquified phenol for the same purpose.

Method of Danna:

More recently, Danna (48, 49) has described a simpler method for the eradication of sebaceous cysts, and the efficacy

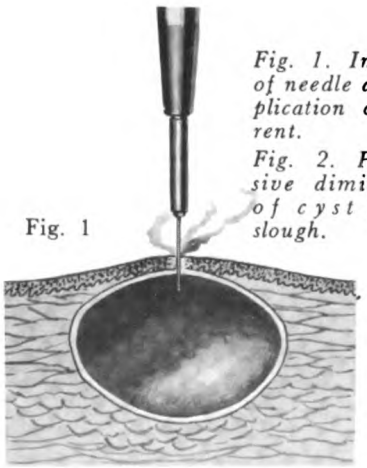
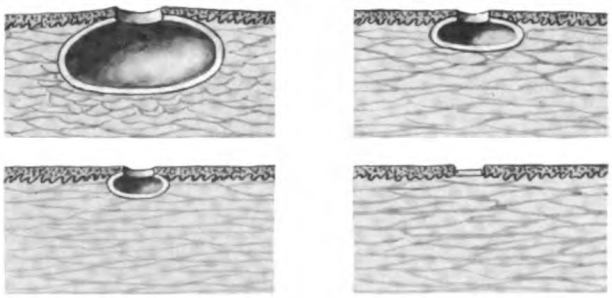


Fig. 1. Insertion of needle and application of current.

Fig. 2. Progressive diminution of cyst after slough.

Fig. 1

Fig. 2



Treatment of sebaceous cyst. (after Danna).

of his technique has been confirmed by others (67, 162, 182). Nearly half of the cysts treated by Danna were infected and on the point of rupture, and the cysts ranged in size from 1.5 to 6 cm. in diameter.

The small cysts may be treated with the monoterminal (desiccating) current, but the lesions over 3 cm. in diameter are better treated with biterminal coagulation, using the indifferent electrode. The sharp, stinging sensation is easily borne by most patients, and the current may be interrupted temporarily if the patient feels pain. A 1 percent procaine injection into the surrounding skin is advisable for nervous patients.

A needle electrode is inserted into the cyst, as illustrated in figure 1. The insertion of the electrode must be in the center of the top, where the combined thickness of the skin and cyst wall is least. Some operators (162) make an effort to insert the needle through the natural orifice of the cyst. The needle should just enter the superficial portion of the cyst cavity, only a few millimeters below the skin surface.

A moderate current is applied until a whitish eschar forms around the needle. The diameter of the eschar should be one-fourth to one-third that of the cyst. A single puncture is sufficient for cysts up to 3 cm. in diameter, but two or three adjacent punctures are required for larger cysts.

The separation of the slough in five to eight days permits drainage of the cyst cavity, although the cyst contents sometimes consist of inspissated epithelial cells which must be forcibly expressed. Progressive diminution of the cyst (Fig. 2) follows during the next three to six weeks, until the cyst wall levels off with the epidermal surface, showing as a pigmented area which later assumes the qualities of normal skin. In most cases, within seven to ten days, the scab of the cyst has shriveled and is either extruded or can be delivered through a relatively small opening (182). This method of treatment is said to produce a better cosmetic result than does surgical excision (48, 162), and there were no recurrences in Danna's experience.

Robbins and Pensky (162) have reported the successful treatment of 250 infected and noninfected sebaceous cysts by this method. These authors employ the monoterminal current exclusively, and anesthesia was used in none. Blanching of the skin around the needle electrode in these cases was no greater than 3 mm. in diameter, and two punctures were made in large cysts. The lesion was left intact for seven to ten days, at which time the crust was gently lifted, and the sac and its contents were evacuated either intact or in pieces. In the case of scalp wens, on the tenth postoperative day a small incision was made into the slough and the cyst delivered *in toto*. One treatment produced permanent eradication of the cyst in 90 percent of this series, and the remainder required a second treatment.

Rhinophyma

This advanced stage of acne rosasea is a serious cosmetic disorder which has long been effectively treated by electrosurgical procedures. A method commonly

Rhinophyma, before and after treatment by "electroshaving".

used in the past has been the fractional destruction of hyperplastic sebaceous glands by multiple insertions of a desiccating or coagulating needle electrode (33, 60). This method usually requires more than one treatment, given at intervals of several weeks; and it is not as precise as the use of the electrocutting current which has become preferred for advanced cases (15, 65, 87, 145, 166).

Electrocutting Techniques:

The monoterminal "electroshaving" method recently described by Niedelman (145) is an office procedure which is stated to be inexpensive, bloodless, and capable of cosmetic effects better than or equal to plastic surgery. After routine preparation of the involved skin, a total of 10 to 15 cc. of 2 percent procaine solution (containing 1:25,000 epinephrine) is injected around the nose, ringing it completely, including the upper lip and corners of the mouth. This ordinarily provides adequate anesthesia, but an infraorbital block may also be done if necessary. The cutting current is used, *without* the indifferent electrode. With a spatula-shaped straight blade electrode, the hypertrophic areas are carefully shaved off. The current is set to produce a mild cutting effect without intensive coagulation; a Bovie setting of 50 to 60 has been found satisfactory. The proportions of the nose are sculptured to conform to the facial configuration, and care must be taken not to expose bone or cartilage. The treated area is covered with a sterile petrolatum gauze pressure dressing for three days, after which it can be left uncovered, although it should be protected from heat, cold, wind or trauma until epithelial regeneration is

complete.

Other operators have used the more conventional biterminal electrocutting current, with the indifferent plate and loop (37, 66, 127), needle (15) or various (87) electrodes. The control of bleeding provided by the current permits "artistic" sculpturing of the nose to its proper shape and size; any bleeding which does occur is controlled by compression or electrocoagulation, but large vessels should be tied. (Niedelman believes that his monoterminal technique has superior hemostatic qualities.) At times, brief coagulation of papules have been combined with electrocutting sculpture (166). In general, the coagulating effect should be minimal, to avoid destruction of cartilege and resultant perforation (37). The electrodes can be kept free of coagulated tissue between applications by scraping with a knife (87). Bone or cartilege must not be exposed. Farina (66) recommends that a dermal layer of 2 mm. thickness remain above cartilege. Cipollaro (37) adds that there should remain a sufficient supply of sebaceous glands, from which new epithelium grows. Healing is usually complete in three or four weeks (37, 87, 166).

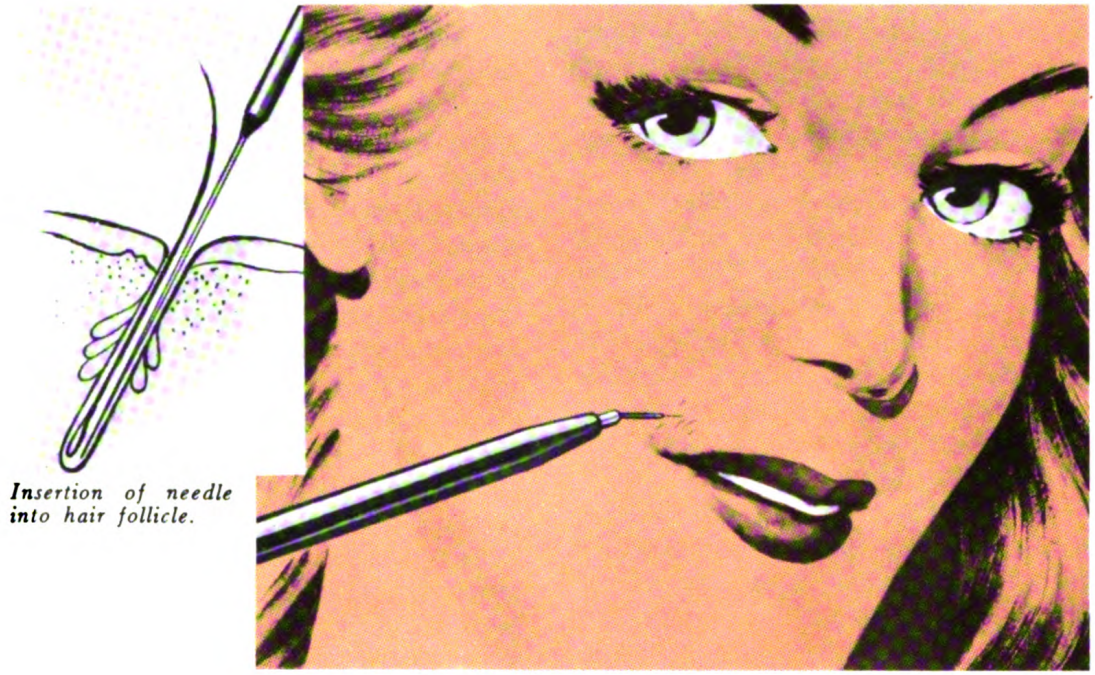
Epilation

Since its introduction to this country more than two decades ago, the methods of epilation with high frequency currents have rapidly replaced the older technique of electrolysis. Among the reasons given by the dermatologists for their preference of electrosurgical methods are the following: Four to five times greater speed, less pain, less after-irritation, fewer recurrences, no danger of tattooing the skin, and an ideal cosmetic effect (63, 64, 68, 84, 100, 110, 116, 141). Cipollaro (35) points out that the pain is more intense with high frequency current, but is felt for only about one second, whereas in galvanism the discomfort is prolonged over a period of 15 to 45 seconds. In the experience of the latter operator, the recurrence rates following electrocoagulation or electrolysis are both about 20 percent.

The responsibility for the permanent removal of unwanted hair is being assumed by more physicians because of the frequent poor results from beautyshop treatment. Good equipment, aseptic precautions, and careful technique are essential for the best results.

Principles:

When the epilation needle is inserted into the hair follicle and the current is applied, the greatest current density is at the *point,* so that coagulation takes place first only in the immediate vicinity of the tip. If the point is at the level of the papilla, the adjacent follicular epithelium, and the vessels and nerves which feed the papilla will be destroyed. If the current is too strong or applied too long, a cylindrical column of coagulation extending to the skin will be produced (35). When properly applied, the coagulation will occur chiefly at the root of the hair without affecting the surface of the skin, so that visi-



Insertion of needle into hair follicle.

ble scarring will not occur.

Equipment:

A spark-gap current is more effective than undamped (vacuum tube) diathermy (35, 144). In the interests of convenience and proven dependability, the physician should use a steel noninsulated needle (84, 100). Some operators use a blunt (slightly bulbous-tipped) epilation needle, which is less likely to perforate the follicle; but others prefer a sharply pointed needle, which is easier to insert (146). The special angulated epilation needle is convenient to use (163). Partially insulated needles are difficult to insert and have been found to possess no advantage. The needles used in this procedure are necessarily fragile. Have several on hand, because a bent or broken needle is useless.

It is essential to use equipment manufactured for the purpose; ordinary high-frequency circuits will produce excessive destruction since the current cannot be suitably controlled for epilation (35). The Office Bovie incorporates a special epilating circuit. If the Bovie to be used does not have this circuit, a special attachment —the *Epilation Adaptor*—should be used. Either the special epilating circuit or the Adaptor, introduces resistance in the patient's circuit which decreases the intensity of current coming from the machine. This spreads the range of power control over the dial and makes power settings more exact. A biterminal technique (with indifferent electrode) is most often recommended.

Preparation:

The patient should be in a comfortable relaxed position, and the physician

should have maximum visibility and easy access to the field of operation. A strong artificial light, and a magnifying glass on an adjustable stand or magnifying spectacle lenses, are valuable adjuncts in the proper insertion of the needle (100).

Needles, forceps, or other instruments to be used should be kept in an antiseptic solution before operating. The operator cleans his hands and the patient's skin in the usual manner. He should remember to allow any flammable liquids to evaporate completely before proceeding. No removal of hair should be done on an area even slightly infected (100).

Patients who have been accustomed to removing hairs by any method should be instructed to allow the hair to grow for not less than two weeks; by that time the protruding hair will indicate the direction of the follicle so that the needle can be accurately introduced (141).

Niedelman (141) offers several suggestions in treating persons of blond complexion, although usually a slight pull with the tweezers is sufficient to show the location of the follicle. The exact entrance can be marked by applying 5 percent lamp black in vanishing cream; this is wiped off, leaving the pores marked as black specks which can be later removed with soap and water. The lanugo hairs can be blackened with colored rinse, which can later be removed with dye remover or carbon tetrachloride.

Note:

It is well to practice inserting the needle into one's own follicles or to make test insertions in less visible areas on the patient's skin, such as the arm, before proceeding to treat the face.

Technique:

The power setting required (using either the special epilating circuit or the Adaptor) for biterminal operation, will probably be in the vicinity of 50 to 60, although the exact setting must be determined by experience. The current is not applied until after the needle is in place. With the shaft of the needle parallel to the direction of the hair shaft, the point is inserted into the pore. The needle should slip along the shaft of the hair easily and without resistance till it reaches the neck of the follicle and enters the papilla (110, 141). A slight resistance will be felt as the proper depth is reached. If done correctly, there is no pain. The needle is usually inserted to a depth of about ⅛ inch since most hair roots extend this distance below the surface, but a few large hairs may require an insertion of nearly ¼ inch. Niedelman (144) finds the optimal depth almost invariably to be ⅛ inch, and marks his needles with polyethylene tubing to control depth of insertion to this level. Slight traction on the skin may help to dilate the follicular opening and straighten the hair (110).

After the needle is inserted to the required depth, the current is applied by pressing the foot switch. This particular part of the technique varies with different operators, but probably the best method is to apply short "bursts" of current, each burst lasting a fraction of a second. The bursts of current are repeated until the operator, by means of a pair of forceps holding the hair, begins to feel that the hair is ready to slide out of its follicle. The number of times the current is turned on varies with the thickness of the hair. Above the upper lip, one to three times is usually

sufficient, while on the chin, four to six times may be necessary. According to Niedelman (144) each burst of current may last from a fraction of a second to as long as three seconds, and this may be repeated two or three times; the duration of each application of current depends on the type of hair and sensitivity of the patient. With proper equipment and current, according to Cipollaro (35), it should usually take no more than two seconds to destroy the hair follicle. The effectiveness of treatment is tested by pulling the hair gently with a forceps. When the papilla has been destroyed, the hair will slide out of the follicle *easily*, without offering resistance (100, 163).

The withdrawal of the needle, as in the case of its insertion, must take place when the current is off, since current applied too near the surface of the skin may result in visible scarring. The presence of blood is an indication that the needle has not been kept within the hair follicle; the needle should not be reintroduced since this might lead to infection (110). If the technique is correct, pain is minimal.

A skilled operator can remove at least 200 hairs in one hour. It is inadvisable, however, to treat contiguous hairs or to make immediate repeated attempts in the same follicle after an initial failure (116). Niedelman (144) states that 40 or 50 hairs can be removed in five minutes, and the first treatment should be no longer than this. The most important requisite for keeping pain and unpleasant after-effects at a minimum is that the space between the follicles destroyed at a given sitting should not be less than 1/8 inch. Hairs remaining in these spaces are removed on a subsequent visit. With such precautions, treatment may be scheduled at daily intervals (144), although other operators delay the second treatment for one or two weeks (163).

After Effects:

After-irritation of the skin is reduced to a minimum by not removing hair too closely adjacent at the same sitting, and by adequately spacing the visits. With a careful technique, irritation is practically nonexistant (163). Patients with vasomotor disturbances are most likely to develop erythema, but this usually disappears in 10 minutes to half an hour with no permanent changes (116, 141, 163). A very few patients may develop red spots and tiny crusts which persist for seven or eight days (110). Occasional pustular reactions have been reported (144). Most authors report far less scarring with this method than with electrolysis.

Partial recurrence is to be expected; this is both apparent and real. Hairs formerly removed by the patient will grow out and give the impression of recurrence. Some hairs which were treated will also return, indicating that the papillae were not destroyed; these, of course, must be treated a second time.

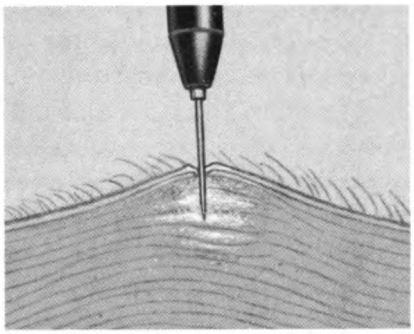
Postoperative Care:

The purpose of after-care is to reduce irritation and prevent infection. Karp (100) uses intermittent boric acid compresses for two days, after which alcohol and calamine lotion are prescribed. Niedelman (144) applies alcohol at the completion of therapy, followed by the application of a skin-colored lotion containing 0.12 per cent bichloride of mercury and 1 percent phenol. Should pustules form, an antibiotic ointment or a hydrocortisone-

antibiotic ointment may be used (144, 179).

Miscellaneous Skin Lesions

As the physician gains facility with his apparatus, he will find that a great variety of dermatologic lesions are amenable to treatment by electrosurgical methods. Any list of techniques must be incomplete, although the principles of treatment are generally the same regardless of the type of lesion. The following applications of electrosurgery to dermatologic practice deserve mention:



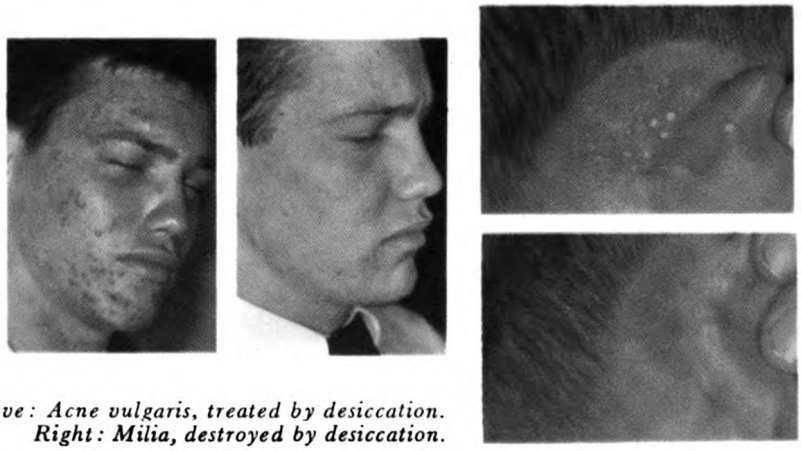
Aborting Boils.

Furuncles:

Boils, when detected early, often can be aborted by inserting the needle electrode into the central follicle and applying a mild coagulation current for a fraction of a second (123, 127). Small *acne pustules* may also be quickly sterilized in this manner (105).

Acne Vulgaris:

A method of careful destruction of comedos, milia, and pustules, first described by Nomland (147) in 1943, has largely replaced x-ray control of exacerbations of acne at the University Hospitals in



Above: Acne vulgaris, treated by desiccation.
Right: Milia, destroyed by desiccation.

Iowa City (160). For this purpose, monoterminal desiccation with a sharp needle and a very low power setting (1 to 5) are used; the operator tests the setting by drawing the needle across his palm with the current on, and he should just feel the spark without discomfort. (The Epilation circuit can be used to provide better regulation of power output.) After cleansing with alcohol, the needle is inserted into the ostium of the comedo, or into the milium or pustule, to a depth of 1 to 3 mm. A binocular loupe facilitates proper insertion. The current is applied for one or two seconds, depending on the size and depth of the lesion. The current is left on as the needle is withdrawn, so that the ostium is fulgurated for a fraction of a second, a measure which tends to keep the opening patent so that detritus or pus can be manually or spontaneously extruded. Both openings of double comedos are treated, and the bridge between them is lightly desiccated. The treatment of facial acne by this method requires three to five sessions of 15 minutes' duration, at intervals of three weeks. This treatment is most successful for superficial acne, in which desiccation is minimal; the small crusts fall off in about four days, leaving red spots which fade after three weeks. This type of therapy for severe acne, with cysts and large comedos, must be more intense and is followed by scarring, although these scars are reported to be much less severe than those produced by acne pustules (147). Acne conglobata does not respond. Concomitant roentgen therapy may be given.

Molluscum Contagiosum:

These lesions are easily removed by superficial electrodesiccation (8, 81). Destruction of each and every lesion prevents recurrence. Goodman (82) states that if each lesion is fulgurated for a second or two, the molluscum bodies will disappear within a few days with no sign of scarring. Other operators prefer to curette the lesion following desiccation (61).

Fibromas:

Such tumors may be excised with the cutting current, or destroyed by desiccation if small (33, 61).

Cutaneous tags (fibroma molle, soft or pedunculated fibromas, papillomas) are exceedingly common small tumors of middle-aged or elderly women, most often seen on the neck, upper throat, axillae, or face. These are generally easily destroyed without scarring by the very brief application of monoterminal desiccation (127, 174). Many can be removed at one sitting and anesthesia is not required. If desired, the pedicle may first be clipped, and just the base desiccated (12, 25).

Keloids:

Old keloids are not amenable to radiation therapy alone. The hypertrophic tissue is usually removed with a cold scalpel, but the cutting current has been used effectively by some (60, 127, 139, 156). The loop electrode is often used for this purpose. The excess tissue is curetted off with the electrode until the area is at an even level with the surrounding normal skin. If the fibrous tissue is no more than 5 mm. in thickness, it can also be reduced to skin level by desiccation and curettage (156).

Since the keloidal idiosyncrasy is still present, surgical removal must be followed by radiation: Morse (139) advises three-

fourths of an x-ray erythema dose given three to five days following electrosurgical removal. Pfahler and Keefer (156) give an 80 percent erythema dose immediately after electrosurgical excision; the granulations and scar formation are then watched and additional radiation applied at two week intervals if needed.

Acne Keloid (dermatitis papillaris capillitii) has been treated in a similar manner (33, 109). The recent abrasive brush technique seems to be preferable.

Xanthomas:

Small lesions of *xanthoma tuberosum multiplex* may be destroyed with electrodesiccation (76, 81, 108, 127). Careful desiccation or fulguration of *xanthoma palpebrarum* (xanthelasma) have been reported to leave supple, smooth and superficial scars (46). Any destructive measure must, of course, be used with great care on the eyelids, to avoid cicatraces and ectropion. Xanthelasma also respond to repeated local applications of trichloracetic acid.

Multiple Benign Cystic Epitheliomas (sweat gland adenomas; syringomas):

When desirable for cosmetic purposes, these small yellowish nodules can be permanently removed by superficial desiccation (9, 12, 33, 61, 127). Resulting scars are insignificant if the treatment is skillfully performed (12). Each nodule must be separately and briefly desiccated. Since they are usually numerous, different areas of involvement are treated at intervals.

Sebaceous Adenomas:

This designation, in the interest of brevity, includes sebaceous nevi, the acquired or "senile" type, the adenoma sebaceum of Balzer, and also the angiofibromatous variety (Pringle) which may be associated with tuberous sclerosis. The cosmetic therapy of these disorders is usually performed by monoterminal desiccation or fulguration (9, 25, 127, 174). The multiple small facial lesions generally require only very mild instantaneous surface applications of the current, a fact which is important in the cosmetic result (37). It is best not to attempt treatment of multiple lesions at one sitting, but to give several treatments at sufficient intervals to allow complete subsidence of reactions from previous therapy.

Large solitary sebaceous adenomas are preferably removed by excision.

Mucous Cysts:

Mucous retention cysts of the lip or oral cavity are effectively treated with a mild biterminal coagulating current, or if small, with the monoterminal current (33, 105, 127). A needle electrode, inserted directly into a small cyst, "boils out" the mucinous fluid and at the same time destroys the lining membrane (105). If the cyst membrane is not completely destroyed, the lesion will recur; larger cysts usually require the additional application of a desiccating or coagulating ball-tipped electrode, to insure obliteration of the cyst lining.

Granuloma Pyogenicum:

The most common and effective method of therapy is the complete destruction of this lesion by electrodesiccation or coagulation, followed by curettage and light redesiccation of the base (9, 12, 25, 34, 60, 127, 209).

Verrucous Tuberculosis:

The local therapy of *tuberculosis verrucosa cutis* or *anatomic tubercle,* has often been effectively accomplished by electrodesiccation or coagulation, followed by curettage and redesiccation of the base (8, 12, 60, 127, 209).

Ulcers:

Small chronic ulcerations of varied etiology have been effectively treated by sterilization with the fulgurating spark or by desiccation (8, 47, 76, 209). Hartman (89) effectively employs repeated mild fulgurations applied through a thin layer of gauze, for the treatment of chronic leg ulcers.

Glossitis Rhombica Mediana:

Electrodesiccation, followed by curettage and redesiccation, has been successful in the treatment of this unusual lesion of the tongue (74, 148, 180).

Tattoo Marks:

Tattoo marks and permanent stains with powder grain have been cosmetically improved with carefully applied fulguration, although scarring will result from any type of destructive therapy (33, 76, 180). Niedelman (145) has employed monoterminal "electroshaving" for tattoos, as described under Rhinophyma.

Tattoo, treated by desiccation.

Miscellaneous Chronic Dermatoses:

Hartman (89) reports the successful use of very mild (exfoliative rather than destructive) applications of the monoterminal current in a variety of long-standing, localized, pruritic, lichenified and hypertrophic dermatoses which did not respond to x-ray or other dermatologic therapy. Electrosurgical destruction is stated to be an effective treatment for neurodermatitic nodules of the scalp (80).

The Indifferent Electrode

Showing convenient method of applying indifferent electrode without necessity of patient disrobing.
Patient sits on his hand in contact with indifferent electrode.

Bibliography

1. Adams, W. M. and Hendrix, J. H., Jr.: Facial lesions of interest to the general practitioner and the plastic surgeon, South, M. J. *45*:689-695 (Aug.) 1952.
2. Aiken, D.: Diathermy treatment of angiomata, Brit. M. J. *2*:1123-1125, (Nov. 10) 1951.
3. Aiken, D.: Personal communication.
4. Allen, A. C.: A reorientation on the histogenesis and clinical significance of cutaneous nevi and melanomas, Cancer, N. Y. *2*:28-56 (Jan.) 1949.
5. Allen, A. C. and Spitz, S.: Histogenesis and clinicopathologic correlation of nevi and malignant melanomas, Arch. Dermat. & Syph. *69*:150-171 (Feb.) 1954.
6. Anderson, C. R.: Treatment of vascular nevi, J. Pediat. *25*:148-149 (Aug.) 1944.
7. Anderson, N. P.: Moles, melanomas and epitheliomas in children, California Med: *78*:17-20 (Jan.) 1953.
8. Andrews, G. C.: Clinical and electrical aspects of endothermy in dermatology, J. Radiol. *6*:475-480 (Dec.) 1925.
9. Andrews, G. C.: Diseases of the Skin, Philadelphia, W. B. Saunders, 1946, Chap. 5.
10. Andrews, G. C. and Cipollaro, A. C.: Treatment of skin cancer, New York State J. Med. *50*:2674-2675 (Nov. 15) 1950.
11. Andrews, G. C., Domonkos, A. N., and Post, C. F.: Treatment of angiomas: Summary of twenty years' experience at Columbia Presbyterian Medical Center, Am. J. Roentgenol. *67*:273-285 (Feb.) 1952.
12. Becker, S. W. and Obermayer, M. E.: Modern Dermatology and Syphilology, Philadelphia, J. B. Lippincott, 1947.
13. Becker, S. W.: Diagnosis and treatment of pigmented nevi, Arch. Dermat. and Syph. *60*:44-65 (July) 1949.
14. Becker, S. W.: The changing mole, Minnesota Med. *34*:1153-1158 (Dec.) 1951.
15. Behaegel, Th.: The treatment of rhinophyma with diathermic needle, Arch. belges dermat. and syph. *3*:463-466 (Nov.) 1947.
16. Berger, S. S.: The treatment of pigmented nevi, Canad. M. A. J. *70*:161-167 (Feb.) 1954.
17. Bierman, W.: Electrosurgery, Am. J. Surg. *50*:768-775 (Dec.) 1940.
18. Bierman, W.: Physical Medicine in General Practice, New York, Paul B. Hoeber, 1944, Chap. 8.
19. Blaisdell, J. H.: Vascular nevi and their treatment, New England J. Med. *215*:485-488 (Sept. 10) 1936.
20. Blech, G. M.: Clinical Electrosurgery, New York, Oxford University Press, 1938, Chap. 7.
21. Braund, R. R., Murdoch, J. and Chambers, J.: Treatment of the pigmented mole, Memphis M. J. *23*:206-210 (Nov.) 1948.
22. Brenner, I. M.: Proctologic electrosurgery, Arch. Phys. Therapy *18*:579-582 (Sept.) 1937.
23. Brown, J. B., Fryer, M. P. and McDowell, F.: Hemangiomas, Ann. Surg. *137*:652-659 (May) 1953.
24. Callaway, J. L.: The common wart, South. Med. & Surg. *106*:340-341 (Sept.) 1944.
25. Callaway, J. L.: Treatment of benign tumors of the skin, Postgrad. Med. *12*:59-64 (July) 1952.
26. Cannon, A. B.: Pigmented growths of the skin; their significance and treatment, New York State J. Med. *29*:857 (July) 1929.
27. Cannon, A. B.: Treatment of some common disfigurements of the skin, New York State J. Med. *40*:1567-1572 (Nov.) 1940.
28. Cannon, A. B.: Skin Tumors, Bull. New York Acad. Med. *23*:163-172 (March) 1947.
29. Carney, R. G.: The care of hemangiomas, Mississippi Valley M. J. *75*:108-110 (July) 1953.
30. Caro, M. R. and Szymanski, F. J.: Seborrheic and senile keratoses, M. Clin. North America *35*:419-431 (March) 1951.
31. Cawley, E. P. and Wheeler, C. D.: Precancerous dermatoses, Rocky Mt. M. J. *50*:399-402 (May) 1953.
32. Chapman, D. and Klopp, C. T.: Care of the common mole, M. Ann. District of Columbia *23*:308-312 (June) 1954.
33. Cipollaro, A. C.: Electrosurgery in dermatology, M. Rec. *143*:437-440, 471-472 (May 20) & (June 3) 1936.
34. Cipollaro, A. C., in Watkins, A. L.: Physical Medicine in General Practice, Philadelphia, J. B. Lippincott, 1946, pp. 79-85.
35. Cipollaro, A. C., in discussion of Ellis, F. A.: Electrolysis versus high frequency currents in the treatment of hypertrichosis, Arch. Dermat. & Syph. *56*:303-305 (Sept.) 1947.
36. Cipollaro, A. C.: Cancer of the skin, Pennsylvania M. J. *51*:180-187 (Nov.) 1947.
37. Cipollaro, A. C.: Electrosurgery for the treatment of cutaneous neoplasms, Arch. Phys. Med. *34*:621-626 (Oct.) 1953.

Bibliography

38. Clark, W. L., in Keen, W. W.: Surgery, Philadelphia, W. B. Saunders, 1922, Vol. 6, p. 136; Vol. 8, p. 805.
39. Clark, W. L., in Mock, H. E.: Principles and Practice of Physical Therapy, Hagerstown, W. F. Prior, 1937, Vol. II, Chap. 20.
40. Conway, H. and Docktor, J. P.: Neutralization of color in capillary hemangiomas of the face by intradermal injection (tattooing) of permanent pigments, Surg., Gyn. & Obst. *84*:866-869 (April) 1947.
41. Costello, M. J.: Epilation by electrodesiccation of hairs of the scalp infected by fungi, Arch. Dermat. & Syph. *54*:210 (Aug.) 1946.
42. Costello, M. J.: Management of vascular nevi; round-table discussion, Pediatrics *4*:825-832 (Dec.) 1949.
43. Crossland, P. M.: Personal communication.
44. Cumberbatch, E. P.: Old-standing lupus vulgaris; results of treatment by fulguration, Proc. Roy. Soc. Med. *24*:273, 1930-1931.
45. Cumberbatch, E. P. and Hamer, W. D.: Fulguration and electrodesiccation, Practitioner *135*:71-82 (July) 1935.
46. Daily, R. K. and Daily, L., Jr.: Physical Medicine in Ophthalmology, in A.M.A. Handbook of Physical Medicine and Rehabilitation, Chicago, 1950, p. 324.
47. Dalton, C. H. C.: Fulguration and diathermy coagulation in certain superficial conditions, Brit. J. Phys. Med. *10*:134-135 (Dec.) 1935.
48. Danna, J. A.: Simple treatment of sebaceous cyst, New Orleans M. & S. J. *98*:5-8 (July) 1945.
49. Danna, J. A.: The treatment of sebaceous cyst by electrosurgical marsupialization, Ann. Surg. *123*:952-956 (May) 1946.
50. DeCholnoky, T.: Cancer of the face; a clinical and statistical study of 1062 cases, Ann. Surg. *122*:88 (July) 1945.
51. Delario, A. J.: Common vascular nevi and their treatment, Urol. & Cutan. Rev. *51*:465-476 (Aug.) 1947.
52. Delario, A. J.: The common non-vascular nevi and their treatment, Am. J. Surg. *77*:53-62 (Jan.) 1949.
53. Delherm, L. and Marchand, J. H.: Fulguration of plantar warts, J. de radiol. et d'electrol. *33*:408-409 (March) 1952.
54. Dodson, A. I. and Frohbose, W. J.: Minor urologic surgery, S. Clin. North America *31*:1411, (Oct.) 1951.
55. Driver, J. R. and MacVicar, D. N.: Cutaneous melanomas: A clinical study of sixty cases, J. A. M. A. *121*:413-420 (Feb. 6) 1943.
56. Ducourtioux, M.: Plantar verruca and its therapy by electrocoagulation, Rev. med. franc. *17*:31-33 (Jan.) 1936.
57. Dufresne, O.: The treatment of angiomata, Canad. M. A. J. *58*:139-142 (Feb.) 1948.
58. Editorial: Moles and melanomata, Lancet *1*:427-428 (Feb. 28) 1953.
59. Eller, J. J.: X-Rays, radium, endothermy and other physical agents in dermatology, M. J. & Rec. *125*:541-545, & 593-595, (April 20) & (May 4) 1927.
60. Eller, J. J. in Kovacs, R.: Electrotherapy and Light Therapy, Philadelphia, Lea and Febiger, 1938, Chap. 35.
61. Eller, J. J.: Tumors of the Skin, Philadelphia, Lea and Febiger, 1939.
62. Elliott, J. A. and Welton, D. G.: Epithelioma; report on 1,742 treated patients, Arch. Dermat. & Syph. *53*:307-332 (April) 1946.
63. Erdos-Brown, M.: Removal of superfluous hair with monopolar diathermy needle, Arch. Dermat. & Syph. *46*:496-501 (Oct.) 1942.
64. Etcherorne, C. L. Epilation by diathermocoagulation and its advantages over electrolysis, Semana med. espan. *2*:200-204 (July) 1935.
65. Farina, R.: Rhinophyma; simple electrosurgical decortication, Rev. Hosp. clin. *4*:107-112 (April) 1949.
66. Farina, R.: Rhinophyma; plastic correction, Plast. & Reconstruct. Surg. *6*:461-466 (Dec.) 1950.
67. Farrington, J.: Personal communication.
68. Fenyo, J.: Diathermy for cosmetic purposes, Zentralbl. f. Haut u. Geschlechtskr. *25*:551, 1928.
69. Ferguson, L. K.: Surgery of the Ambulatory Patient, Philadelphia, J. B. Lippincott, 1942, p. 426.
70. Figi, F. A.: Treatment of angioma of the face, Arch. Otolaryng. *24*:271-281 (Sept.) 1936.
71. Figi, F. A.: Hemangioma of the face, Proc. Staff Meet., Mayo Clin. *12*:437-442 (July 14) 1937.
72. Figi, F. A.: Hemangiomas of the mouth, Ann. Otol., Rhin. & Laryng. *56*:853-866 (Dec.) 1947.
73. Figi, F. A.: Pigmented nevi of the face and neck, S. Clin. North America *23*:1059-1075 (Aug.) 1943.

Bibliography

74. Fordyce, J. A. and Cannon, A. B.: A hitherto undescribed condition of the tongue, Arch. Dermat. & Syph. *8*:749-753 (Dec.) 1923.
75. Fowlkes, R. W., in discussion of Shaw, C.: Benign pigmented nevi, South. M. J. *46*:286-290 (March) 1953.
76. Fox, E. C.: Electrotherapeutic measures in benign and malignant skin diseases, Texas State J. Med. *31*:402-406 (Oct.) 1935.
77. Fox, H.: Warts, moles and corns, Am. J. Surg. *6*:418-422 (April) 1929.
78. Frank, S. B.: Management of pigmented nevi, Arch. Dermat. & Syph. *69*:172-187 (Feb.) 1954.
79. Gendrean, J. E. and Dufresne, O.: The treatment of plantar warts, Canad. M. A. J. *49*:35-37 (July) 1943.
80. Goldman, L.: Personal communication.
81. Goodman, H.: Cosmetic dermatology, J. A. M. A. *86*:736-737 (March) 1926.
82. Goodman, H.: Treatment of molluscum contagiosum, Brit. J. Dermat. & Syph. *47*:413 (Oct.) 1935.
83. Goodman, H.: Electromedical cosmetology, Urol. & Cutan. Rev. *46*:726-727, 1942.
84. Goodman, H.: Hair removal with high frequency current, Urol. & Cutan. Rev. *48*:257-258 (May) 1944.
85. Granger, F. B.: Physical therapeutic technique, Philadelphia, W. B. Saunders, 1929, Chap. 32.
86. Guequierre, J. P. and Weidman, F. D.: High frequency currents in performing biopsies, J. A. M. A. *103*:1693-1694 (Dec. 1) 1934.
87. Gurdin, M. and Pangman, W. J.: A simple electrosurgical treatment of rhinophyma, California Med. *73*:171-172 (Aug.) 1950.
88. Harrison, F. G.: Electrosurgery and Other Physical Therapy Measures in Urology, in Mock, H. E.: Principles and Practices of Physical Therapy, Hagerstown, W. F. Prior, 1937, Vol. II, Chap. 21.
89. Hartman, M. S.: Electrodesiccation: a new method of application, Arch. Dermat. & Syph. *67*:212 (Feb.) 1953.
90. Havens, F. Z. and Lockhart, H. B.: Angiomas of interest to the otolaryngologist, Ann. Otol. Rhin. & Laryng. *62*:36-50 (March) 1953.
91. Hemphill, W. J. and Piper, W. N.: Basal and squamous cell cancer of the skin, GP *10*:52-57 (July) 1954.
92. Herring, H. M.: Electrosurgery in surface lesions, M. J. & Rec. *113*:85-86 (Jan.) 1931.
93. Hoffman, C. A.: Electrophysical treatment of cavernous angiomas, Klin. Wchnschr. *7*:804-805 (April) 1928.
94. Hollander, L.: Dressing for electrocoagulation wounds, Arch. Dermat. & Syph. *33*:730 (April) 1936.
95. Hollander, L.: Treatment of warts, GP *5*:55-59 (June) 1952.
96. Horne, S. F.: The precancerous dermatoses, North Carolina M. J. *11*:269-280 (June) 1950.
97. Hurd, L. M.: Diathermy; surgical and medical in otolaryngology, Laryngoscope *43*:730-739 (Sept.) 1933.
98. Innes, F. L. F.: Classification of haemangiomata, Brit. J. Plast. Surg. *6*:76-77 (July) 1953.
99. Jennings, W. K.: The pigmented nevus, GP *5*:35-39 (March) 1952.
100. Karp, F. L.: High frequency current in treatment of hypertrichosis, Arch. Dermat. & Syph. *43*:85-91 (Jan.) 1941.
101. Karp, F. L. and Frank, S. B.: Electrosurgical removal of plantar warts, Arch. Dermat. & Syph. *45*:328-333 (Feb.) 1942; also Year Book of Dermat. & Syph., 1946, pp. 52-53.
102. Karp, F. L.: Electrosurgery in removal of plantar warts (loop treatment), Arch. Dermat. & Syph. *53*:496-497 (May) 1946.
103. Karsner, H. T., in Mock, H. E.: Eletrosurgery, J. A. M. A. *104*:2341-2350 (June 29) 1935.
104. Kazanjian, V. H. and Roopenian, A.: Clinical experience in the treatment of hemangiomata, Plast. & Reconstruct. Surg. *13*:325-340 (May) 1954.
105. Kelly, H. A. and Ward, G. E.: Electrosurgery, Philadelphia, W. B. Saunders, 1932, Chap. 5.
106. Kime, E. N.: Electrosurgery, New England J. Med. *30*:83-87 (Feb.) 1929.
107. Kime, E. N.: Electrosurgical excisional biopsy, J. Indiana M. A. *31*:556-559 (Oct.) 1938.
108. Klauder, J. V.: The treatment of nevi with particular reference to high frequency current, J. A. M. A. *90*:1763-1768 (June) 1928.
109. Kovacs, R.: Electrotherapy and Light Therapy, Philadelphia, Lea and Febiger, 1938, Chap. 19.
110. Kovacs, R.: Minor electrosurgery, M. Rec. *155*:163-165 (March 4) 1942.
111. Krusen, F. H. and Erickson, D.: Electrosurgery, in Cyclopedia of Medicine, Surgery and Specialties, Philadelphia, F. A. Davis, Vol. V., pp. 454-468.
112. Krusen, F. H. and Elkins, E. G.: Electrosurgery, South. Surgeon *7*:61-67 (Feb.) 1938.

Bibliography

113. Krusen, F. H.: Physical Medicine, Philadelphia, W. B. Saunders, 1941, p. 429.
114. Kuznitzsky, E.: Cancer and precancerous lesions of the skin, J. M. Soc. New Jersey *45*:379-384 (Aug.) 1948.
115. Laurence, G.: Treatment of angiomas, Rèv. du practicien, Paris *4*:1683-1685 (June 21) 1954.
116. Lerner, C.: Treatment of hypertrichosis by electrocoagulation, New York State J. Med. *42*:879-882 (May 1) 1942.
117. Lewis, G. M.: Verruca plantaris: a method of removal by electrosurgery, New York State J Med. *35*:869-870 (Sept. 1) 1935.
118. Lewis, G. M.: Pigmented nevi: their relationship to malignant melanoma and treatment, N. Y. State J. Med. *53*:1654-1658 (July 15) 1953.
119. Lister, W. A.: The natural history of strawberry nevi. Lancet *1*:1429-1434 (June 18) 1938.
120. Lumer, M.: Facial hypertrichosis in female: local therapy by diathermocoagulation, Semana med. espan. *2*:891-897 (Oct. 20) 1938.
121. MacCollum, D. W.: Treatment of hemangiomas, Am. J. Surg. *29*:32-35 (July) 1935.
122. MacDonald, E. J.: Malignant melanoma in Connecticut, in The Biology of Melanomas, New York Academy of Sciences *4*:71, 1948.
123. MacKee, G. M.: Treatment of skin diseases by physical therapeutic methods, J. A. M. A. *98*:1646, 1932.
124. MacKee, G. M. and Cipollaro, A. C.: Treatment of Malignancies of the Skin, in Mock, H. E.: Principles and Practice of Physical Therapy, Hagerstown, W. F. Prior, 1937, Vol. II, Chap. 18.
125. MacKee, G. M. and Cipollaro, A. C.: Cutaneous Cancer and Precancer, New York, The American Journal of Cancer, 1937.
126. MacKee, G. M. and Cipollaro, A. C.: Skin Diseases in Children, New York, Paul B. Hoeber, 1946.
127. MacKee, G. M. and Cipollaro, A. C.: The Treatment of Skin Diseases by Physical Methods other than Radiation, in A.M.A. Handbook of Physical Medicine and Rehabilitation, Chicago, 1950, pp. 294-315.
128. MacKee, G. M. and Eller, J. J.: Endothermy and combined therapy in dermatology. Phys. Therapy *44*:391-394 (July) 1926.
129. MacKechnie, H. A.: Small tumors of the skin, Canad. M. A. J. *56*:56-58 (Jan.) 1947.
130. Martin, C. L., in Pohle, E. A.: Clinical Radiation Therapy, Philadelphia, Lea and Febiger, 1950, p. 867.
131. Matthews, D. N.: Birthmarks and moles, Proc. Roy. Soc. Med. *44*:609-622 (July) 1951.
132. Matthews, D. N.: Treatment of haemangiomata, Brit. J. Plast. Surg. *6*:83-88 (July) 1953.
133. McCuiston, C. H.: Infantile cavernous hemangiomas, Arch. Derm. and Syph. *69*:219-229 (Feb.) 1954.
134. McFee, W. D.: Modern treatment of accessible growths, Phys. Therapy *48*:529-535 (Nov.) 1930.
135. McLaughlin, C. R.: Plantar warts: a plea for rational treatment, Lancet *1*:168-169 (Jan 31) 1948.
136. Mead, S. W.: Oral surgery, St. Louis, C. V. Mosby, 1946, p. 1033.
137. Mock, H. E.: Electrosurgery, J. A. M. A. *104*:2341-2350 (June 29) 1935.
138. Montgomery, H.: Benign and malignant moles; their differentiation and treatment, M. Clin. North America *28*:968-977 (July) 1944.
139. Morse, J. L.: Moles, warts, and keloids, Am. J. Surg. *36*:137-144 (April) 1937.
140. New, G. B.: Cancer of the face: treatment and plastic repair, Laryngoscope *59*:731-742 (July) 1949.
141. Niedelman, M. L.: Epilation, fifteen-year comparative evaluation of electrolysis and electrocoagulation, Arch. Phys. Med. *26*:290-296 (May) 1945.
142. Niedelman, M. L.: The management of warts, Am. Pract. *2*:327-337 (Jan.) 1946.
143. Niedelman, M. L.: Treatment of common skin diseases in infants and children, J. Pediat. *32*:566-579 (May) 1948.
144. Niedelman, M. L.: Epilation by electrocoagulation: improvements in technique, J. Clin. Endocrinol & Metab. *13*:451-456 (April) 1953.
145. Niedelman, M. L.: Rhinophyma — treatment by electroshaving, Arch. Dermat. & Syph. *70*:91-93 (July) 1954.
146. Niedelman, M. L.: Personal communication.
147. Nomland, R.: Treatment of acne vulgaris with comedos by monoterminal electrodesiccation, Arch. Dermat. & Syph. *48*:302-304 (Sept.) 1943.
148. Ormsby, O. S. and Montgomery, H.: Diseases of the Skin, Philadelphia, Lea and Febiger, 1943.

Bibliography

149. Pack, G. T., Perzik, S. L. and Scharnagel, I. M.: The treatment of malignant melanoma: report of 862 cases, California Med. *66*:283-287 (May) 1947.
150. Pack, G. T.: A clinical study of pigmented nevi and melanomas, in The Biology of Melanomas, New York, New York Academy of Sciences, 1948.
151. Pack, G. T. and Miller, T. R.: Hemangiomas: classification, diagnosis and treatment, Angiology *1*:405-426 (Oct.) 1950.
152. Pack, G. T., Lenson, N. and Gerber, D. M.: Regional distribution of moles and melanomas. Arch. Surg. *65*:862-870 (Dec.) 1952.
153. Peck, S. M. and Klein, G.: Physical methods of dermatology, Brit. J. Phys. Med. *17*:57-65 (March) 1954.
154. Pecker, A.: Diathermocoagulation of plantar verruca, acta. dermat.-venereol. *18*:575-579, 1937.
155. Pendergrass, E. P., Katterjohn, J. C. and Butchart, J. B.: Some considerations in the treatment of hemangioma in infants and young children, Am. J. Roentgenol. *60*:182 (Aug.) 1948.
156. Pfahler, G. E. and Keefer, G. P.: The treatment of keloids by irradiation and electrosurgery, Am. J. Roentgenol. *59*:378-386 (March) 1948.
157. Pfahler, G. E. and Sampson, D. A.: Electrosurgery as adjunct to radiation therapy in treatment of cancer, Am. J. Roentgenol. *46*:302 (Sept.) 1941.
158. Pillsbury, D. M., Sulzberger, M. B., and Livingood, C. S.: Manual of Dermatology, Military Medical Manuals, Philadelphia, W. B. Saunders, 1943.
159. Pritcher, J. L.: Plantar warts, a simple method of treatment, Arch. Dermat. and Syph. *32*:923 (Dec.) 1935.
160. Radcliffe, C. E.: Personal communication.
161. Radcliffe, C. E. and Paul, W. D.: Exhibit, American Congress of Physical Medicine, Washington, D. C., September 1954.
162. Robbins, S. J. and Pensky, N.: Removal of sebaceous cysts by electrosurgical means, Arch. Dermat. & Syph. *62*:411-417 (Sept.) 1950.
163. Robinson, M. M.: Removal of superfluous hair by monopolar coagulation, Med. Ann. District of Columbia *15*:531-536 & 577 (Nov.) 1946.
164. Robinson, M. M.: Personal communication.
165. Ronchese, F.: Radium in treatment of hemangioma, Arch. Dermat. & Syph. *60*:717-725 (Nov.) 1949.
166. Rosenberg, W. A. and Felsher, I. M.: Rhinophyma and acne rosacea treated with the electrosection current, Illinois M. J. *97*:281-282 (May) 1950.
167. Roys, H. C.: Management of pigmented nevi, Northwest Med. *51*:211-214 (March) 1952.
168. Sachs, W., MacKee, G. M. and Sachs, P. M.: Keratosis (seborrheic and senile), Arch. Dermat. and Syph. *59*:179-191 (Feb.) 1949.
169. Saunders, T. S.: Minimal scarring after electrodesiccation, Arch. Dermat. and Syph. *45*:1165-1166 (June) 1942.
170. Schiller, A. E.: The use of the monopolar current in skin blemishes, Arch. Phys. Therapy. *8*:569-573 (Nov.) 1927.
171. Schmidt, W. H.: High frequency currents in surgery, S. Clin. North America *19*:1545-1556 (Dec.) 1939.
172. Schmidt, W. H.: The surgical uses of high frequency current, Arch. Phys. Med. *34*:686-691 (Nov.) 1953.
173. Schoch, G., quoted by Frank, S. B.: Management of pigmented nevi, Arch. Dermat. & Syph. *69*:172-187 (Feb.) 1954.
174. Senear, F. E. and Szymanski, F. J.: Cutaneous new growths of geriatric interest, J. Am. Geriat. Soc. *2*:240-246 (April) 1954.
175. Shaw, C.: Benign pigmented nevi: a survey of treatment by dermatologists, South. M. J. *46*:286-290 (March) 1953.
176. Shutt, C. H.: High frequency currents in surgery, J. Missouri M. A. *42*:410-413 (July) 1945.
177. Slaughter, D. P.: Symposium on minor surgery: superficial tumors of the head and neck area, S. Clin. North America *28*:69-81 (Feb.) 1948.
178. Smith, L. M., in discussion of Fox, E. C.: Electrotherapeutic measures in benign and malignant skin diseases. Texas State J. Med. *31*:406 (Oct.) 1935.
179. Spoor, H. J.: Personal communication.
180. Stratton, E. K.: Electrodesiccation and electrocoagulation as means of destroying benign and malignant skin lesions, California & West. Med. *25*:192-196 (Aug.) 1926.
181. Stratton, E. K.: Nevus pigmentosus and pilosus verrucosus, its removal by electrocoagulation, J. A. M. A. *94*:1233 (April) 1930.

Bibliography

182. Sulzberger, M. B. and Baer, R. L.: Year book of Dermatology and Syphilology. Chicago. Year Book Publishers, 1946, pp. 51-53.
183. Sutherland-Campbell, H.: Common warts; an effective treatment, Arch. Dermat. and Syph. *30*:821-822 (Dec.) 1934.
184. Templeton, H. J.: Warts, California Med. *68*:23-24 (Jan.) 1948.
185. Templeton, H. J.: Electrosurgery in dermatology, Urol. and Cutan. Rev. *53*:630-632 (Oct.) 1949.
186. Thi, L.: Various methods of therapy with special reference to diathermocoagulation of plantar warts, Medicine *17*:497-502 (June) 1936.
187. Torre, D. and Lewis, G. M.: Application of simple minor surgical techniques to dermatologic practice, New York State J. Med. *51*:2000-2004 (Sept. 1) 1951.
188. Traenkle, H. L.: Problems encountered in the treatment of cutaneous cancer, N. Y. State J. Med. *47*:2414-2419 (Nov. 15) 1947.
189. Traenkle, H. L.: Routine management of carcinoma of the skin and lips, N. Y. State J. Med. *49*:1659-1661 (July 15) 1949.
190. Traub, E. F. and Keil, H.: The common mole, Arch. Dermat. & Syph. *41*:214-252 (Feb.) 1940.
191. Traub, E. F.: The treatment of nevi, Clinics *3*:974-981 (Dec.) 1944.
192. Traub, E. F., in discussion of Elliott, J. A. and Welton, D. G.: Epithelioma, Arch. Dermat. & Syph. *53*:330-331 (April) 1946.
193. Traub, E. F.: Cutaneous cancer from the standpoint of the dermatologist, Arch. Dermat. & Syph. *53*:563 (June) 1946.
194. Traub, E. F.: The pigmented, hairy and warty nevi and their relationship to malignancy, South. M. J. *40*:1000-1005 (Dec.) 1947.
195. Traub, E. F.: Early recognition of possibly dangerous nevi and the best procedure to avoid development of malignant melanomas, New York State J. Med. *49*:1661-1664 (July 15) 1949.
196. Traub, E. F.: Nevi, M. Clin. North America *35*:301-313 (March) 1951.
197. Traub, E. F.: Prognosis and treatment of nevi, Postgrad. Med. *10*:153-154 (Aug.) 1951.
198. Tyler, A. F.: New technique designed for electrocoagulation of vascular tumors, Nebraska M. J. *18*:6-9 (Jan.) 1933.
199. Tyler, A. F.: Treatment of hemangiomata by physical means, Urol. and Cutan. Rev. *42*:276-277 (April) 1938.
200. Upton, W. C. T.: The treatment of cutaneous neoplasms, Med. J. Australia *1*:512-514 (April 11) 1953.
201. Vollack, R.: Diathermy in external new growths, Am. J. Phys. Therapy *3*:491-494 (Feb.) 1927.
202. Wallace, H. J.: The conservative treatment of haemangiomatous naevi, Brit. J. Plast. Surg. *6*:78-82 (July) 1953.
203. Ward, G. E. and Geschicter, C. F.: Electrosurgical biopsy. Am. J. Roentgenol. *35*:248-258 (Feb.) 1936.
204. Ward, G. E. and Covington, E. E.: Hemangiomas of skin, J. A. M. A. *114*:2069-2075 (May 25) 1940.
205. Webster, J. P., Stevenson, T. W., and Stout, A. P.: The surgical treatment of malignant melanomas of the skin, S. Clin. North America *24*:319-339 (April) 1944.
206. Webster, J. R.: The identification and management of the more common nevi, M. Clin. North America *33*:219-238 (Jan.) 1949.
207. Wells, A. H.: Melanomata and nevi, Minnesota Med. *33*:456-461 (May) 1950.
208. Winer, L. H.: Hemangiomas: histologic structure and treatment, California Med. *77*:242-247 (Oct.) 1952.
209. Wise, F. and Eller, J. J.: Electrodesiccation in dermatology, Arch. Dermat. & Syph. *13*:344-351 (March) 1926.
210. Wise, F. and Sulzberger, M. B.: Yearbook of Dermatology and Syph., Chicago, Year Book Publishers, 1934, p. 485.
211. Wolf, H. F.: The Practice of Physical Medicine, New York, Wilcox and Follet, 1947, Chap. 8.
212. Wright, C. S. and Guequierre, J. F.: Physical therapy in skin diseases, Arch. Phys. Therapy *15*:99-102 (Feb.) 1934.

PART THREE
MINOR ELECTROSURGERY IN GYNECOLOGY

There is probably no more widely accepted or valuable application of electrosurgery than in the treatment of gynecologic diseases. Although there are other important applications in this field, electrosurgical currents are most commonly used for the therapy of chronic cervicitis. The techniques of cervical electrocoagulation and conization are treated separately; but it is suggested that the reader consider the interrelationship of these two techniques, and the applicability and effectiveness of each for the treatment of a wide variety of cases. The advantages of electrosurgical methods will be considered under individual disease entities, as well as the details of preparation, operative technique, and postoperative care.

Electrosurgical therapy of the cervix does not require the displacement of the uterus toward the introitus, although the cervix is often steadied with a tenaculum applied to one lip away from the site of treatment. Except where mentioned, cervical dilatation is unnecessary. Exposure is usually obtained with an ordinary self-retaining metal speculum, but this must not be contacted with the noninsulated portion of the active electrode. The electrode is made to contact the tissue before the current is applied, and the current is immediately discontinued when the desired effect has been obtained and before it is withdrawn. Gynecologic techniques generally require either biterminal coagulation or cutting, necessitating placement of the indifferent (dispersive) electrode. Although the metal speculum has been used for this purpose, by attaching it to the indifferent terminal with a clip cord, the ordinary indifferent plate is generally preferable. This may be applied to the abdomen, held in place by the patient's hands or with a sandbag; or it can simply rest beneath the patient's sacrum.

Chronic Cervicitis

Treatment by Electrocoagulation

Advantages and Indications:

Electrocoagulation has been a popular and effective ambulatory method of treating endocervicitis and cervical erosions for many years, and the medical literature indicates that it has entirely replaced radial cauterization in many clinics during the past two decades. A large number of gynecologists, of course, continue to use the nasal-tip cautery ef-

fectively; and many of these physicians employ conization for cervicitis resistant to that form of therapy. Those gynecologists who prefer electrocoagulation for the routine management of chronic cervicitis have claimed that it has the following advantages over thermal cautery: There is no burning or charring of the tissue; tissue destruction is more uniform and better controlled; infected racemose glands of the endocervix are more easily and effectively treated; there is no danger of accidental burning of adjacent tissues since the heat is generated entirely within the tissue and the electrode is not hot; there is little danger of primary or secondary hemorrhage; cervical stenoses are less frequent (related to the absence of "burning" or carbonization); and a greater percentage of satisfactory results may be secured in a wider variety of cases (1, 3, 37, 40, 50, 56, 66, 73, 85, 87, 94, 95, 100, 105, 111, 113, 118, 126, 142, 143).

The *indication* for cervical electrocoagulation is *chronic* cervicitis, which rarely heals spontaneously and is usually resistant to topical hygienic measures. The clinical manifestations, of course, include leucorrhea, "erosion" (columnar cell metaplasia), eversion (ectropion), retention (nabothian) cyst formation, and the frequent predisposing cervical lacerations. The treatment of this chronic disorder is considered essential by most gynecologists, not only for symptomatic relief and the occasional sterility problem thus helped, but more importantly as cancer prophylaxis. A complete pelvic examination must of course precede operative therapy, and appropriate bacteriologic studies should be made.

One important disadvantage of coagulation, in comparison to conization, is the lack of a tissue specimen for histologic study. A specimen for biopsy, however, can and should be obtained prior to treatment, with a punch or an electrocutting loop electrode (see Cervical Biopsies, page 74). Many gynecologists routinely obtain a cytologic (Papanicolaou) smear prior to therapy, and supplement this with indicated "spot" biopsies obtained from one or more sites. The Schiller iodine test may of course be used to assist in the delineation of diseased areas, either for the purpose of selecting specimens, or to determine the extent of proposed coagulation.

Aside from the biopsy consideration, the choice between coagulation and conization is a matter of clinical judgment and the experience or preference of the operator. Generally speaking, conization is used for more advanced disease than is coagulation, with special reference to severe laceration, ectropion, or extensive cystic changes. On the other hand, most cases of moderately advanced cervicitis can be successfully treated by electrocoagulation (95, 143), although more than one treatment may be necessary to achieve a complete cure of the infection, or a return of the cervix to normal appearance. If very severe, the cervical canal and one lip of the cervix can be coagulated at one time, and the other lip treated later (143). Most routine cases, however, are effectively treated in one session. If retreatment is necessary, it should be done no sooner than six or eight weeks after the previous coagulation (53, 96).

Sometimes the coagulation and conization techniques can be effectively combined: For example, a very large boggy cervix can be reduced in size by coagula-

tion, and the treatment later completed with conization. At other times, the cervical canal can be coned, and then the remaining eroded or cystic areas coagulated.

The majority of gynecologists emphasize the importance of the infected racemose glands in the chronicity of cervicitis, and consequently feel that the destruction or removal of these infected loci within the endocervical canal is an essential part of the treatment. On the other hand, the infection is commonly confined to the lower (distal) segment of the cervical canal, where the glands are deeper and more numerous. Coagulation as high as the level of the internal os is neither necessary nor advisable, and treatment of the canal must always be preceded by passage of a sound to determine its length. Deep destruction is not recommended, since the depth of infected tissue is seldom more than two or three millimeters (84). Furthermore, the sterilizing action of the heat produced in tissues probably extends beyond the actual coagulum (40, 143).

Most operators recommend treating the endocervical canal distal to the internal os. It has been the experience of some (143) that if the erosion alone is coagulated and the canal neglected, the erosion is very apt to recur; however, if the canal alone is coagulated, the erosion will often heal spontaneously. A few (45, 96) believe that coagulation of just the external columnar epithelium suffices for mild "simple" erosions. Some gynecologists (132) routinely use conization for eradication of infected endocervical glands.

Results:

The rate of cure of chronic cervicitis by electrocoagulation in several large series ranges between 90 percent and 100 percent (6, 16, 109, 132, 143). The rate of recurrence after one year, in one study of 400 cases, was 7 percent (143).

Contraindications:

The generally accepted contraindications to cervical coagulation, or other operative procedures, are: 1) *Pregnancy.* Although cervical coagulation has been successfully performed during the first trimester (42), practically all authorities avoid such therapy during pregnancy because of the possibility of inducing abortion and the greater likelihood of bleeding from the vascular cervix. After delivery, the chronically infected cervix is usually not treated before the sixth postpartum week. 2) *Acute infections,* gonorrheal or otherwise. The risk of metastatic infection or its pelvic lymphatic extension is increased if acute or subacute cervicitis is present. If there is any doubt, a course of the appropriate antibiotic, by systemic route, is advised. Any acute or subacute infection of pelvic organs (parametritis, salpingitis) similarly contraindicate coagulation. The unexpected finding of gonococci on smear does not necessarily contraindicate treatment of *chronic* cervicitis (44), but it does demand that adequate penicillin treatment be given, preferably before operative therapy. 3) *Menstruation.* All authorities recommend that electrocoagulation be performed within a few days after cessation of a normal menstrual period, since this allows separation of coagulum and some healing to occur prior to the next menstruation—which in turn minimizes the danger of secondary hemorrhage and infection. Some therapists feel that *menorrhagia* contraindicates coagula-

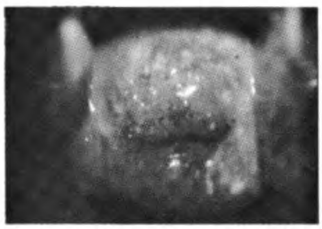
tion (132), whereas others do not (16), 4). *Carcinoma* or *Tuberculosis* of the cervix, if clinically suspected, should be confirmed microscopically and treated by appropriate measures.

Complications:

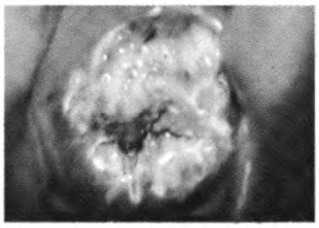
The *complications* of cervical electrocoagulation in general have not been serious, and have occurred infrequently. They can be largely avoided by proper selection of cases, good technique, and proper postoperative care. The complications are: 1) *Hemorrhage,* which is most likely to occur between the 8th and the 14th day when the slough separates, and which is almost invariably easily controlled by vaginal packing (6, 45, 98, 105, 113, 118). It is avoided by proper timing of therapy, and by avoiding deep coagulation or coagulation in the area of the internal os where the cervical artery is located (86). Its incidence in several series has been reported to be: 2 in 100 (45), 3 in 600 (113), and 3 in 1,000 (105). 2) *Ascending Infection* (adnexitis) following electrocoagulation is very uncommon, if acute or subacute cervical and pelvic inflammations are first brought under control with antibiotics, and if the tissues in the immediate vicinity of the internal os are not destroyed. Reported incidences of such infections, most of which are mild, are as follows in several series: 1 in 600 (113), 4 in 1000 (100), "several" in 1000 (105), and 2 in 1,449 cases (6). 3) *Cervical stenosis* is reported to be very rare following coagulation, particularly if the destruction has not been unnecessarily deep and if proper postoperative care is given. The scars which do form are soft and pliable, and dilate easily with instrumentation or delivery. Reported incidences of cervical stenosis are 1 in 1,000 (100), none in 600 (113), and one author (105) knows of but one case in over 10,000 cervical coagulations.

Preparation:

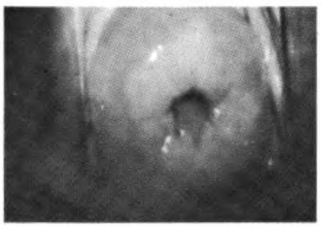
It is advisable to perform coagulation within a few days after the cessation of



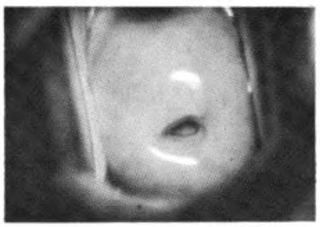
1. Chronic cystic cervix, with endocervicitis, before treatment.



2. Gray slough present immediately following coagulation.



3. Healed erosion, canal not fully healed.



4. Cervix entirely healed.

normal menstruation, since this allows separation of the coagulum and some healing to occur before the next menstrual period. *Local anesthesia* is very seldom used, because of the insensitiveness of the cervix (40, 94, 109, 110, 132, 143). Some uterine cramps may occur, due to heating of tissues and liberation of steam into the cervical canal; this can be largely avoided by applying the current for only a few seconds at a time and allowing the heat to dissipate between applications.

Some authors (3, 40, 74, 86, 94) have occasionally employed topical anesthesia; this can be accomplished by inserting a swab or cotton pledget, saturated with 35 percent cocaine solution, into the cervical canal for several minutes. Most surgeons, however, believe that the advantage of topical cocaine anesthesia for this purpose is insufficient to justify the risk of toxicity.

The canal should be cleansed and dried before treatment is done, so that an even coagulum can be obtained. Cotton swabs dipped in caroid powder or hydrogen peroxide are often used to remove thick cervical secretions (4, 40, 74, 110). It is also well to keep the cervix as dry as possible during the operation by frequent sponging of the surface.

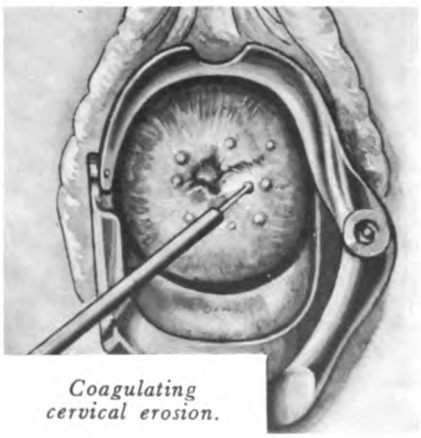
The *indifferent electrode* must be used, and can be conveniently applied to the lower abdomen, held in place with a sandbag or by pressure of the patient's hands; or it may be placed under the buttocks of the patient. A self-retaining speculum is used, and there is no need to pull the cervix down into the introitus.

There is little uniformity of technique for this procedure, and many modifications of the electrocoagulation principle have been used with apparently equally good results. The more common methods will be presented in the following discussion:

Techniques:

For coagulation of the *endocervical canal,* a ball-tipped electrode of 3 to 5 mm. in diameter is probably most commonly used (3, 6, 16, 44, 100, 113, 131). After the canal has been sounded to determine its length, a ball electrode, which usually fits the os rather snugly, is inserted to a level short of the internal os. Some operators routinely insert the electrode about one-half inch (143) or between ¼ and ½ inch (70) into the canal. Then the current is applied with the footswitch, and the electrode is rotated and slowly withdrawn; light pressure is made upon the endocervical walls as the ball is removed in a spiral fashion. If preferred, several adjacent linear streaks of coagulation can be made. A depth of coagulum within the canal of 2 mm. is usually sufficient.

A rod electrode is also employed for endocervical coagulation, using either the blunt or pointed end. Usually, when this



Coagulating cervical erosion.

electrode is employed, the blunt end is inserted to the desired depth and the electrode is lightly pressed against one side of the canal. The current is then applied very briefly, or until the operator—observing the coagulum forming at the external os—judges that sufficient coagulation has occurred. The electrode is then pressed against adjacent untreated endocervical tissue, and the process repeated until the entire circumference has been uniformly coagulated.

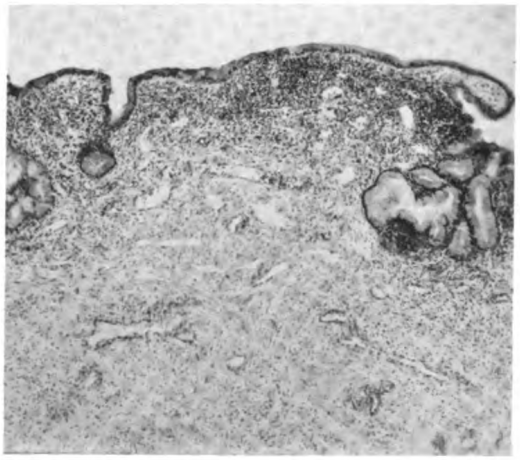
It is often wise for the inexperienced operator to err on the side of undertreatment at first, since additional therapy can be given later if needed. The approximate Bovie power settings for the electrodes mentioned are listed on page 10.

Following the treatment of the distal cervical canal, the areas of surface *erosion* are coagulated. If a ball electrode has been used, it is convenient to continue the coagulation of the external cervix with it. Applying light pressure against the mucosa, the ball may be slowly moved in a circular or spiral manner, while the current is applied, until the diseased area has been covered. The current should be interrupted to allow dissipation of heat, particularly if the patient experiences discomfort. Some operators feel that keeping the electrode in motion prevents unnecessarily deep coagulation. The ball electrode may also be used to provide intermittent and overlapping circles of coagulation, until the entire erosion has been replaced by a white coagulum. The pointed rod, of course, may be similarly used: The electrode is touched to the surface, and the current applied until a white circle appears around it; this is repeated in overlapping fashion until the entire erosion is coagulated. No matter which electrode is used, it should be kept in contact with the tissue while the current is applied, and excessive power should be avoided. Sparking and carbonization are undesirable; the proper color of coagulated tissue is a creamy white, not yellow brown.

Nabothian cysts, if small, are effectively destroyed by routine methods of coagulation described above. If large, the operator may elect to treat them individually, before coagulating intervening diseased areas: The cysts can be easily destroyed by pushing the pointed end of a rod electrode or a thick needle electrode into them while the coagulating current is being applied (56, 95). A large cyst may also be incised with a cutting current, its contents evacuated, and its walls coagulated with a small ball electrode (5).

Other Techniques:

Other methods of cervical coagulation will be mentioned only briefly, since they are used less frequently. Modifications of the original endocervical electrodes of Ende (36) and Cherry (22) are still used,



Microscopic section through an erosion.

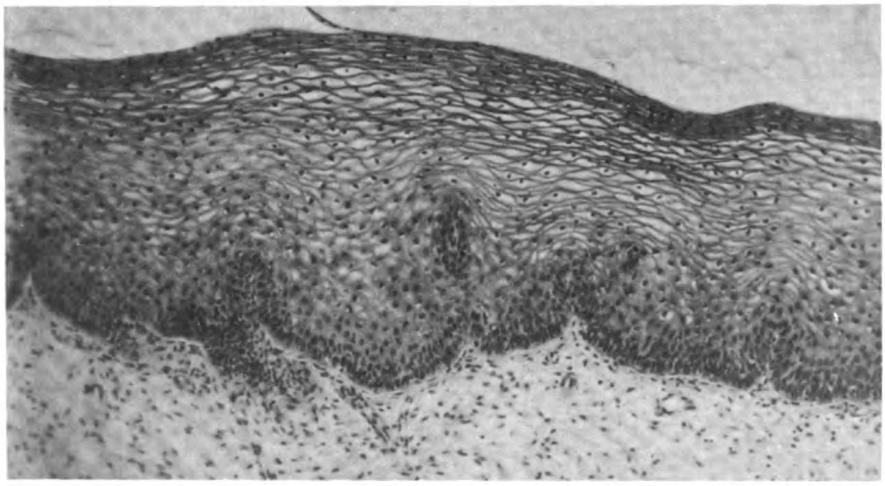
although their popularity has diminished. The most common electrode of this type consists of parallel metal bars separated by a nonconducting bakelite shaft into which they are set. No indifferent plate is used with this electrode. When the electrode is inserted into the cervical canal and the current applied, coagulation of that portion of tissue between the two bars takes place. The shaft of the electrode is revolved and the coagulation repeated until the entire circumference of the canal has been treated.

Davis (31) and other gynecologists use the double-needle (biactive) electrode, which needs no indifferent plate. The electrode is touched to the cervix, the current is applied until a white coagulum appears between and around the needle points, and this is repeated in overlapping fashion until the diseased area has been covered.

The *monoterminal* current, without the indifferent electrode, can be used with a small ball or needle electrode to produce very superficial destruction (6, 141), which at times may suffice for mild erosions. The monoterminal current requires about twice the power, for an effect roughly comparable to superficial coagulation using the indifferent electrode.

Some operators (20, 58, 110, 116) have produced conical areas of coagulation by multiple insertions of needle or blade electrodes into the cervical tissue. Deep or extensive coagulation, however, has been replaced in recent years by *conization*. The present tendency is that of conservative coagulation, which can be repeated later if needed. Deep destruction increases the incidence of secondary hemorrhage or other postoperative complications.

Many gynecologists have described electrodes or methods of their own devising (22, 36, 48, 73, 84, 107, 118, 124). There is no evidence, however, that special instruments produce better results than those more easily available and more commonly used. The procedure of electrocoagulation is simple if the operator selects one technique and gains facility with it. Any technique can be modified to meet unusual



Normal cervix after coagulation. Healed in six weeks.

variations from the common types of cervical lesions.

Postoperative Treatment:

The white coagulum is allowed to remain in place, and will usually separate in 10 to 15 days, depending on the amount of tissue destruction. The patient must be informed that a profuse discharge will appear, beginning about 24 hours after the treatment, but that this is innocuous and will clear up spontaneously after about two weeks. The discharge is often offensive to the patient during the second week when the slough is separating; most gynecologists permit gentle acid douching at this time, although it is not absolutely necessary, and a few consider douching inadvisable. The discharge may also become slightly sanguinous during the second week, but only very rarely is packing necessary for hemorrhage. Restriction of activity is seldom necessary, although some physicians discourage performance of hard work for two weeks. Coitus should be discontinued for one month.

No antibiotic or acid creams or suppositories are necessary, although they are used by some. Systemic chemotherapy is generally indicated only if signs of parametrial infection occur. (A profuse purulent leucorrhea or pelvic inflammation should have been treated with the appropriate antibotic prior to coagulation.)

Frequent office visits during the early postoperative period are seldom necessary if the patient has been adequately instructed, and if she can contact her physician if the unusual symptoms of hemorrhage or pelvic infection occur. Most physicians instruct the patient to return at the end of the second week, and at two-week intervals thereafter until healing is complete. The cervix is healed, depending on the extensiveness of the disease and the amount of coagulation, in four to eight weeks.

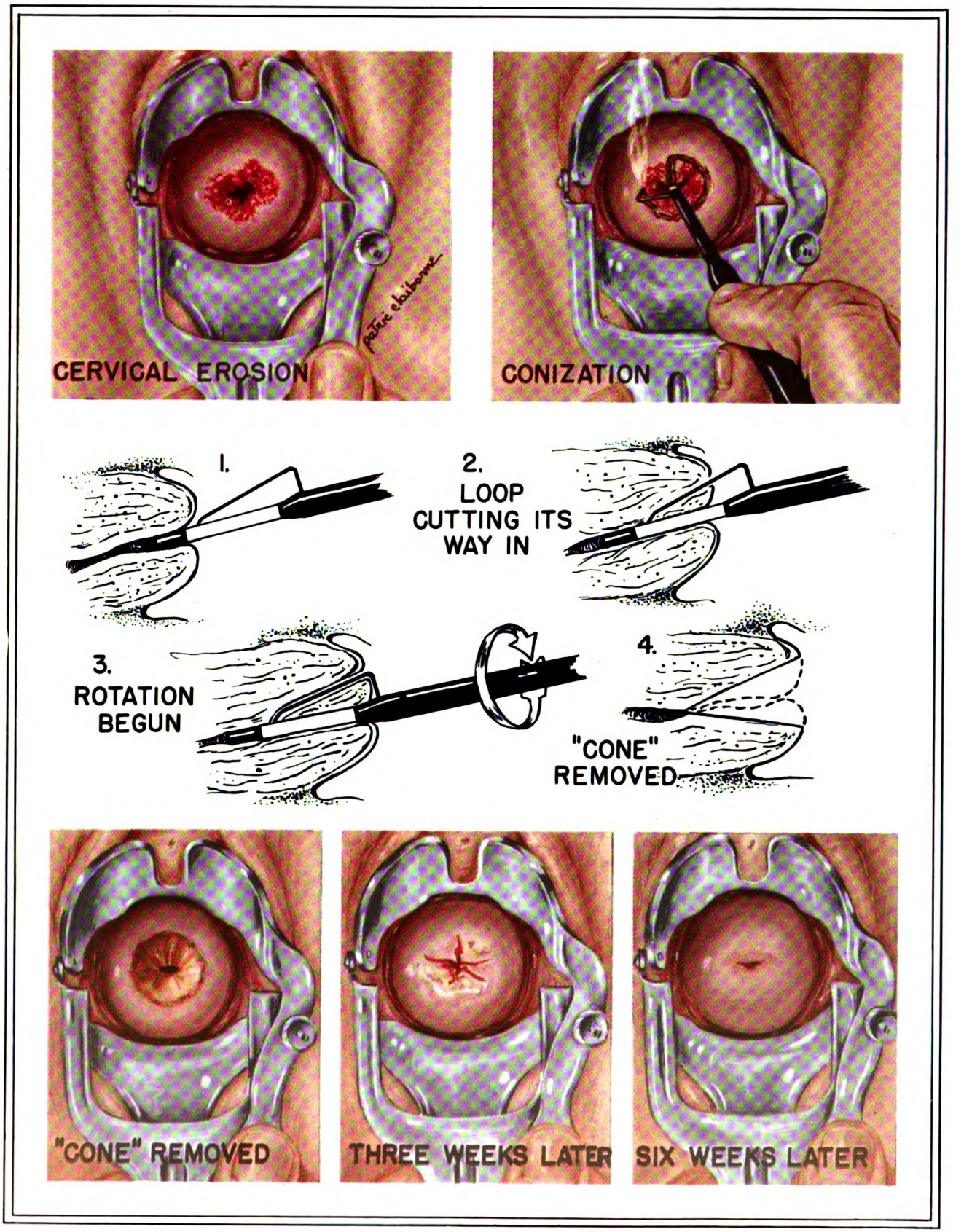
Although stenosis is rare, most gynecologists routinely sound the cervical canal during and/or after the healing period. Thus, Zelezny-Baumrucker and Baumrucker (143) insert a thin mercurochrome-dipped applicator into the canal once a week until healing is established. Ground (49) and Roblee (110) dilate the cervix gently when healing has occurred, six to eight weeks following the coagulation. Black (12) believes that it may be advisable to dilate the cervix monthly for four months. Karnaky (70) finds that dilation is rarely necessary if the coagulation has been superficial.

Chronic Cervicitis

Treatment by Conization

Advantages:

Since its introduction by Hyams (61) in 1928, cervical conization has become an indispensable technique of almost every gynecologist. Advantages of this method are reported to be: Relative ease and rapidity of treatment; the hemostasis obtained; accurate and complete removal of



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Drawn by Patric Claiborne, Courtesy Medical Art Section, Medical Center of Washington, D.C.

infected tissues; rapid healing; a high percentage of cures in cases resistant to other therapeutic measures; and the rarity of resulting fibrosis or stenosis (11, 21, 25, 46, 63, 65, 66, 86, 87, 92, 125, 133, 135). An additional advantage in the case of wide conization, according to some gynecologists, is the removal of a large intact piece of diseased tissue which can be sectioned for evidence of malignant change (11, 17, 25, 30, 63, 66, 130). Cervical biopsy will be discussed later.

Indications:

The chief *indication* for conization is severe chronic endo-exocervicitis, particularly that associated with hypertrophy and laceration, which has not responded or which is not likely to respond to more conservative measures. The cases suitable for coagulation or conization obviously overlap to a considerable degree, and the choice between the two methods is often determined by the operator's personal experience and preference. Sometimes a combination of the two are used. Many excellent results in cervicitis of moderate severity have been achieved with conization, and it has become the most common operative method of therapy in many clinics. Most physicians agree, however, that this method is of particular value in the treatment of advanced, long-standing cervicitis, with marked eversion, enlargement, laceration, and/or extensive cystic disease. Conization, according to many, has replaced to a large extent the operations of Sturmdorf tracheloplasty, trachelorrhaphy, or cervical amputation (25, 46, 65, 92, 95, 125).

Results:

Hyams (63), in a study of 779 office conizations, reported 90 percent cures, and no cases of stenosis or other serious complications. Graffagnino (46), in a series of 400 cases of leucorrhea due to chronic cervicitis, achieved 95 percent cures following conization. Crossen (28) reported 91 percent primary cures of chronic cervicitis, and an additional 7.5 percent were improved and eventually cured by cauterization of slight eversion or isolated cysts. Hawkins (57) achieved "good results" in 94 percent of 630 conizations.

Contraindications:

The contraindications are those of any operative therapy of the cervix, chiefly: acute or subacute infections of the cervix or adnexae, and pregnancy. The clinical suspicion of carcinoma is not necessarily a contraindication, since some gynecologists use conization as a method of complete biopsy; more commonly, however, the reports of smears and biopsies are obtained prior to the decision to use conization or other therapeutic measures. The operation is not performed during or shortly before menstruation. Some physicians prefer to reserve conization for cases resistant to other therapeutic methods (such as cauterization or coagulation), and for postmenopausal patients. There is, however, an extensive experience with conization during the childbearing period, and there is no evidence that this procedure interferes with cervical dilation in subsequent pregnancies (21, 28, 112, 135).

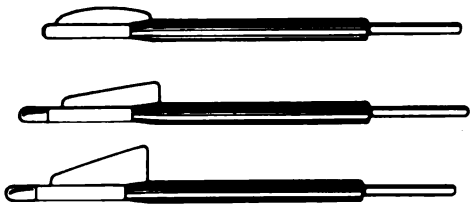
Office vs. Hospital Treatment:

The decision to perform conization in the office or the hospital depends upon the severity of the disease and complicating factors, the amount of tissue to be re-

moved, and the clinical judgment and experience of the surgeon. Many gynecologists perform this procedure in both ambulatory and hospitalized patients. The conservative conizations of Hyams (61, 63) were performed entirely on ambulatory patients, and others (46, 67) routinely use conization as an office technique. Haber (52) performs slight and moderate conizations on outpatients but hospitalizes patients for radical conization. Stadiem (126) reported that 40 percent of his cases were done on an out-patient basis. Karnaky (66) routinely performs wide conizations on ambulatory patients. Crossen (25) limits office conization to cases in which all the cervicitis is within a one-half inch radius of the external os. Te Linde (130) believes that hospitalization is desirable but not absolutely necessary, and others (12, 92) have stated their preference for hospitalization. Ingersoll and Meigs (65) counsel that conization should be performed in the office only after the operator has become experienced in the technique. By and large, office conizations are conservatively performed; whereas extensive conizations require brief hospitalization, usually of one to three days' duration (21, 28, 52, 55).

Electrodes and Their Uses:

The conization electrodes are made in three sizes, as illustrated below. The



Conization electrodes.

smallest one is similar to Hyams' original instrument, it conforms to the fusiform shape of the cervical canal, and it was designed to remove the infected endocervical glands of ambulatory patients. It is best suited to the treatment of chronic endocervical infection with leucorrhea and erosion, but with minimal amounts of laceration, eversion, or cystic change. Although this electrode is most commonly used for chronic cervicitis of mild degree, rather extensive cases have been treated by using multiple turns of this electrode, and some physicians use it almost exclusively (65).

It is not always necessary or advisable to remove every clinical manifestation of cervicitis in one session, particularly in ambulatory patients. Removal of the infected endocervical glands, with their irritating discharges, is often followed by the replacement of the remaining areas of erosion by normal squamous epithelium. Nabothian cysts remaining after conization are often destroyed by coagulation or cauterization, and some operators routinely combine the techniques of conservative conization and coagulation (78).

For the repair of *extensive* cervical disease, most gynecologists use the triangular conization loops, which are modifications by Kelley and Crossen. These electrodes not only remove the endocervical mucosa, but a variable portion of muscle around the external os. Most or all of the diseased area can be conveniently removed, and healing is accompanied by inversion of the periphery so that the ectropic and lacerated cervix returns to a relatively normal size and shape. In present gynecologic practice, the medium-sized conization electrode is the one most com-

monly used, both in ambulatory and hospitalized patients. Thus, in more than 1000 conizations performed by Karnaky (70), the medium electrode was used in 90 percent of the cases; and the general popularity of this instrument size is confirmed by manufacturers' records.

A modification of the triangular electrode is advocated by Hawkins (57): A concave shape of the cutting wire permits a wide excision at the squamo-columnar junction without removing too much of the deeper cervical structure.

Preparation:

Daily acid douches or other local hygienic measures, may be prescribed for a month or more preceding operative therapy. It is best to perform the conization shortly after the menstrual period, so that the cervix will have about three weeks to heal before the onset of the next period; Crossen and Wolfe (27) believe that this is an important factor in the prevention of postoperative bleeding.

The indifferent electrode must be used, and can be conveniently applied to the patient's thigh, abdomen, or buttocks. With the vaginal speculum inserted, the vagina and cervix are cleansed of all discharge, by swabbing with caroid powder or hydrogen peroxide, and wiped dry. It is important that the cervical canal be free of all discharge.

Local anesthesia is commonly but not invariably used for ambulatory patients. It may be obtained by allowing a small crystal of cocaine to dissolve in the cervical canal; or more commonly an applicator saturated with 35 percent cocaine solution is allowed to remain in the cervical canal for about 10 minutes (25, 63, 90, 131). It is customary to administer a barbiturate prior to cocaine anesthesia, to reduce the incidence of toxic effects. Karnaky (70) achieves adequate analgesia with methampyrone (Novaldin), 5 to 8 cc. intramuscularly or 15 to 40 grains rectally, administered 15 to 30 minutes before conization. For hospitalized patients, a short-acting general anesthetic such as sodium pentothal, is preferred (17, 55).

Technique:

The direction and length of the cervical canal are determined, and the depth necessary to insert the instrument is measured. The cervix need not be drawn to the introitus. The insulated tip of the instrument may extend to the internal os, but the cutting wire generally should not remove more than the distal one-half or two-thirds of the cervical canal. Some operators prefer to limit excision to the distal one-third of the cervical canal (57). The risks of hemorrhage or stenosis are markedly reduced by avoiding the internal os. It is to be remembered that the cervical canal may be shortened when ectropion (eversion) exists (78). The extended insulated tip serves as fulcrum for even turning of the electrode. The proper sized coning electrode is inserted into the handle, which is connected to the active terminal of the machine. The *cutting* current is set to deliver the proper amount of power, the usual power setting being 35 to 45 on the Bovie. (Karnaky (69) reports that a Bovie power setting of 35 to 40 is optimal, and that a setting above 45 produces excessive heating of cervical tissue.)

The tip of the instrument is placed into the external os with the loop just con-

tacting the tissue. The cutting current is then turned on with the foot switch and the electrode is advanced into the canal to the required depth, the loop cutting its way in. The insulated tip guards against cutting the internal os. It is well to release the footswitch at this time, prior to revolving the electrode.

To excise a conical segment of tissue, it is necessary to revolve the electrode through a 360 degree circle. The manner in which this is done, however, depends upon the experience and preference of the operator, and the type of anesthesia used.

In hospitalized cases, with general anesthesia being employed, it is not uncommon for the operator to revolve the electrode through a complete circle in one continuous motion. Many surgeons, however, prefer to use a series of short cuts, either in hospital or office practice.

The pain associated with conization seems to be caused chiefly by uterine contractions in response to overheating of cervical tissue. This can be mitigated by turning the electrode in short arcs, and by permitting the heat to dissipate between cuts. The decreased production of tissue heat by this technique has been confirmed by cervical temperature measurements (69), and Karnaky (68-70) believes that the incidence of cervical stenosis is thus materially reduced. The "stop-and-go" method advocated by Karnaky (68, 69) is as follows: After the electrode has cut to the proper depth, a 2 to 4 mm. arc is cut in one direction, and the current is not reapplied for a period of four to ten seconds. Then a similar short arc is cut in the opposite direction. The technique of cutting short segments in opposite directions, with intervening rest periods, is continued until the cone of tissue is excised. This method is reported to produce little pain, and excessive fibrosis is avoided (69).

Under ordinary circumstances the cutting current will prevent hemorrhage; but if bleeding does occur, a needle or ball-tipped electrode may be inserted into the handle and the coagulating current lightly applied to any actively bleeding points (17, 18, 21, 52). Moderate oozing usually ceases spontaneously, or after light packing. Bleeding from larger arteries, which occurs uncommonly, is best controlled by suture (18, 28, 126), since deep coagulation is undesirable.

If additional tissue must be removed following the regular central conization, the outlying affected areas can also be coned out by reinsertion and extra turns of the electrode (25, 92, 126). There will still be preservation of a funnel shaped cavity which will heal with good inversion (25).

In cases of extensive conization, Crossen (25, 28) finds that inversion and rapidity of healing are facilitated by turning in just the anterior and posterior cervical lips with a Sturmdorf suture. This procedure also eliminates bleeding. Hospitalization is advisable for radical conization.

The patient should be informed that a vaginal discharge will become profuse and often sanguinous after the third to fifth day. This will subside after complete separation of slough in about two weeks (92).

Postoperative Teatment:

After-care is largely a matter of personal preference. Many gynecologists pack

the coned area and vagina for 24 hours or longer, whereas others use no packing. Hyams (63) and Wallace (134) leave an applicator saturated with 2 percent mercurochrome in the cervical canal for several minutes, followed by light vaginal packing with mercurochromed gauze for one day. Hahn (53) employs firm vaginal packing for 24 hours postoperatively, and TeLinde (130) inserts a gauze wick into the coned area for the same length of time. Brings (17) packs an Oxycel sponge tightly into the cervical canal, and allows this to remain. Hansen et al (54) pack the coned area with iodoform gauze, and remove this at the first office visit two or three days later.

Harper (55) packs the coned area with sterile cotton saturated with aqueous gentian violet, and places a sponge into the vagina. The sponge is removed in one day, and the packing is removed in the first return visit in five to seven days. The packing is then reinserted, and removed in another five to seven days. This procedure is said to reduce infection and odor, and to prevent secondary hemorrhage.

Karnaky (67, 70) uses cotton packing of the coned area of the cervix and the vagina, in conjunction with acid jelly, powder or tablets which are said to reduce infection and to promote healing. The packing is renewed two or three times the first week and twice weekly as needed thereafter.

Other gynecologists routinely employ sulfonamide creams in the postoperative period, in the belief that vaginal discharge and healing time are thereby reduced (55, 83).

A number of operators permit gentle acid or antiseptic douches after removal of the packing (11, 28, 121), although many consider them unnecessary or inadvisable, at least until after the fifth day (18, 63, 135).

Coitus is interdicted for one month (11). Depending on the extent of the operation, it may be advisable to restrict activity for one week or longer (25).

The frequency of return visits depends upon clinical judgment and the type of postoperative therapy used. The patient may be seen in the office once or twice weekly during the healing of the wound (17, 55, 135); or, after removal of the pack, visits at intervals of two weeks or longer may suffice (21, 53, 130).

Most operators comment on the rarity of stricture following conization, but advise that the usual precautions be taken. Many gynecologists pass a small sound, swab, dilator, or dressing forceps into the cervical canal at one or two-week intervals during the healing period, and after healing is complete (17, 18, 74, 126, 129, 135). Other operators wait until healing is complete, or nearly so, before testing patency of the cervical canal; this maneuver is repeated once or more at monthly intervals (11, 21, 53, 55). Crossen (28) formerly passed a sound routinely at four to six weeks, but now does so only when the external os appears narrow, or when there is dysmenorrhea or decreased menstrual flow.

Miller and Todd (92) found that any strictures which occur following conization were mild, requiring only dilation or passing of a sterile sound or hemostat. Karnaky (66), in a series of 729 conizations, found that stenosis occurred in 7 percent; but these in contrast to the fibrous stenoses produced by thermocautery, were

membranous in type and could easily be broken down. Hawkins (57) reported stenosis in 13 (1.9%) of 670 conizations; 10 of these were corrected with Hegar dilators in the office, 2 were dilated under anesthesia, and one eventually required hysterectomy.

Following conization, the cervix will usually be healed in four to six weeks (25, 63, 126, 135).

Cervical Biopsy

The difficulties in the diagnosis of early carcinoma of the uterine cervix are well known, and many gynecologists emphasize that cancer may masquerade as chronic cervicitis or coexist with it. For example, Locke and Caldwell (81) reported 29 cases of cervical cancer indistinguishable from chronic cervicitis by inspection or palpation, TeLinde and Galvin (129) reported 11 such cases, Brings (17) discovered two cases of carcinoma out of 185 cases of grossly benign cystic cervicitis treated by conization, and Hawkins (57) found 11 cancers in 1,000 coned cervices thought to be benign. In addition to the cytologic (Papanicolaou) smear, which is being applied with increasing frequency in routine cases of cervicitis, the removal of suspicious tissue for biopsy is often indicated. Some authorities recommend biopsy of every cervix which shows any deviation from normal (81).

Electrosurgical excision of tissue for biopsy is a procedure used by many gynecologists, who feel that it offers certain advantages over the punch or scalpel. For office work, a *loop* electrode, of circular or rectangular shape, is most often used (63, 73, 84, 87, 88, 96, 104). The use of an electrocutting loop electrode, in experienced hands, is convenient and rapid; the specimen is bloodlessly obtained; the method is not traumatic so that cell structure is not crushed or mutilated; and the sealing of small blood and lymph vessels, and the small amount of manipulation required, are believed to lessen the danger of metastasis of malignant cells or the spread of infection (63, 85, 96, 102, 103, 104, 125, 127).

The *preparation* is the same as that for any operative procedure: It is preferable to perform the biopsy after a menstrual period, rather than just before one, in order to avoid secondary bleeding. The secretions are removed from the cervical and vaginal walls, and the operative field is swabbed dry. Anesthesia is usually not necessary, and the cervix is not drawn down. Schiller's iodine test may be employed as an aid in selecting sites for taking tissue. Specimens for biopsy, as usually obtained from the cervix, are limited to the portio where squamous cell carcinoma has its origin. The cervix is generally not dilated, although a nonpatulous canal may be gently opened with graduated sounds to permit introduction of a loop if this is desired (93). Conization is preferred when endocervical biopsy is indicated.

While a small section of the loop electrode lightly contacts the selected site, the cutting current is applied with the footswitch, and the loop is *immediately* drawn through and out of the tissue so as to excise a liberal wedge. (See Experi-

ments with Electrocutting, page 14.) Some experience is necessary for the best results. The electrode should move rapidly through the tissue, so that the layer of coagulated cells at the cut edge will not be so thick as to interfere with histologic interpretation. The bed from which the tissue is removed bleeds slightly if at all; oozing is readily controlled by light coagulation.

Some physicians have objected to the layer of coagulum on the tissue specimen, but this should not be sufficient to concern the pathologist *if* proper equipment, current, and operative technique are used. Many operators consider that electrocutting loop excision produces less tissue distortion than does scalpel or punch (71, 93, 127, 139). Montgomery and Bowers (96) cite two professors of pathology, who find that specimens of cervical tissue excised with loop electrodes are "eminently satisfactory and not distorted."

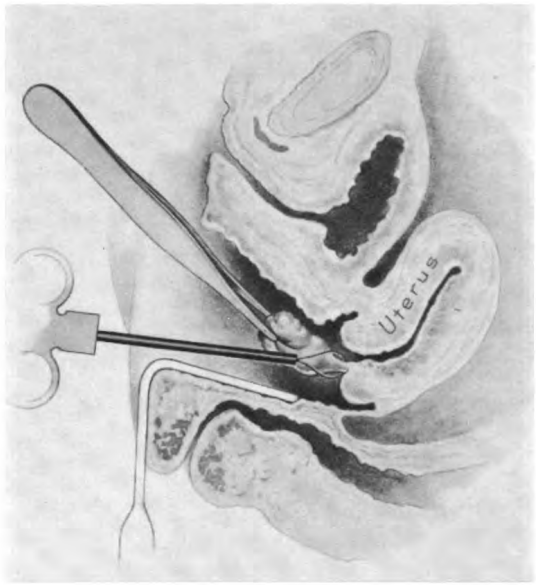
Conization, since its inception, has been used by a number of gynecologists to obtain large specimens of tissue for microscopic examination (11, 17, 25, 30, 52, 63, 87, 90, 114, 120, 129, 135). The preparation, technique, and postoperative care are the same as those described under chronic cervicitis. Dilatation of the cervix is unnecessary. Although conization is most commonly used for the *treatment* of advanced cervicitis, its *diagnostic* value is sometimes the primary indication. Crossen (29), Schwartz (120) and many others point out that the entire diseased area, including the endocervix (the site of origin of adenocarcinoma), can thus be excised and subjected to critical examination. The lesion is cured if it is benign, or if carcinoma *in situ* exists within the confines of the removed block. Conization, of course, is not recommended when invasive carcinoma is known or believed to exist, although such cases have been discovered accidentally in this manner. TeLinde (129, 130) finds conization-biopsy useful when there is no clear indication where a specimen should be taken, or when ordinary tissue specimens fail to give decisive answer to the question of early cancer.

Although tissue obtained with a small conization electrode of Hyams has been used for histologic study (63), most pathologists consider such specimens too thin and distorted for adequate interpretation. When conization is used for purposes of biopsy, a large triangular electrode (Crossen) is recommended, good technique is essential, and brief hospitalization is usually advised. Of course, the cutting wire must not pass directly through a suspicious area needed for microscopic examination (25).

Cervical Polyps

Polypi are frequently removed by electrosurgical methods: They may be destroyed by electrocoagulation or excised with the cutting current (10, 35, 80, 85, 137, 138). Both procedures require the use of the indifferent electrode, and cervical dilatation is usually necessary.

Levant (80), while applying slight traction to the polyp with a dressing forceps, coagulates the pedicle of the growth: A needle electrode is inserted to a depth of about one-eighth inch into the stalk and the coagulating current is applied until blanching of the adjacent tissue is



Removal of cervical polyp with snare.

observed. The needle is removed and reinserted into a different part until the entire pedicle is coagulated. The polyp will slough spontaneously within three to seven days, or it may be severed through the coagulated portion. This method of removal avoids the hemorrhage associated with twisting and tearing of healthy mucosa, and is said to be superior to thermal cautery which may cause scarring and stenosis (80).

Martzloff (85) and others use a *wire snare* tonsillotome, combined with the *coagulating* current, a method also commonly used for the removal of rectal and nasal polyps. The snare can be connected to the active terminal of the electrosurgical unit by means of a clip cord. (If a metal vaginal speculum is used, it is advisable to insulate the cannula of the snare with rubber tubing to prevent inadvertant contact of the metal surfaces. Special insulated snares, for use with electrosurgical units, are commercially available.) Following dilatation of the cervix, the wire snare is placed over the growth to the base of the pedicle, and the polyp is held steady with a mouse-tooth forceps. The loop is closed to engage the pedicle, and the coagulating current is applied with a footswitch while the wire is *slowly* tightened to detach the polyp. This combination of crushing and coagulation reduces danger of hemorrhage. If oozing should occur following removal, a gauze pack is placed in the cervical canal and removed in 48 hours.

Many gynecologists perform ligation of the pedicle of the polyp, prior to its removal, to eliminate postoperative hemorrhage. When this procedure is impracticable, Martzloff (85) coagulates the base through a hemostat: The hemostat is applied to the base of the pedicle, a ball-

tipped coagulating electrode is touched to the blades of the hemostat, and then the current is applied until the base is coagulated. The growth may then be safely excised through the coagulated stalk. The indifferent plate must of course be used, so that the current will flow away from the operator's hand. Metal surfaces of hemostat and speculum must not contact one another; and the hemostat must not contact tissue other than that being coagulated.

Ward (137) and others have employed the *cutting* current to sever the pedicle. A *slow* cut is preferable, to provide adequate coagulation in the interests of hemostasis and prevention of recurrence. A loop or any other cutting electrode may be conveniently used. Following such removal, additional coagulation of the base with a pointed or ball-tipped electrode is often performed.

Although malignant change in mucous polypi of the cervix is uncommon, it is advisable that all such polypi receive histologic examination. Many surgeons routinely hospitalize patients for cervical polypectomy, in the belief that adequate cervical dilatation and complete removal of the base of the pedicle are advisable for cancer detection (78). Underlying cervical infection, if present, should receive appropriate treatment.

Skenitis and Bartholinitis

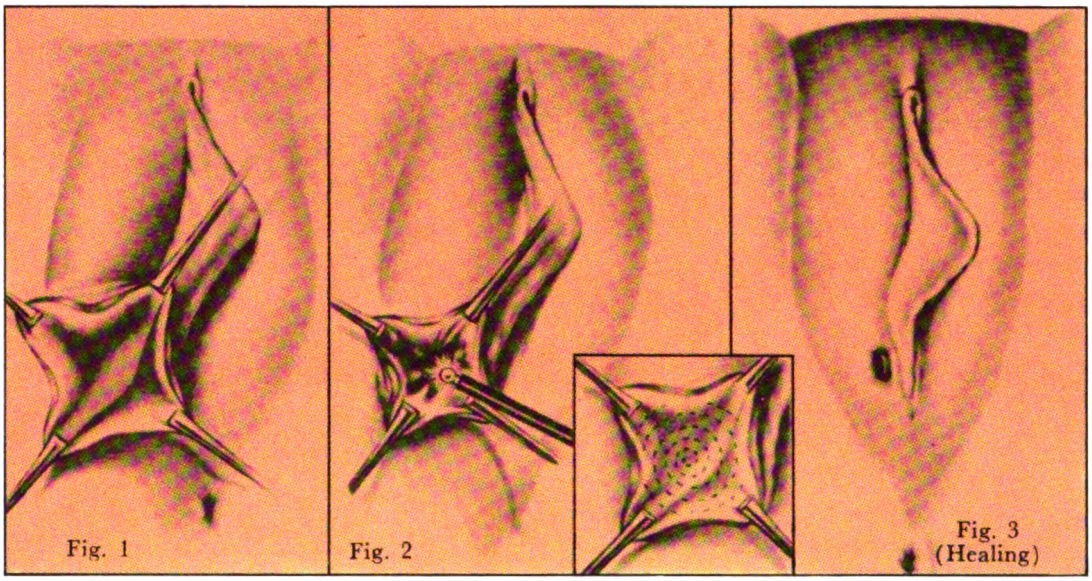
Chronic infections of Skene's and Bartholin's glands, which can cause recurrent infections of the urethra and cervix, have often been effectively treated by electrodesiccation or electrocoagulation (10, 22, 23, 25, 43, 44, 75, 76). During preliminary examination, exudate should be manually expressed from these glands, and the proper bacteriologic studies made.

If destruction of the glands is indicated, anesthesia is obtained with local procaine infiltration, and a needle electrode is introduced through the duct and into the depths of the gland; just enough current is applied to coagulate the gland and duct (76). Ward (137) advises that the current be continued until there is blanching of the tissue adjacent to the needle. This author states that the dehydration sterilizes the infection, and that healing is prompt and complete. After drainage of an acute vulvovaginal abscess, when the acute infection has entirely subsided, Gerardi (43) recommends the destruction of this gland and its duct linings by coagulation. Schauffler (117) prefers to destroy the glandular epithelium at the time of incision.

Roeser and Kretschner (115) state there are usually more than one infected Skene's gland, and one should not overlook openings which may be obscured by inflammatory folds or swelling of the mucosa. The needle should reach the bottom of the infected gland, in some cases requiring an insertion of ½ to ¾ inch. Following coagulation, these authors advise warm Sitz baths, and re-examination in eight or ten weeks to be sure all the infected glands have been destroyed.

Dodson and Frohbose (34) find that chronically inflamed Skene's glands are

easily and adequately destroyed with the *cutting* current: A needle electrode is inserted to the depth of the gland, the cutting current is applied, and pressure is made toward the lumen of the urethra until the intervening tissue is divided.



(After Schauffler)

Bartholin Cyst and Abscess

Abscesses and cysts of the vulvovaginal glands have often been eradicated by electrosurgical methods (10, 22, 25, 44, 48, 75, 117, 137). Simple incision and drainage of a Bartholin's gland abscess may be followed by a persistent sinus, recurrent abscess, or the formation of a cyst. It is possible to eliminate these sequelae by adequate destruction of the glandular epithelium at the time of drainage. Sterile cysts, while more commonly removed by enucleation, can be treated in the same manner. The technique of Ward (137) and others is as follows:

Local anesthesia is obtained by the infiltration of procaine into the subcutaneous and deep tissues around and beneath the cyst (48). For very large cysts, hospitalization and general anesthesia are often preferable. A flat blade or needle electrode may be used with the cutting current to make a cross incision and there should be very little or no bleeding (137). After evacuation of the contents, the epithelial lining is destroyed by desiccation or coagulation (10, 44, 137, 138), and the wound is packed with iodoform gauze. After the coagulated tissue sloughs, the wound heals from its base. Repacking is performed as needed to permit drainage, prevent premature closure, and encourage granulation.

In the experience of Schauffler (117),

scalpel enucleation of vulvovaginal cysts has disadvantages of technical difficulty, primary or secondary hemorrhages, postoperative edema and discomfort, relatively prolonged disability, and frequent recurrences. Schauffler reported the superiority of electrosurgical therapy for both abscess and cyst, and the details of his technique are as follows:

A wide crucial incision is made on the anterior and inner aspects of the swelling (Figure 1). The cyst or abscess is opened, and the incision carried widely to allow complete flattening and exposure of the cavity wall by tension on the tabs of the crucial incision. The floor is explored for diverticula or communicating pus sacs.

The lining of the cavity is then destroyed by electrocoagulation, using a dull-pointed or small ball-tipped active electrode. The coagulating current is applied to the center of the exposed lining which has been carefully sponged dry. A coagulating current with a penetration of about 2 mm. is used, requiring a power setting of about 25 or 35, and the entire lining is destroyed by an outward spiral or snail-like progression with the electrode (Figure 2). Care must be taken to cover every bit of the base of the lining, including possible diverticula. As the electrode follows the spiral path outward from the center, the cavity lining shrinks and retracts centrally, leaving at the end of treatment a clean, dry core of bloodless, coagulated cavity wall.

The extent of the exposed wall will have receded to about one-half its original size. Instead of a gaping hemorrhagic cavity there is a clean, dry, shallow pit with a solid core, which later forms a clean slough. Packing is used in the usual way, and the wound may be probed on subsequent visits to facilitate healing from the base. The total operative time of this procedure is reported to be five or ten minutes, and the postoperative course is very mild (117).

Urethral Caruncle

Caruncle is a clinical term for a red polypoid tumor which usually originates from the posterior wall of the urethral meatus and which commonly causes symptoms of bleeding and severe dysuria. It may be sessile or pedunculated, and often has the appearance of a raspberry or cockscomb. It is very prone to recur unless the entire tumor, including the base from which it has originated, is removed or destroyed (131).

These tumors show considerable histologic variation, but signs of inflammation are always present, and they are not true neoplasms. They have been divided into granulomatous, papillomatous, angiomatous, or adenomatous types; but such categories are relatively meaningless. Some believe that they may arise in response to chronic infections of the urethra or Skene's glands, whereas others believe they always represent a localized urethral prolapse associated with inflammatory changes (8, 101, 128). Most authorities believe that caruncles are not potentially malignant, but that urethral carcinoma can exist simultaneously and be overlooked. For this reason, a method of treatment by which a

specimen is obtained for biopsy is often recommended.

Caruncles are most commonly treated by electrosurgical methods. Desiccation, coagulation, and the cutting current are all effective when properly applied. Advantages claimed for electrosurgical techniques include: ease, convenience, and painlessness of operation; applicability to ambulatory patients; control of bleeding; immediate relief of symptoms; and permament cure without stricture (2, 51, 89, 131, 136). Thermal cautery is less effective because the external charring may prevent heat from penetrating the deeper layers, resulting in incomplete removal and recurrence; bleeding is less well controlled, and stricture more likely to occur (2, 51, 89). Radiation is not recommended (136). Some operators reserve electrosurgery for pedunculated or papillary growths, and remove those with broad bases by excision and primary closure (34). Others remove the caruncle with sharp scissors and then coagulate the base (97).

Preparation:

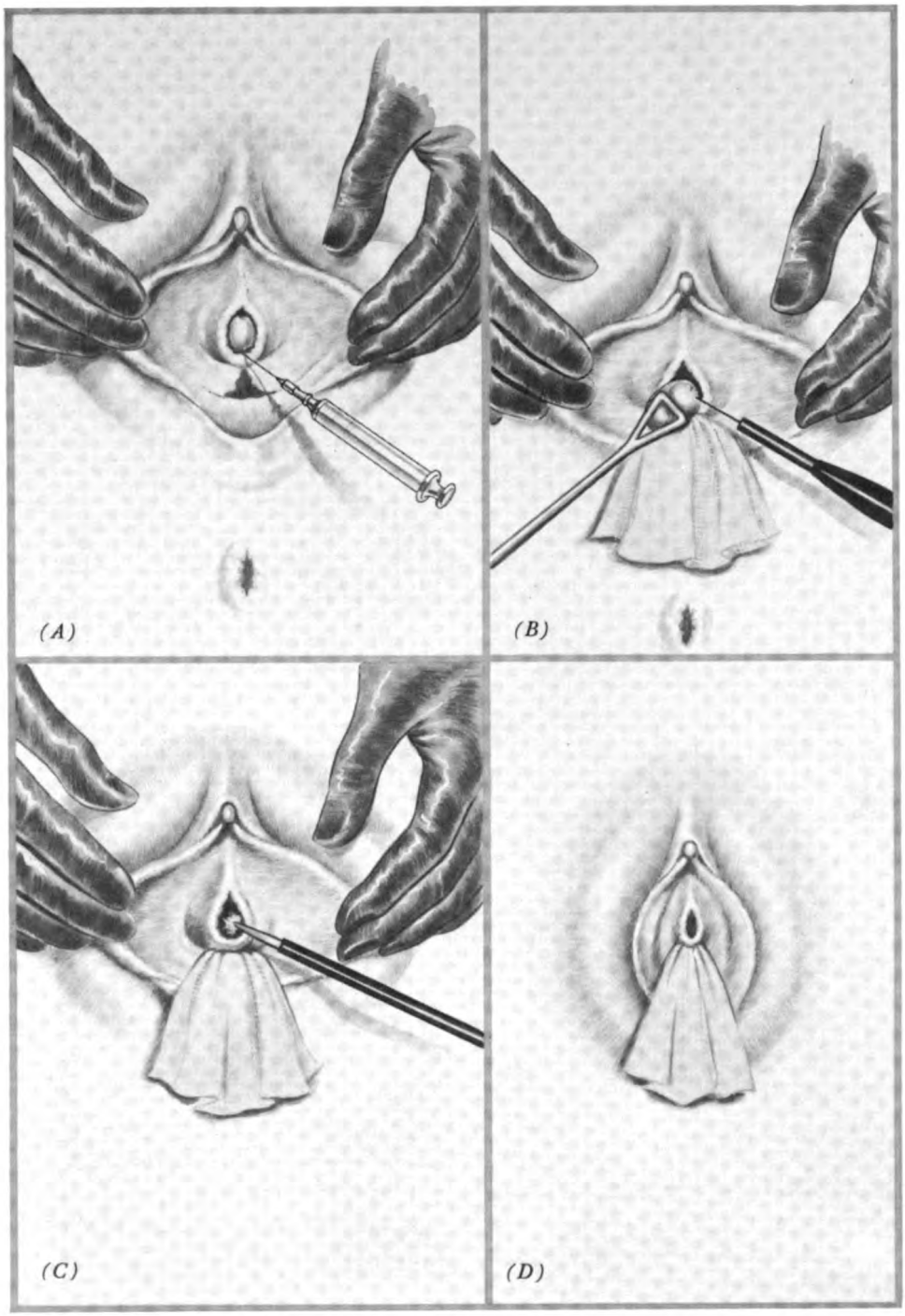
The patient voids, and the urethral meatus and surrounding tissues are cleansed and dried. Local anesthesia is usually obtained by the injection of a small amount of 0.5 to 1.0 percent procaine into the tissue below and around the tumor (2, 19, 34). The topical application of 10 percent cocaine to the caruncle for five minutes may be used instead (79, 128). Burns (19) states that the base of the caruncle may be well exposed by injecting procaine into the submucosa well back of the attachment of the tumor; this often rolls the caruncle with its base out through the meatus, rendering it more accessible. Further exposure can be obtained, if necessary, by retraction of the meatus; and an anterior meatotomy is occasionally advisable.

Technique of Desiccation:

This method is the oldest and probably still the most popular. The monoterminal current, without the indifferent electrode, and a needle electrode are used. For very small tumors, the application of a 1/16 inch spark (fulguration) will probably suffice to completely dehydrate the growth (2, 77). Complete destruction, however, is better assured by the insertion of the needle to the base of the lesion (79, 89). After insertion of the needle, the coagulating current is applied until the desired amount of dehydration around the needle is observed. As many punctures are made as are necessary to completely whiten the red growth.

The dehydrated mass is allowed to slough in the normal healing process, and the patient may return in ten days for observation, at which time another treatment may be given if the caruncle has not been completely destroyed (79). Following treatment there is rapid relief from symptoms, and there is no postoperative irritation or stricture formation, although there is occasionally slight bleeding at the time the slough separates.

This technique of desiccation is simple and rapid in execution, but has disadvantages in that two or three treatments may be necessary for complete removal, and no tissue is available for biopsy. However, a piece of tissue may be removed before treatment is begun (48, 136). TeLinde (131) and others first clip off the caruncle, and then fulgurate the base thoroughly.



Removal of Urethral Caruncle (After Guiterrez).

(A) Novocaine injected at four points.
(B) Tumor removed with heavy needle.
(C) Coagulation of wound.
(D) Normal appearance after operation.

The need for retreatment, of course, depends on the conservatism with which desiccation is used. If desired, the desiccated tissue may be clipped away, and the base of the growth retreated to insure adequate destruction.

Technique of Coagulation:

Many operators have routinely used biterminal coagulation for the eradication of caruncles (19, 34, 128). The indifferent electrode is applied to the abdomen or placed under the buttocks. A simple and highly effective method is that of applying the coagulating current through a hemostat: After anesthesia and adequate exposure are obtained, the base of the tumor is enclosed within the blades of a narrow pointed hemostat. The excess tissue then may be cut away and saved for histologic examination (19). While the hemostat remains in place, a coagulating electrode (such as a ball-tipped one) is applied to the clamp near the growth. A mild coagulating current is then applied until the base of the tumor is destroyed (19, 34).

Electrosurgical Excision:

Many operators prefer to excise caruncles, believing that complete removal is thereby assured, and a large specimen for biopsy is obtained as a part of the treatment (51, 59, 106, 136). The indifferent electrode and cutting current are used. The technique of Gutierrez (51) is as follows (Figures A to C): 2 percent procaine is injected with a fine needle at four points equidistant from one another at the margin of the meatus; ten minutes are allowed to elapse to secure complete anesthesia. The caruncle is grasped with a clamp or Allys forceps and drawn out as far as possible from the urethral orifice, revealing its point of implantation. A coarse needle electrode is applied to one side of the tumor, the cutting current is begun with the footswitch, and the needle severs the tumor at its base. A portion of underlying submucosal tissue should be removed with the caruncle (37, 59, 106). Hess (59) and Walther (136) use a loop electrode for the same purpose: A loop just large enough to encompass the tumor is passed over the lesion to its base, and the current is applied while the electrode is moved to excise the base of the growth. With either electrode, a Bovie power setting of about 30 to 40 will be needed. The procedure is usually bloodless, although any slight bleeding can be readily controlled with the coagulating current.

Following removal of the caruncle, the base of the wound is usually carefully coagulated with a needle electrode, to prevent recurrence or to secure hemostasis (19, 37, 106); remember to switch to the coagulating current. Postoperative treatment consists of an initial application of a mild antiseptic, and a sterile vaseline gauze dressing to be held in position for 24 hours. The patient returns twice a week for irrigation and the occasional passage of a sound to avoid any possibility of stricture. However, the scar resulting from this procedure is stated to be so slight and supple that no deformity of the urethra occurs (51).

Bibliography

1. Baker, A. E.: The management of endocervicitis, South Med. & Surg. *96*:111-112 (March) 1934.
2. Ballenger, E. G.: Treatment of urethral caruncles by fulguration, J. A. M. A. *69*:1420, 1917.
3. Barrett, R. L.: Electrocoagulation of erosions and endocervicitis in late puerperium, J. A. M. A. *103*:1516-1520 (Nov. 17) 1934.
4. Barrett, R. L.: Puerperal cervix, Am. J. Surg. *33*:541-545 (Sept.) 1936.
5. Barrett, R. L.: Electrosurgical treatment of cervical lacerations, erosions and endocervicitis, Maine M. J. *27*:178-183 (Sept.) 1936.
6. Bayer, R.: The ambulant coagulation therapy of chronic cervicitis, Zbl. Gyn. *75*:68-79 (No. 2) 1953.
7. Beecham, C. T.: Nonmalignant diseases of the cervix, S. Clin. North America *25*:1299-1305 (Dec.) 1945.
8. Begg, R. C.: There are no urethral caruncles, Lancet *1*:825 (April 14) 1951.
9. Berger, J.: Colposcopic study of 110 uterine cervices following electrocoagulation, Compt. rend. Soc. fr. gyn. *23*:38-43 (Feb.) 1953.
10. Bierman, W.: Physical Medicine in General Practice, New York, Paul B. Hoeber, 1944, Chap. 20.
11. Black, W. T.: Good and bad results in the treatment of cervicitis, J. A. M. A. *112*:191-196 (Jan. 21) 1939.
12. Black, W. T.: The treatment of chronic cervicitis, Arch. Phys. Therapy *20*:427-431, 1939.
13. Block, F. B.: Benign lesions of the cervix, Am. J. M. Sc. *206*:794-805 (Dec.) 1943.
14. Boland, B. F.: Electrosurgery in gynecology, M. Rec. *142*:375-377 (Oct. 16) 1935.
15. Boland, B. F.: Cervical lesions and their treatment by electrosurgical methods, M. Rec. *149*:385-386 (June 7) 1939.
16. Bosch, H. and Bonorden, W.: Electrocoagulation therapy of chronic cervical catarrh and erosion, Deutsche med. Wchnschr. *76*:945-948 (July 20) 1951.
17. Brings, L.: Conization and carcinoma of the cervix, GP *6*:42 (Oct.) 1952.
18. Brown, T. K.: Management of endocervicitis, Wisconsin M. J. *41*:117-120, 168 (Feb.) 1942.
19. Burns, E.: Diagnosis and treatment of minor lesions of the urethra and bladder in women, Nebraska M. J. *35*:246-252 (Aug.) 1950.
20. Chaffin, R. C.: Surgical consideration of the cervix uteri, Am. J. Surg. *6*:56-63 (Jan.) 1929.
21. Champion, P. K. and Thompson, N. J.: Effect of conization of the cervix on subsequent pregnancy, Am. J. Obst. & Gynec. *62*:1321-1326 (Dec.) 1951.
22. Cherry, T. H.: Further advancement in gynecologic diathermy, New York State J. Med. *30*:1333-1335 (Nov. 15) 1930.
23. Corbus, B. C. and O'Conor, V. J.: Diathermy in the Treatment of Genito-Urinary Diseases, St. Paul, Bruce, 1929.
24. Crossen, H. S. and Crossen, R. J.: Diseases of Women, St. Louis, C. V. Mosby, 1944.
25. Crossen, H. S and Crossen, R. J.: Operative Gynecology, St. Louis, C. V. Mosby, 1938, Chap. 7.
26. Crossen, R. J.: New electrode for conization, J. Missouri M. A. *32*:125-128 (April) 1935.
27. Crossen, R. J. and Wulff, G. J. L.: Three hundred cases of extensive conization; with further report on use of special electrode, Am. J. Obst. & Gynec. *37*:849-855 (May) 1939.
28. Crossen, R. J.: Wide conization of cervix: follow-up of 1000 cases, Am. J. Obst. & Gynec. *57*:187-206 (Jan.) 1949.
29. Crossen, R. J.: Common gynecologic problems, GP *5*:49-55 (May) 1952.
30. Davis, C. H.: Lesions of the cervix uteri—diagnosis and treatment, New England J. Med. *213*:699-705 (Oct. 10) 1935.
31. Davis, C. H.: Gynecology and Obstretrics, Hagerstown, W. F. Prior, 1953, Vol. III, Chap. 7 & 10.
32. Dearman, A. M.: Electrotherapy in endocervicitis, West Virginia M. J. *32*:458-461 (Oct.) 1936.
33. Derow, D.: Coagulation and ionization of cervical erosions and endocervicitis, Arch. Phys. Therapy *21*:154-163 (March) 1940.
34. Dodson, A. I. and Frohbose, W. J.: Minor urologic surgery, S. Clin. North America *31*:1413-1416 (Oct.) 1951.
35. Emge, L. A.: Inflammatory diseases of the cervix, in Davis, C. H.: Gynecology and Obstetrics, Hagerstown, W. F. Prior, 1941, Vol. II, Chap. 2.
36. Ende, F. M.: Coagulation diathermy in cervicitis, using a new electrode, Am. J. Obst. & Gynec. *18*:72-80 (July) 1929.

Bibliography

37. Findley, D.: End results in the treatment of Cervicitis, Am. J. Obst. & Gynec. *49*:614-624 (May) 1945.
38. Fine, S. G.: Chronic endocervicitis and treatment by electrocoagulation, J. M. Soc. New Jersey *33*:507-509 (Sept.) 1936.
39. Frankenthal, L. E., Kobak, A. J., and Krohn, L.: Diathermy in ambulatory gynecologic patients, Arch. Phys. Therapy *15*:197-200 (April) 1934.
40. Frost, I. F.: Cervical infections and treatment by electrocoagulation, Am. J. Surg. *34*:221-226 (Nov.) 1936.
41. Frost, I. F.: The correct technique in electrocoagulation of the cervix and its attending dangers, J. M. Soc. New Jersey *34*:621-624 (Oct.) 1937.
42. Frost, I. F.: Erosion and infection of the antepartum cervix and their treatment by electrocoagulation, Am. J. Surg. *45*:20-23 (July) 1939.
43. Gerardi, R.: Treatment of chronic bartholinitis by electrocoagulation, Bol. Inst. de matern *14*:153-154 (Dec.) 1945.
44. Goldblatt, S.: Gonorrhea in the female: a study of 3,838 cases with special reference to electrosurgical treatment of gonorrheal endocervicitis, Ven. Dis. Inform. *20*:157-163 (June) 1939.
45. Graber, E. A. and O'Rourke, J. J.: The treatment of cervical erosion by a simple method of electrocoagulation, Am. J. Obst. & Gynec. *67*:639-646 (March) 1954.
46. Graffagnino, P.: The chronically diseased cervix as a focus of systemic infection, New Orleans M. & S. J. *87*:83-86 (Oct.) 1934.
47. Graves, R. C. and Guiss, L. W.: Urethral tumors, J. Urol. *46*:929-947 (Nov.) 1941.
48. Greenhill, J. P.: Office Gynecology, Chicago, Year Book Publishers, 1940.
49. Ground, W. E.: Further studies of endocervicitis, cervicitis and erosions, Arch. Phys. Therapy *17*:520-524 (Aug.) 1936.
50. Guillium, W. H.: The treatment of cervicitis and endocervicitis by electrophysical modalities, M. Rec *143*:428-431 (May 20) 1936.
51. Gutierrez, R.: Electrosurgical treatment of caruncles of the female urethra, Urol. & Cutan. Rev. *40*:223-231 (April) 1936.
52. Haber, J. J.: Conization and early diagnosis of carcinoma of the cervix, Am. J. Surg. *67*:67-76 (Jan.) 1945.
53. Hahn, G. A.: Newer methods in the management of the abnormal cervix, S. Clin. North America *28*:1401-1413 (Dec.) 1948.
54. Hansen, A. M., Jennings, M. H. and Wood, C. L.: Differential diagnosis and treatment of lesions of the cervix, J. Internat. Coll. Surg. *22*:643-648 (Dec.) 1954.
55. Harper, W. F.: Treatment of chronic cervicitis, J. M. A. Alabama *22*:201-203 (Feb.) 1953.
56. Harriman, W. F.: Treatment of endocervicitis with actual cautery and electrocoagulation, Am. J. Obst. & Gynec. *18*:250-256 (Aug.) 1929.
57. Hawkins, M. C., Jr.: Re-evaluation of conization of the cervix, South. M. J. *48*:383-390 (April) 1955.
58. Henson, J. W.: Cervicitis; prenatal, puerperal and postnatal prophylaxis, Virginia M. Monthly *60*:739-743 (March) 1934.
59. Hess, E.: Primary carcinoma of the female urethra with special reference to caruncle, Pennsylvania M. J. *48*:1150-1155 (Aug.) 1945.
60. Hoerner, J. K.: Office gynecology, Ohio State M. J. *44*:613 (June) 1948.
61. Hyams, M. N.: A new instrument for excision of the diseased endocervix with surgical diathermy, New York State J. Med. *28*:646-648 (June 1) 1928.
62. Hyams, M. N.: High frequency current in the treatment of chronic endocervicitis, Arch. Phys. Therapy *11*:171-178 (April) 1930.
63. Hyams, M. N.: Conization of the uterine cervix, Am. J. Obst. & Gynec. *25*:653-661 (May) 1933.
64. Hyams, M. N.: Evaluation of various methods of treatment of chronic cervicitis, New York State J. Med. *44*:1785-1791 (Aug. 15) 1944.
65. Ingersoll, F. M. and Meigs, J. V.: Minor gynecologic surgery, S. Clin. North America *31*:1401-1402 (Oct.) 1951.
66. Karnaky, K. J.: Cervicitis, Radiol. Rev. & Mississippi Valley M. J. *60*:127-130 (July) 1938.
67. Karnaky, K. J.: The use of an acid jelly postoperatively after vaginal and cervicial operations, Texas State J. Med. *39*:178-184 (July) 1943.
68. Karnaky, K. J.: Practical Office Gynecology, Springfield, Charles C. Thomas, 1947.
69. Karnaky, K. J.: Electronic studies in obstetrics and gynecology—temperature study, Missis-

Bibliography

sippi Valley M. J. *76*:60-61 (Jan.) 1954.

70. Karnaky, K. J.: Personal communication.
71. Karaner, H. T., cited by Mock, H. E.: Electrosurgery, J. A. M. A. *104*:2350 (June 29) 1935.
72. Kelly, H. A. and Ward, G. E.: Electrosurgery, Philadelphia, W. B. Saunders, 1932, Chap. 12.
73. Kimble, H. E.: Electrocoagulation in cervicitis, Arch. Phys. Therapy *14*:550-553 (Sept.) 1933.
74. Kleegman, S. J.: Office treatment of the pathologic cervix, Am. J. Surg. *48*:294-310 (April) 1940.
75. Kolischer, G.: Diathermy in gynecology, Am. J. Obst. & Gynec. *19*:550-552 (April) 1930.
76. Kovacs, R.: Electrotherapy and Light Therapy, Philadelphia, Lea and Febiger, 1938.
77. Kretschmer, H. L.: Fulguration treatment of caruncle, S. Clin. Chicago, *2*:833 (Aug.) 1918.
78. Lambert, B. de F.: Personal communication.
79. Levant, H. L.: Caruncle, M. Rec. *139*:346 (April 4) 1934.
80. Levant, H. L.: Cervical polypus, M. Rec. *142*:217-218 (Sept.) 1935.
81. Locke, F. R. and Caldwell, J. B.: The early diagnosis of carcinoma of the cervix with emphasis on routine biopsy, Am. J. Obst. & Gynec. *57*:1133-1139 (June) 1949.
82. Malpas, P.: The recurrence rate of urethral caruncles, J. Obst. & Gynec. Brit. Emp. *52*:367-369 (Aug.) 1945.
83. Marbach, A. H.: A multiple sulfonamide therapeutic measure in the postoperative care of the cervix and vagina, Am. J. Obst. & Gynec. *55*:511-517 (March) 1948.
84. Marcel, J. E.: Chronic cervicitis and diathermocoagulation, Bull, et. mem. Soc. d. med. de Paris *138*:23-31 (Jan. 12) 1934.
85. Martzloff, K. H.: Diseases of the Cervix Uteri, in Lewis' Practice of Surgery, Hagerstown, W. F. Prior, 1954, Vol. X, Chap. 14.
86. Maryan, H. O.: The treatment of chronic cervicitis by electrosurgery, M. Clin. North America *27*:99-108 (Jan.) 1943.
87. Mason, L. W.: Chronic cervicitis and its treatment by electrosurgery, Colorado M. *33*:177-182 (March) 1936.
88. McConn, O. S.: Surgical diathermy in the treatment of chronic cervicitis, Memphis M. J. *4*:216-217 (Oct.) 1927.
89. Meaker, S. R.: Urethral caruncle and its treatment, Urol. & Cutan. Rev. *43*:667-668 (Oct.) 1939.
90. Meyer, R.: Cited by Haber, J. J. (52).
91. Mikels, F. M.: Electrosurgery in the treatment of uterine cervical lesions, Am. J. Surg. *7*:818-823 (Dec.) 1929.
92. Miller, N. F. and Todd, O. E.: Conization of the cervix, Surg., Gynec., & Obst. *67*:265-268 (Sept.) 1938.
93. Mock, H. E.: Electrosurgery: A discussion of indications, advantages, disadvantages and warnings concerning its use, J. A. M. A. *104*:2341-2350 (June 29) 1935.
94. Moench, G. L. and Schulman, A.: A preliminary report on the results obtained with electrocoagulation in chronic inflammation of the cervix uteri, Med. J. & Rec. *131*:131-133 (Feb. 5) 1930.
95. Mohler, R. W.: Diagnosis and treatment of chronic cervicitis, S. Clin. North America 18:1537-1546 (Dec.) 1938.
96. Montgomery, T. L. and Bowers, P. A.: Management of the chronically diseased cervix, J. Internat. Coll. Surgeons *19*:629-636 (May) 1953.
97. Moore, N. S.: Problems involving the female urethra, South. M. J. *38*:149-150 (Feb.) 1945.
98. Netter, M. L.: Concerning endocervical diathermocoagulation, Compt. rend. Soc. franc. gyn. *17*:220-226 (Dec. 15) 1947.
99. Novak, J.: Nature of caruncle, Urol. & Cutan. Rev. *47*:217-218 (April) 1943.
100. Nygren, E.: 1000 Cases of erosion of the portio treated by electrocoagulation, Acta obst. et gynec. Scandinav. 28:314-321, 1949.
101. Palmer, J. K., Emmett, J. L. and McDonald, J. R.: Urethral caruncle, Surg., Gyn. & Obst. *87*:611-620 (Nov.) 1948.
102. Palmer, R.: Dysplasias of cervix and treatment by biopsy and diathermic exeresis, Comp. rend. Soc. fr. gyn. *23*:43-49 (Feb.) 1953.
103. Phaneuf, L. E.: Biopsy of uterine cervix, Am. J. Surg. *36*:226-230 (April) 1937.
104. Phaneuf, L. E. and Belson, M. O.: Biopsy of the uterine cervix, New England J. Med. *220*:859-861 (May 25) 1939.
105. Raffi-Surbled, Mme.: On electrocoagulation of the cervix, Compt. rend. Soc. franc. gyn.

Bibliography

22:219-221 (May 5) 1952.

106. Ratner, M. and Schneiderman, C.: The relationship of urethral caruncle to carcinoma of urethra, Canad. M. A. J. *58*:373-376 (April) 1948.
107. Remington, G. A.: Coagulation of the cervical canal for chronic follicular cervicitis, Phys. Therapy *50*:16-19 (Jan.) 1932.
108. Reuth, J. E.: Endocervicitis and pelvic infections, Arch. Phys. Therapy *15*:200-202 (April) 1934.
109. Robecchi, E.: Diathermocoagulation of the cervix, Minerva ginec. *3*:585-586 (Oct.) 1951.
110. Roblee, M. A.: Treatment of cervicitis by cautery and electrocoagulation, Am. J. Obst. & Gynec. *22*:64-73 (July) 1931.
111. Roblee, M. A.: Cervicitis; five years' experience with diathermy, Arch. Phys. Therapy *17*:514-520 (Aug.) 1936.
112. Roblee, M. A., cited by Schwarz, O. H. and Woolf, R. B.: Cervical dystocia, with special reference to the fibrous nature of the cervix, Am. J. Obst. & Gynec. *55*:162-163 (Jan.) 1948.
113. Rohwedder, P.: Cervicitis and its therapy by electrocoagulation, Geburtsh. u. Frauenh. *10*:463-468 (June) 1950.
114. Rodriguez, Lopez, M.B.: Electrical conization in chronic cervicitis; its prophylactic and diagnostic value in neoplasm of the cervix, Dia med. *26*:1265-1270 (July 12) 1954.
115. Roeser, E. H. and Kretschmer, H. L.: Para-peri-urethral infection of the female urethra, Illinois M. J. *89*:16-19 (Jan.) 1946.
116. Royston, G. D., and Roblee, M. A.: The treatment of pelvic inflammation by medical and surgical heat, Am. J. Obst. & Gynec. *24*:381-389 (Sept.) 1932.
117. Schauffler, G. C.: A quick, easy, efficient treatment of Bartholin cyst and abscess, J. A. M. A. *102*:839 (March 17) 1934.
118. Schellenberg, W.: The technique of electrocoagulation of chronic cervicitis, Zbl. Gyn. *75*:1018-1019 (No. 26) 1953.
119. Schutt, C. H.: High-frequency currents in surgery, J. Missouri M. A. *42*:410-413 (July) 1945.
120. Schwarz, O. H., in discussion on Locke, F. R. and Caldwell, J. B. (75).
121. Seaman, J. A.: The importance of endocervicitis in urologic tract infections, South. M. J. *38*:398-405 (June) 1945.
122. Sichel, M. S.: Electrocoagulation in endocervicitis, West. J. Surg. *42*:261-262 (May) 1934.
123. Snelling, M. M.: Several procedures in the management of cervical diseases and injuries, Mississippi Doctor *17*:266-273 (Oct.) 1939.
124. Soter, S. D.: Treatment of endocervicitis by electro-cauterization and electro-coagulation, Illinois M. J. *63*:539-543 (June) 1933.
125. Stadiem, M. L.: The treatment of diseases of the cervix by the electrosurgical unit, Am. J. Obst. & Gynec. *28*:514-520 (Oct.) 1934.
126. Stadiem, M. L.: Electrosurgery of the cervix after six years, Arch. Phys. Therapy *19*:398-402 (July) 1938.
127. Stein, I. F.: Gynecologic office procedures, M. Clin. North America *26*:195-217 (Jan.) 1942.
128. Stevens, W. E.: The Female Urethra, in Lewis' Practice of Surgery, Hagerstown, W. F. Prior, 1954, Vol. IX, Chap. 25, pp. 20-21.
129. TeLinde, R. W. and Galvin, G.: The minimal histological changes in biopsies to justify a diagnosis of cervical cancer, Am. J. Obst. & Gynec. *48*:774-794 (Dec.) 1944.
130. TeLinde, R. W.: Operative Gynecology, Philadelphia, J. B. Lippincott, 1946, pp. 342-344.
131. TeLinde, R. W.: The Female Urethra and Skene's Ducts, in Lewis' Practice of Surgery, Hagerstown, W. F. Prior, 1954, Vol. X, Chap. 11.
132. Tischer, H.: Coagulation therapy of intractable erosions, Geburtsh, u. Frauenh. *10*:469-478 (June) 1950.
133. Walker, R. B.: Treatment of chronic endocervicitis by surgical endothermy, M. J. Soc. New Jersey *27*:413-418 (May) 1930.
134. Wallace, J. E.: Conization of cervix with the electric scalpel, Oklahoma State M. J. (April) 1932.
135. Wallace, J. E.: Surgery of the cervix with the electric knife, J. Oklahoma State M. A. *41*:186-191 (May) 1948.
136. Walther, H. W. E.: Caruncle in females, J. Urol. *50*:380-388 (Sept.) 1943.
137. Ward, G. E.: Electrosurgical gynecological office procedures, Am. J. Surg. *8*:379-381 (Feb.) 1930.
138. Ward, G. E.: Physical Agents in Treatment of Gynecologic Conditions, in Mock, H. E.:

Bibliography

Principles and Practice of Physical Therapy, Hagerstown, W. F. Prior, 1933, Vol. II, Chap. 33.

139. Weidman, F. D. and Guequierre, J. P.: High-frequency currents in performing biopsies, J. A. M. A. *103*:1693 (Dec. 1) 1934.
140. Whittier, C. A.: The treatment of benign lesions of the cervix uteri, J. Nat. M. A. *32*:239-241 (Nov.) 1940.
141. Wilson, K. J.: Electrosurgical treatment of the pathologic cervix, J. Oklahoma M. A. *35*:47-50 (Feb.) 1942.
142. Wilson, K. J.: Some gynecologic conditions arising in the cervix and their treatment, J. Oklahoma M. A. *38*:280-283 (July) 1945.
143. Zelezny-Baumrucker, O. and Baumrucker, G. O.: Electrocoagulation of 400 erosions, Surg., Gynec. & Obst. *67*:17-25 (July) 1938.

PART FOUR

MINOR ELECTROSURGERY of the NOSE and THROAT

The electrosurgical currents have a number of important applications in otolaryngology. Their most common uses include: The relatively permanent shrinking of chronically congested inferior turbinates, the removal of nasal polyps and other benign tumors, the destruction of vascular nevi, the control of recurrent epistaxis, and the removal of small lymphoid masses which are difficult to eradicate by other measures. These and other techniques appropriate for the management of ambulatory patients will be described in the sections to follow.

Certain advantages of electrosurgery will be mentioned where indicated. In general, the coagulating or cutting currents are convenient to use, they can be accurately applied, and they provide good hemostasis. They have additional value in preventing recurrence of certain benign growths; and when properly used, carbonization is avoided so that mucosal reaction, postoperative discomfort, secondary hemorrhage, and excessive cicatrization are minimized.

Instruments designed for specific purposes in otolaryngologic electrosurgery are commercially available, such as certain wire snares, suction cannulae, or coagulating electrodes of special shape and dimension. Except where mentioned, these are not essential for the techniques described in this manual. It is necessary, however, to properly insulate any metallic instrument through which an electrosurgical current is applied, so as to avoid inappropriate contact and undesired coagulation of normal mucosa. Cannulae can be simply insulated with snugly fitted rubber tubing. Metal nasal specula or tongue depressors may be used, and in fact these are employed as indifferent electrodes by some operators. More commonly, the indifferent plate is applied in routine fashion. If exposure is obtained with a metal instrument, precautions must be taken not to contact it with the metallic (noninsulated) portion of the active electrode. The electrode is always properly placed before current is applied, and the current is turned off as soon as the proper effect is achieved.

The techniques to be described are generally performed under topical anesthesia, using either cocaine or pontocaine. For most procedures, 5 percent cocaine or 1 percent pontocaine solution, applied to the mucosa for five (not more than ten) minutes, provides adequate anesthesia (67). *Accuracy* in placement of the anesthetic solution is more important than its strength.

Many laryngologists employ 10 percent or 20 percent solutions of cocaine for some purposes, but these concentrations must be used with caution since undesirable systemic reactions may follow their use. A barbiturate is commonly administered 30 minutes before such applications to counteract the central nervous system stimulation of cocaine (67).

Chronic Vasomotor Rhinitis

Treatment by Submucous Coagulation

Principles and Indications:

Chronic nasal obstruction, due to the soft tissue swelling of vasomotor rhinitis, is a distressing condition which often requires nonspecific local therapy for symptomatic relief. The etiologic factors, which are often multiple and indefinite include: allergies, irritants, climatic or thermal conditions, psychiatric factors, and endocrine or metabolic dysfunction. It is obvious that causative agents must be sought, but the response to therapy (i.e. elimination of allergens or irritants, desensitization, and antihistaminics) is frequently disappointing (67, 72). Electrocoagulation of the inferior turbinates is probably the most common surgical procedure in the treatment of vasomotor rhinitis, and it is one of the most successful (29).

The *principle* of electrosurgical therapy is the provision of air space by the elimination of some of the cavernous spaces of the inferior turbinate, which is the chief nasal obstructor (67). A ribbon of coagulation and thrombosis is produced, healing by fibrosis and contraction. After healing, a groove is left in the turbinate. The coagulation is best performed below the mucosal surface, so as to avoid severe postoperative local reaction and the destruction of ciliated epithelium.

For this treatment to be effective, the tumescence *must* be at least partially reversible by the use of topical vasoconstrictors (67, 72), and the turbinate should pit on pressure (7). Bony or fibrous hypertrophies must be treated by other operative measures.

The *indication* for submucous coagulation is the presence of objective nasal *obstruction,* due to a chronically congested ("hyperplastic") inferior turbinate. Other symptoms, such as excess secretion, headache, sneezing, and pruritis, are relieved to a variable and unpredictable degree (72).

Complicating disorders necessitating treatment, such as obstructing deviations or spurs of the septum, or bony hypertrophies of turbinate tips, are generally first treated by submucous resection; and submucous coagulation is performed several months later if necessary. Polypectomy and turbinate coagulation can be performed at the same session. Some inferior turbinates jut out toward the septum; these may be fractured by pressure with a long-bladed nasal speculum, and then the turbinate is further displaced with the same instrument toward the naso-antral wall. If the latter procedure is indicated, Shahinian (72) delays submucous coagu-

lation of that turbinate for two weeks. Richardson (67), on the other hand, routinely combines these two forms of therapy at the same time.

The technique of submucous coagulation, according to Wahrer (91), also can be used effectively for the shrinking of hypertrophied *middle* turbinates, which obstruct sinus drainage or prevent proper aeration of the Eustachian orifice.

Advantages:

The advantages of submucous coagulation, according to many otolaryngologists, include the following: The technique is conveniently and painlessly performed in the office under topical anesthesia; primary and secondary hemorrhages rarely occur; the function of the mucosa is preserved; postoperative reaction and discomfort are minimal; synechiae do not form; symptomatic relief is obtained in one to three weeks, and the benefit can be expected to last for two to ten years or longer (5, 7, 29, 38, 46, 47, 55, 57, 67, 72, 80). Thermal or chemical cauterization, conversely, have a maximal surface effect and mucosal epithelium is destroyed; postoperative local reaction and discomfort are more severe; healing is relatively slow following burning or carbonization; complications of secondary hemorrhage and synechiae are more common; and the treatment is less effective. Submucosal injection of sclerosing fluid has also been used, but only small areas can be treated in this manner at one time, and its effects are more difficult to control (67, 72).

Results, Complications, and Precautions:

When properly performed, there is little postoperative discomfort other than a congested nose for one to six days. An improved airway may be obtained after seven days, and healing is usually complete by the end of three weeks. In a series of 412 cases of submucous coagulation reported by Shahinian (72), gratifying results were reported in all but a few; the only complications were six cases of postoperative nasal infection, easily treated with systemic chemotherapy for several days. Richardson (67) reported 96.5 percent success in 175 patients treated by this method.

Complications can be avoided by proper electrode placement and proper current. Excessive application of current, either too intense or too long in duration, can produce undesirable *carbonization* with slow healing and other disadvantages of galvanocautery. *Infection* of the coagulated area is more likely to occur following overenthusiastic treatment, but this complication is usually not serious. *Turbinate slough* could result from excessively severe coagulation, although this is more likely to occur from malposition of electrodes (72). If the biactive (twin-needle) electrode is used, one must not permit one of the needles to slip along the lateral side of the turbinate; both needles must be inserted on the septal side of the turbinate, and they should both maintain a uniform depth in the mucosa.

The physician inexperienced in this technique will benefit from preliminary experimentation upon a piece of raw meat (72). It should be remembered, however, that meat is not hydrated as well as human flesh, and that the power setting may be as much as 30 to 40 percent higher than that needed for living tissue (91).

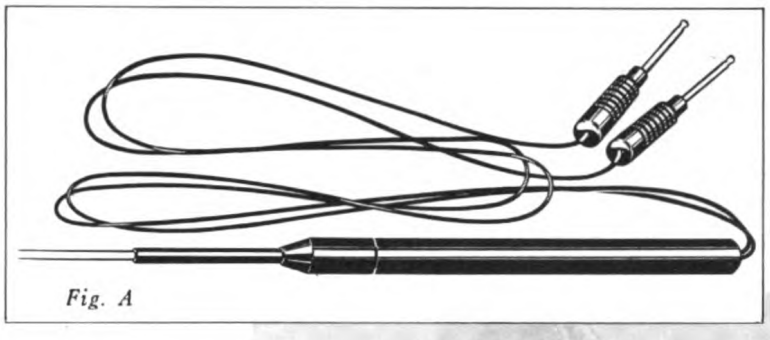
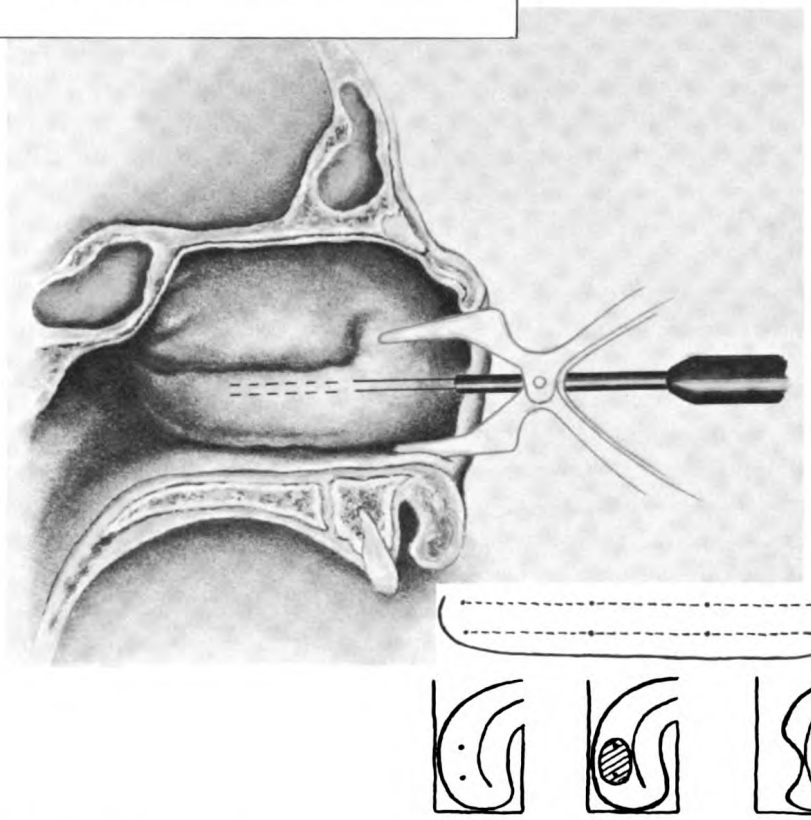


Fig. A

Biterminal electrode with parallel needles



Insertion of Biterminal Electrode for submucous coagulation. Usually two or three insertions are necessary. See text.

Equipment:

An electrosurgical unit with a spark-gap current is used. The electrode most commonly employed is the *biactive* one, consisting of parallel needles in an insulated handle (Figure A). No indifferent plate is used with this electrode. Shahinian (72) has devised a simple electrode of this type, which allows placement of one needle at a time, and permits good visulization during treatment.

A *single* long needle electrode was used in the original method of submucous coagulation described by Beck (5), and this method is still effectively used by many otolaryngologists. An indifferent plate must be used with this electrode. (The original needle used for this technique was insulated except at the tip. No insulating material is entirely satisfactory

for this purpose without greatly increasing the diameter of the needle, and clinical and experimental trial has shown that insulation is unnecessary. If the electrode is withdrawn evenly, the point of the electrode is continually coming in contact with new tissue, and coagulation will take place only at the tip. Therefore, an uninsulated needle may be used with the assurance that no portion of the turbinate receives more coagulation than another, provided that the needle is withdrawn at a constant rate of speed without hesitations.)

Preparation:

Local anesthesia is usually secured with cocaine solution, applied to the turbinate with small cotton packs or on a long cotton pledget. A small amount of 1:1000 epinephrine is often added, or the anesthetic solution may be diluted with an equal amount of 1 percent ephedrine in saline (67). Shahinian (72) also injects 0.5 cc. of 2 percent procaine into the anterior tip of the turbinate, just distal to the mucocutaneous line.

Biactive Electrode Technique:

The indifferent plate is not used. After anesthesia is obtained and the conductor cords are attached to the proper terminals of the machine, the two needles are introduced into the submucosa of the turbinate, and are pushed in for a distance of ¾ inch to 1½ inch. The needles are kept parallel to the long axis of the turbinate, avoiding contact with the bone and keeping carefully below the surface of the mucosa. The needles should rest about 2 mm. from the bone; during insertion they may be angled intermittently until contact is made with bone, then withdrawn slightly and threaded submucosally for several millimeters more (72).

It is often difficult to properly position the double-needle electrode for the entire length of the turbinate. For this reason, most laryngologists insert it carefully at more than one site. Morrison (57) advises two such punctures, one anterior and one posterior. Richardson (67) inserts the needles submucosally for a distance of about ¾ inch at three sites: in the anterior, middle, and posterior thirds of the turbinate. The treatment of different areas of a single turbinate is usually but not invariably completed in the same session.

After the needles are in place, the electrode is held stationary while the coagulating current is applied with the footswitch. A Bovie power setting of 15 to 25 will be sufficient. The current is applied until a white spot appears between and around the points of puncture; with a proper power setting this should occur in five or six seconds. This amount of time allows the operator to evaluate the effects as they are occurring, and excessive coagulation can be avoided (91). The current is then turned off and the needles are withdrawn. When properly done, there is no coagulation on the surface of the mucosa, except around the points of needle puncture.

Alternate Technique:

The single-needle electrode requires the use of the indifferent plate. After anesthesia is complete, the long needle is inserted into the anterior tip of the turbinate and carried along the submucosa of its medial side. Keeping 2 mm. away from the bone and periosteum will prevent ex-

cessive postoperative pain (7). The coagulating current (a Bovie power setting of approximately 25 to 35) is then turned on, and the needle is slowly and evenly withdrawn without disconnecting the current. Just before the needle point emerges from the anterior tip of the turbinate, the current is turned off.

One such treatment of the most redundant area of the turbinate is usually sufficient. If desired, the same procedure may be repeated along the inferior border; this will cause the tissue to shrink away from the floor of the nose (46). The treatment may be repeated in two or three weeks if necessary.

Postoperative Care:

No pack or local medication is necessary other than light mineral oil nose drops or vaseline to combat dryness if any surface mucosa has been damaged (68). The patient is informed that his nose will be congested for three to ten days, and he is advised not to blow his nose forcibly or to pick at the mucosa (72). To avoid the discomfort of bilateral nasal congestion, only one turbinate is treated at one session; coagulation of the opposite side is delayed for two to four weeks.

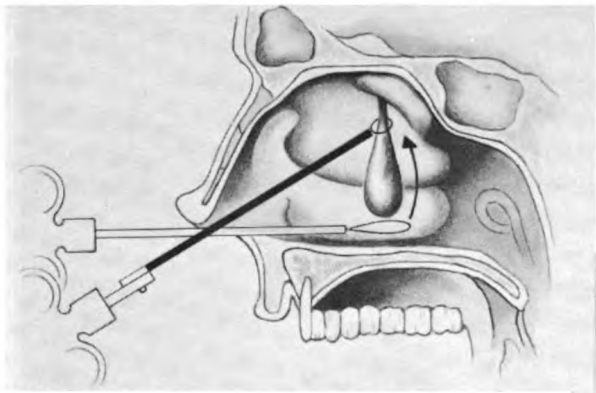
Nasal Polyps and Other Benign Tumors

Mucous polyps, which often result in nasal obstruction, retention of secretions, and secondary infection, are frequently removed by electrosurgical methods. It is necessary, of course, to detect and treat underlying allergies, or chronic infections of the sinuses, if one hopes to achieve a permanent cure. Once a nasal polyp makes its appearance, nothing short of extirpation will relieve the resulting obstruction; and many rhinologists state that the application of electrosurgical currents at the polyp's point of origin will prevent its recurrence in the area so treated. (It will not, of course, prevent polyp formation in other portions of the nasal space, if the etiologic factors persist.) An additional advantage of electrosurgical polypectomy is the *hemostasis* obtained. Most operators prefer to remove polypoid growths in a manner which permits histologic examination of the excised specimen; this applies particularly to tumors which are of uncertain or nonallergic origin. Richardson (68) warns that the repeated removal of so-called polypi without biopsy may cause delay in diagnosis and proper treatment of cancer.

Topical anesthesia is necessary for any method of polypectomy, and can be obtained with cocaine solution applied on cotton pledgets superior and inferior to the attachment of the polyp.

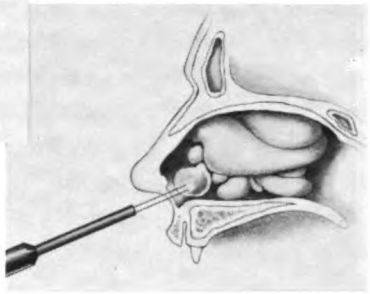
Wire Snare and Coagulation:

A common application of electrosurgery is its combination with the nasal snare (44, 46, 59, 71)). A special instrument may be obtained for this purpose, or an ordinary wire snare can be connected to the active terminal of the machine by means of a clip cord. The indifferent electrode must be applied. The cannula of the snare should be insulated with rubber



Above: Removal of Nasal Polyp with Wire Snare and Coagulation Current. (The cannula is insulated with thin rubber tubing, and the clip cord is attached to a noninsulated portion. The indifferent electrode is also applied.)

Below: Destruction of Mucous Polyp with Biactive (turbinate) Electrode and Coagulating Current. A single needle is more commonly used. See text.



tubing; this obviates the need to avoid contact with a metallic speculum or with other portions of the nasal cavity while the current is on. When the loop has engaged the pedicle of the polyp, the coagulating current is applied with the footswitch, and the loop is gradually pulled into the cannula of the snare so as to sever the tumor and to coagulate its attachment at the same time. The polyp is removed with the snare or with forceps, and is preserved for biopsy.

Localized hypertrophies of the anterior and posterior tips of the turbinates are removed in the same manner (44, 46, 71, 72). Other benign tumors may be similarly excised, but it is best to avoid the application of biterminal coagulation to the nasal septum.

Electrocutting:

The *cutting current,* and various cutting electrodes may be used for the excision of nasal tumors, particularly if they are relatively small and suitably situated. Commonly, a loop electrode of sufficient diameter is passed over the tumor to its base, the cutting current is applied with the footswitch as the loop is gently brought home, severing the growth through its mucosal attachment. Better coagulation is achieved by making the cut slowly. The base of the tumor may, of course, be additionally treated with the coagulating current after excision, if desirable for hemostasis or to insure complete removal. The excised tissue is available for biopsy.

Coagulation:

Biterminal electrocoagulation is often employed for the destruction and removal of mucous polyps or other benign tumors. It is often the treatment of choice for very vascular tumors, such as angiomas or angiofibromas, and polyps difficult to engage in the snare can be effectively destroyed by coagulation. The chief disadvantage of treatment of tumors by coagulation is the

lack of specimen for biopsy; Richardson (68) states that polypoid tissue can be safely coagulated only after an adequate histologic diagnosis has been made.

A needle electrode is most commonly used for this technique, although a small ball-tipped electrode will effectively eradicate postoperative granulations or small polypoid recurrences (57). These electrodes require the use of the indifferent plate. Some surgeons prefer to use a biactive (twin-needle) electrode, in which case the indifferent electrode is not needed. Topical anesthesia is sufficient.

Morrison (57) prefers this method only for the destruction of granulations or small polypoid recurrences, whereas other operators (23, 26, 38, 81) selectively or routinely employ coagulation for mass polyposis. Large polyps can be coagulated by making successive punctures with a needle electrode, supplying the current at each point of insertion until a blanched ring appears about the needle. A mild current is desirable, and may be achieved with a Bovie power setting of about 15 to 20, depending on the depth of its insertion. One should keep away from bone and cartilage to prevent necrosis and possible serious complications in the orbit or cranial cavity (57). Hollender (38) prefers to do the requisite coagulation in several sittings, applying topical anesthesia each time part of the polypoid tissue is coagulated.

Sinskey (81) reports a similar technique of fractional coagulation, in which a needle electrode is inserted into the polyp and the current applied for five or six seconds; and this is repeated two or three times at different parts of the polyp. If necessary, the same polyp, or others on the same side of the nose are re-treated after one month. If bilateral polyposis exists, each side is treated every two weeks alternately. It is claimed that the complete eradication of polyps by this method is likely to be followed by a permanent cure, in contrast to the frequent recurrence after cold snare removal (81).

Gutteridge (23) recommends a biactive (twin-needle) electrode, similar to that used for submucous coagulation of the inferior turbinate, since he believes that its destructive effects are better controlled and therefore safer than those of other electrodes. This electrode requires a Bovie power setting in the neighborhood of 15 to 25. No indifferent electrode is used. The needles are inserted into the polyp and the current is applied until blanching between and around the needles occurs; the polyp becomes turgid and rigid. The coagulated portion of the tumor is grasped and removed with alligator forceps, and the remaining tissue is treated in the same manner until the polyp is entirely removed. (The polyp is not necessarily always removed after coagulation: The coagulated portion gradually separates and is discharged as a crust, and the remaining tissue shrinks by fibrosis.) Following removal, a light fulguration of the base of the polyp will induce fibrosis and inhibit regrowth. Postoperative reaction is reported to be minimal, consisting only of mild nasal congestion for several days. Other polyps may be similarly treated at intervals of two weeks.

In addition to the applications described, electrocoagulation or the cutting current are used to treat a wide variety of tumors of the nose, mouth, pharynx, and nasopharynx (6, 8, 20, 41, 46, 61). The electrosurgical treatment of nasopharyn-

geal fibroma, and cancer of the nose and throat, are major procedures not suited to discussion in this manual.

Desiccation:

Monoterminal desiccation or fulguration, without the indifferent electrode, may be used for relatively superficial effects. The monoterminal current is often preferred for use on the nasal septum, to avoid the risk of perforation. It may be of value in destroying granulations or small polypoid recurrences, and it is usually adequate for the destruction of small superficial hemangiomas. It also has been used for the desiccation of the mucosal attachments of polyps, following their removal by cold snare, in order to provide hemostasis and to minimize regrowth (39).

Angiomas

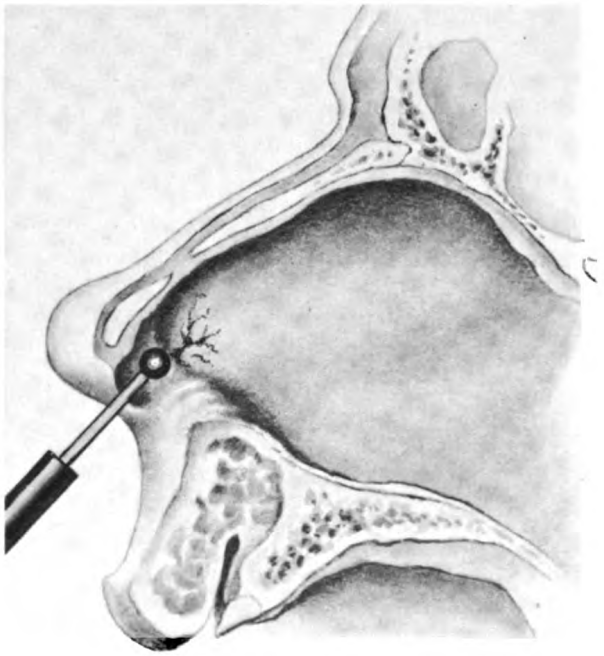
Vascular tumors of particular interest to the otolaryngologist have been well described by Figi (17, 18, 19), Quevedo (64), and more recently by Havens and Lockhart (32). The types of therapy, and the principles of electrosurgical treatment, have been discussed in the dermatologic section of this manual and need not be repeated here.

Hemangiomas of the nasal and oral cavities are usually well treated by electrocoagulation, by interstitial radiation, or by a combination of these two methods. *Superficial* vascular tumors can be readily destroyed by multiple insertions of a needle electrode, using either the monoterminal or biterminal coagulating current. *Cavernous hemangiomas* require deep coagulation, using the indifferent electrode and a needle electrode which is insulated except at its tip. Vascular nevi of infants and young children, particularly those involving the facial skin, are preferably treated by expertly applied radiation.

The lesions of *hereditary hemorrhagic telangiectasia* involving the nasal septum are often difficult to eradicate by any method; but electrocoagulation, according to Figi and Watkins (19), is the method of choice. When these lesions bleed vigorously, they are probably best treated by the application of coagulation through a suction cannula as described under Epistaxis. Constantinople (9) treats these lesions with a biactive (twin-needle) coagulating electrode: Lightly applying one needle on either side of the nevus, which is usually one to three millimeters in diameter, the current is applied so as to coagulate the intervening vascular tissue. Telangiectases of this type which involve the oral mucosa, lip, or skin are more easily eradicated; monoterminal desiccation with a needle electrode will suffice in most cases.

Spider Angiomas of the skin are easily destroyed by inserting a fine needle electrode into the central vessel, followed by the brief application of a monoterminal current (see page 42).

Lingual varicose veins can be obliterated, following topical anethesia, by insertions of a coagulating needle electrode (44, 46).



Treating Epistaxis with Ball-tipped Coagulating Electrode

Epistaxis

Electrosurgical currents are commonly used by laryngologists for the treatment of persistent or recurrent epistaxis which does not respond to routine measures (19, 21, 27, 39, 42, 45, 46, 55). Desiccation or coagulation often give prompt results when other methods fail, the effects are reported to be more quickly obtained and more permanent than those following chemical cauterization, and there is no charring of tissue such as that produced by galvanocautery (19, 39, 84). For any electrosurgical technique, it is imperative to locate the source of the bleeding; and profuse hemorrhage is usually first treated and controlled by packing. The hemorrhagic diatheses, or other predisposing states, will not be considered here, but they must be kept in mind.

The anterior portion of the septum is, of course, the most common source of epistaxis; even vigorous bleeding from this site is usually controlled by the simple measures of sedation, upright position, manual compression or an anterior nasal pack. If bleeding then persists, it is likely to come from a site other than Little's area (Kiesselbach's plexus), requiring either a posterior nasal pack, or the use of the searching suction tip and coagulation as described later. If anterior septal bleeding is temporarily controlled but recurs, the area is briefly packed with cotton containing 1:1000 epinephrine and a suitable topical anesthetic, followed by an effort to permanently seal the bleeding vessel. This

solution serves to shrink the mucosa, slows the bleeding, aids in the localization of the responsible vessel, and provides anesthesia (21, 46).

Little's area may be treated by monoterminal desiccation or by coagulation, but the former is often preferentially used on the septum in order to avoid the risk of perforation. The biterminal current, with the indifferent electrode, may also be used to produce similar effects by fulguration or surface coagulation, with correspondingly lower power settings; but the use of the indifferent elctrode probably has little advantage in such superficial application. Imperatori and Burman (46) recommend the use of fulguration: With a needle electrode held at a one-sixteenth inch distance from the mucosa, a shower of sparks is allowed to play against the area; this coagulates the blood on the surface and obliterates small vessels. The usual power setting for a fine needle will be 20 to 30 with the monoterminal current. A ball-tipped electrode is very commonly used for the same purpose (45). The ball is touched to the bleeding vessel and the current is briefly applied; or the ball electrode is brushed lightly over the mucosal surface, a technique which has an effect very similar to that of fulguration. The current should be turned off while the electrode is introduced or withdrawn, and metal surfaces of electrode and speculum must not come in contact with one another.

Many laryngologists employ a metal suction tube for both diagnostic and therapeutic purposes (21, 27, 31, 42, 56): The small caliber tube is insulated with rubber tubing, leaving about ⅛ inch of exposed metal at the distal tip. When the suction tip contacts the bleeding vessel, a ball-tipped active electrode is touched to the exposed metal at the proximal end of the tube, and the coagulating current is then applied with the footswitch until bleeding ceases. The suction keeps the field dry enough so that visualization is good and coagulation is more quickly effective. If desired, a special cord may be obtained so that the metal suction tube is directly connected to the active terminal of the machine; then it is necessary only to step on the footswitch to obtain coagulation of the bleeding point. For this application of the coagulating current, of course, the indifferent electrode is necessary.

Instrumentation with the suction cannula should be deferred while a temporary nasal pack containing epinephrine and a suitable topical anesthetic is applied. Persistent brisk bleeding in the presence of adequate anterior septal compression is likely to come from the posterior portion of the middle or inferior meati (27, 42, 68). The solution used provides more area for inspection and instrumentation in these areas.

After careful removal of the vasoconstrictor-anesthetic pack, and with good illumination, the nasal cavity is explored with the suction tip. The point of bleeding can usually be found, although this sometimes requires considerable otolaryngologic skill and patience. If the bleeding has temporarily ceased, a small clot in a ruptured vessel may occasionally be seen to protrude from the mucosal surface, and removal or displacement of this will cause recurrence of bleeding (27). After locating the site of hemorrhage, topical anesthesia can again be applied, if necessary, prior to coagulation. After control by coagulation through the suction cannula, it is well to inspect

the surrounding mucosa. Gilmore (21) recommends the coagulation of dilated vessels adjacent to the area which had previously bled.

Nasal Synechiae

Electrocoagulation or desiccation are considered by many to be the methods of choice in the removal of these fibrous bands, since simple cutting or the use of thermocautery are often followed by their prompt reformation (44, 45, 46, 50, 59, 71). After topical anesthesia, a needle electrode and a mild coagulating current are used to destroy the band *in situ*. Multiple punctures with the needle are made until the entire bridge of connective tissue has been coagulated (46); or, just the base of the adhesion on each side is treated (33). The procedure is bloodless and painless, and should cause little or no mucosal reaction. Usually, the coagulated tissue is allowed to remain in place and to slough spontaneously, since the coagulum acts as a barrier to reformation while the two sides are healing (44, 50, 59).

The cutting current is also used to sever synechiae, a procedure which can be performed more quickly and perhaps with a shortened healing period (37). The cutting current will also provide some coagulation of the base, the amount of which is dependent upon the electrode used and the speed of the cut. It is usually advisable, particularly for short bands, to follow excision with the placement of some separating material, in order to prevent reformation of the synechia if the apposing parts of the mucosa should swell. Petrolatum gauze, dental wax, or gutta percha may be inserted and left in place for a few days (37, 46).

Cicatrices in the fossa of "Rosenmuller", which are not infrequent after adenoidectomy; and cicatrices between the soft palate and posterior wall of the nasopharynx, which may occur after exanthematous or syphilitic disease, can also be well treated by coagulation (46).

Coagulation of Lymphoid Tissue

Tonsillectomy by standard dissection with scalpel and scissors is the procedure to be followed whenever possible, since its results in experienced hands are the most effective, reliable, and the most satisfactory to the patient and physician. The removal of large tonsils by electrocoagulation enjoyed considerable popularity two decades ago, but at the same time it was the subject of heated controversy among laryngologists (3, 4, 10, 13, 14, 22, 25, 34, 35, 52, 55, 62, 74-79, 84, 87-90, 93). Enthusiasm for the procedure has largely disappeared, although it is still considered to be a valuable adjunct in a small and highly selected group of adult cases.

In a recent review of the subject, Wahrer (89) gives its present indications as follows: 1) It may be the method of choice in patients who are aged or in very poor physical condition. The advantages here are the facts that the patients remain

ambulatory, eating and sleeping habits are but slightly disturbed, and there is a minimum of pain and bleeding if the method is properly used. 2) A few patients will not consent to standard tonsillectomy or to hospitalization, but will permit ambulatory treatment by electrocoagulation. 3) Tonsil remnants, due to previous incomplete tonsillectomy, are preferentially destroyed by coagulation. The latter procedure will be discussed later.

Coagulation, when properly and safely performed on *large* tonsils, is a fractional procedure requiring repeated applications over many weeks. (Deep coagulation may result in secondary hemorrhage when the slough separates.) It is therefore a tedious and time-consuming affair for the patient and physician, and seldom offers the patient an economic advantage. Partial tonsillectomy ("sterilization") by coagulation, although employed by some, has dubious scientific merit. Tonsillar coagulation should be performed only by a physician experienced in throat surgery.

Technique:

There are only minor variations in the techniques of various laryngologists. The following method of Wahrer (89) is fairly representative, is relatively simple, and is safe in experienced hands:

Three topical applications of 10% cocaine, at five-minute intervals, provide adequate anesthesia. A biactive electrode, containing two curved 3/8 inch needles, is used. (No indifferent electrode is needed. Tongue depressors and pillar retractors are preferably of non-metallic material, such as bakelite or hard rubber.) The needles are inserted into the tonsil to a depth somewhat less than 1/4 inch, and the coagulating current is applied until the surrounding tissue begins to blanch. This should take no more than two or three seconds. The current should be discontinued before the tissue becomes white or swollen. Only three separated areas in one tonsil are thus coagulated, in order to avoid severe or prolonged soreness. Gradual sloughing ensues, which is complete in about ten days. One tonsil is coagulated at one office visit, and the treatments are spaced one week apart. The complete removal of an average pair of tonsils by this method requires at least five or six treatments on each side and is spread over a period of ten or twelve weeks.

Tonsil Tags

The problems of secondary operation are considered to be quite different from primary tonsillectomy. Tags, stumps, remnants, or recurrent lymphoid masses in the tonsillar fossae more often justify electrosurgical removal, since they are small and it is often possible to eradicate such tissue more completely by coagulation than by surgical dissection (9, 11, 34, 38, 45, 69, 89). Fractional treatments are given at the office, with the patient remaining ambulatory and attending to his daily routine. Dissection is preferable for those cases in which the tonsil remnant is large and bound down with scar tissue (89).

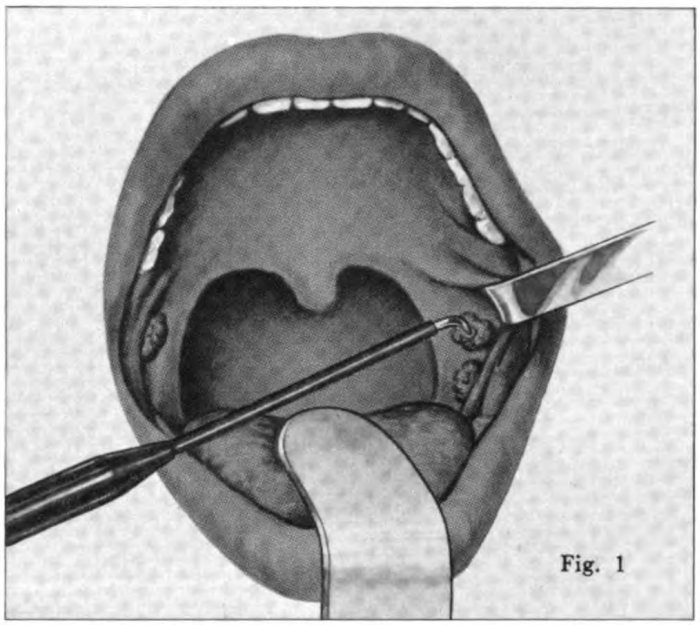


Fig. 1

Coagulation of tonsil tags.

The *biactive tonsil electrode,* consisting of two curved needles set in an insulated handle, is convenient to use for the larger masses. No indifferent electrode is needed. The power setting for this electrode will range between 15 and 25; the deeper the insertion, the more power required. After topical anesthesia has been obtained, the needles are inserted into the lymphoid mass, usually to a depth of only 1/16 to 1/8 inch; and the current is then turned on with the footswitch. Within two or three seconds, an area of blanched coagulum will form between the two needles. At this point the current is turned off and the needle withdrawn.

The *single point tonsil electrode* (insulated, either straight or curved point) may be preferable to use for the smaller lymphoid nodules, since the area of coagulum is smaller; and it may also be used after the greater part of the tissue has been coagulated with the biactive electrode. The indifferent electrode is necessary. The power required for the single point electrode will probably be 20 to 30 on the Bovie, depending on the depth of insertion. The technique is essentially the same as with the biterminal electrode: The needle is inserted into the anesthetized tissue, and the coagulating current is applied until a ring of coagulum of the desired size, usually 2 or 3 mm. in diameter, is seen about the needle. This should occur within two or three seconds. The current is then turned off and the needle withdrawn. It is best to coagulate only a small area with each puncture; use several insertions in preference to leaving the electrode in one position too long.

It is not always advisable to completely eradicate the lympoid tissue in a

single treatment, unless it is localized and relatively small; and it is always preferable to err on the side of undertreatment. Most operators state their preference for conservative or fractional coagulation, in order to avoid severe reaction and discomforting symptoms. The disadvantage of repeated treatment is usually counterbalanced by the increased comfort to the ambulatory patient. Any local tissue reaction should have passed off before a second treatment is given.

Another method of treating small lymphoid nodules is the use of a small *ball-tipped* electrode, with which the indifferent electrode is also required. More superficial coagulation is assured in this manner. With a power setting of approximately 15 to 25 for the small ball, the electrode is made to contact the anesthetized tissue; and the current is applied until the desired area of coagulum is observed. The contacts may be repeated at several points if necessary. Niedelman (62) advises the use of this electrode when there is doubt whether the tissue to be coagulated is muscle or tonsil, since little harm can be produced.

Lingual Tonsils

Otolaryngologists stress the importance of these lymphoid tissues, and post the reminder that their neglect is a result of cursory examination or failure to employ mirror laryngoscopy (12, 16). These nodules may be apparent on routine inspection only when acutely inflamed, edematous, and ulcerated; they should be particularly sought when the pharynx and fauces are but mildly injected in the presence of severe sore throat and fever. Chronic infection of the lingual tonsils may be responsiblle for repeated attacks of sore throat, a persistent dull sore throat, complaints of lumpiness or fullness in the throat, dysphagia, or dry cough (16).

As in the case of the faucial tonsils, huge lingual tonsils are best removed by dissection. Milder enlargements are often removed by coagulation (9, 12, 16, 30, 36, 45, 46, 57). Coagulation is stated to have advantages of relative ease and safety, particularly due to the rather difficult exposure and the brisk hemorrhage often following their removal by dissection or snare (9, 36).

Anesthesia is obtained with topical cocaine solution. Elfman (16) and others also inject 5 cc. of 1 percent procaine into the base of the tongue, just anterior to the lingual tonsil to be treated. The methods of electrosurgical removal are the same as those previously discussed: The most common technique is probably the use of the double-needle (biactive) tonsil electrode, which is inserted to a depth of about 1/16 inch into the tissue. A curved or bent single needle electrode, which requires the use of the indifferent plate, may also be employed. The patient can hold his own tongue with the aid of gauze, and the electrode is directed with a laryngeal mirror. Cracovaner (12) coagulates four or five areas on one side, and repeats the process at weekly intervals on alternate sides until

sufficient tissue has been eliminated. Most other operators also prefer the fractional method. Elfman (16), however, coagulates the entire surface of both lingual tonsils at one sitting.

Other Lymphoid Tissue

Posterior pharyngeal lymphoid tissue, which is usually present in the form of scattered small nodules, is commonly destroyed by surface coagulation in order to relieve irritative symptoms (37, 45, 53, 70, 88). Either a needle or small ball-tipped electrode may be used; it is seldom necessary or advisable to insert a needle within the tissue since only superficial destruction is required.

Hypertrophied adenoids of any size are best treated by the usual surgical methods, but small remnants of scattered lymphoid tissue about the nasopharynx can be adequately removed by electrocoagulation, in the same manner as described for tonsillar remnants (57). This method is of particular value in eradicating lymphoid tissue in the fossa of Rosenmuller and about the Eustachian tubes, which may be responsible for recurrent otitis media (45). The coagulation may be done after retraction of the soft palate, or through a suitable nasopharyngeal speculum.

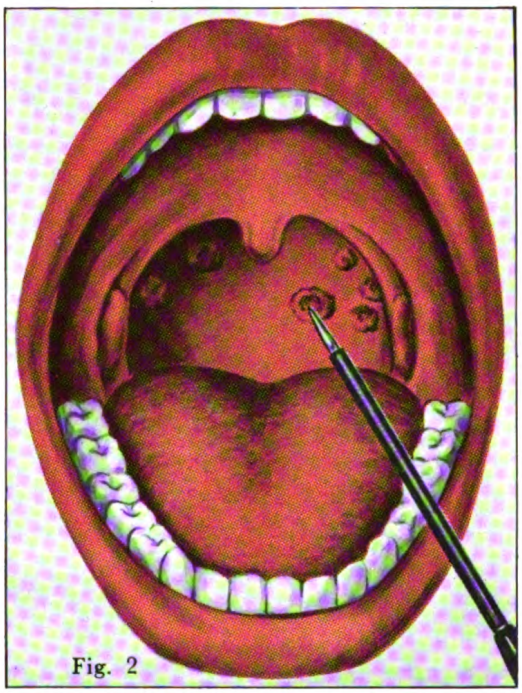


Fig. 2

Above: Electrocoagulation of posterior pharyngeal (lymphoid) nodules. Either the needle or ball electrode may be used.

Abscesses and Cysts

Septal, paratonsillar, and *retropharyngeal* abscesses can be conveniently incised with the cutting current, under topical anesthesia. Either the flat blade or needle electrode may be used, although the needle is usually preferable because of the greater degree of coagulation achieved (57). The power range on the Bovie will probably be 25 to 35 for the coarse (.0275 inch) needle. The operator should remember to have the head in a dependent position for the opening of a retropharyngeal abscess. The dehydration of the wound edges which accompanies the cutting allows a

bloodless incision, prevents premature closure, and facilitates drainage.

Hematomas and *cysts* may be opened similarly (44, 45). Very small cysts of the oral cavity can be eradicated by the mere insertion of a needle electrode; the coagulating current "boils out" the fluid and destroys the cyst lining at the same time. To prevent recurrence of the larger cysts, it is advisable to follow the incision and drainage with the destruction of the lining membrane, using a small ball-tipped electrode and the coagulating current (44, 45).

Uvulotomy

The uvula is anesthetized by painting with a cocaine solution containing a small amount of 1:1000 epinephrine. The indifferent electrode is applied. Traction is made upon the tip of the uvula with an insulated Allys clamp or long curved hemostat. A needle electrode is inserted into the uvula at the predetermined level, and the coagulating current is applied for two or three seconds until blanching occurs. The needle is removed and reinserted at the same level but in a different direction. This is repeated as needed to effect a complete circle of coagulum. The uvula distal to the coagulated zone may then separate, or it may be cut off with a scissors through the dehydrated area. Healing is said to be rapid, with very little reaction (46).

Burman (7) states that less postoperative edema results if the uvula is first clipped off, and merely the raw area coagulated.

An insulated snare, in conjunction with the coagulating current, is used often for bloodless uvulotomy—in the same manner as that described for nasal polyps (60).

Bibliography

1. Adin, L. E. and Singleton, J. D.: Progress in otolaryngology: tonsils and adenoids, Arch. Otolaryng. *59*:360 (March) 1954.
2. Ahmed, N.: Hypertrophied turbinates and polypi as cause of obstruction: treatment with electrocoagulation, Antiseptic *37*:714-720 (Aug.) 1940.
3. Ahmed, N.: Electrosurgery of the tonsils, Abstract, Quart. Rev. Otorhinolaryng. *5*:223-224 (Dec.) 1946.
4. Balmer, F. B.: Refinements in surgery of tonsils including electrosurgery, Illinois M. J. *60*:458-469 (Dec.) 1931.
5. Beck, J. C.: Pathology and intramural electrocoagulation of inferior turbinate, Ann. Otol., Rhin., & Laryng. *39*:349-363 (June) 1930.
6. Bianchi, H. D.: Electrosurgery and prosthesis, Rev. franc. d'ontostomat. *1*:186-191 (Feb.) 1954.
7. Burman, H. J.: Personal communication.
8. Capps, F. C. W.: Discussion on malignant diseases of the nasal cavity and sinuses, Proc. Roy. Soc. Med. *43*:665-671 (Aug.) 1950.
9. Constantinople, P. S.: Electrocoagulation in otolaryngology, M. Ann. District of Columbia *8*:326-327 (Nov.) 1939.
10. Cook, J. A. L.: Diathermy in treatment of diseased tonsils, Practitioner *133*:194-199 (Aug.) 1934.
11. Coulter, J. S.: Physical therapy as applied to the eye, ear, nose and throat, Illinois M. J. *71*:136-139 (Feb.) 1937.
12. Cracovaner, A. J.: Lingual tonsils, Eye, Ear, Nose & Throat Monthly *31*:489-491 (Sept.) 1952.
13. Dillinger, G. A.: Experience gleaned from large series of tonsillectomies by surgical diathermy, M. J. & Rec. *138*:307-311 (Nov. 1) 1933.
14. Doane, L. L.: Further comment on electrocoagulation of tonsils and adenoids, Arch. Phys. Therapy *16*:347-350 (June) 1935.
15. Doane, L. L.: Electrocoagulation of tonsils, M. Rec. *143*:203-206 (March 4) 1936.
16. Elfman, L. K.: Lingual tonsils (a new evaluation), Laryngoscope *59*:1016-1025 (Sept.) 1949.
17. Figi, F. A.: Treatment of angioma of the face, Arch Otolaryng. *24*:271-281 (Sept.) 1936.
18. Figi, F. A.: Hemangiomas of the mouth, Ann. Otol., Rhin. & Laryng. *56*:853-866 (Dec.) 1947.
19. Figi, F. A. and Watkins, C. H.: Hereditary hemorrhagic telangiectasia, Ann. Otol., Rhin. & Laryng. *52*:330-341 (June) 1943.
20. Figi, F. A. and Davis, R. E.: The management of nasopharyngeal fibromas, Laryngoscope *60*:794-814 (Aug.) 1950.
21. Gilmore, M. A.: The control of hemorrhage in otolaryngology, South. Surgeon *13*:403-413 (June) 1947.
22. Ground, W. E.: Tonsillar electrocoagulectomy, M. Rec. *141*:25-28 (Jan. 2) 1935.
23. Gutteridge, E.: Surgical diathermy in the treatment of nasal polyposis, Med. J. Australia *1*:298-299 (Feb. 28) 1953.
24. Haiman, J. A.: End-results of electrocoagulation of tonsils with biactive electrode, Arch. Phys. Therapy *13*:592-594 (Oct.) 1932.
25. Haiman, J. F.: Bi-active electrode in tonsil electrocoagulation, Eye, Ear, Nose, & Throat Monthly *12*:65-66 (March) 1933.
26. Haiman, J. A.: Failure of operative surgery in nasal sinusitis, M. Rec. *143*:198-200 (March 4) 1936.
27. Hallberg, O. F.: Severe nosebleed and its treatment, J. A. M. A. *148*:355-360 (Feb. 2) 1952.
28. Hansel, F. K.: Surgical treatment of nose in allergy, Tr. Am. Laryng., Rhin. & Otol. Soc. *42*:409-419, 1936.
29. Harkins, H. P.: Problems in vasomotor rhinitis ,Arch. Otolaryng. *59*:531-535 (May) 1954.
30. Harris, M. L.: Electrotherapy in otolaryngology, Eye, Ear, Nose & Throat Monthly *22*:103-104 (March) 1943.
31. Harris, H. E.: Nasal hemorrhage, Eye, Ear, Nose & Throat Monthly *26*:81-83 (Feb.) 1947.
32. Havens, F. Z. and Lockhart, H. B.: Angiomas of interest to the otolaryngologist, Ann. Otol., Rhin. & Laryng. *62*:36-50 (March) 1953.
33. Hilgartner, H. L., Jr., and Hilgartner, H. L.: Diathermy in diseases of the eye, ear, nose and throat, South. M. J. *28*:130-132 (Feb.) 1935.
34. Hilgartner, H. L., Jr.: Electrocoagulation of tonsils, Dis. Eye, Ear, Nose & Throat *2*:312-313 (Oct.) 1942.
35. Hollender, A. R.: Electrosurgical tonsillectomy; scientific status in laryngology, Arch Phys. Therapy *13*:789-794 (Dec.) 1932.

Bibliography

36. Hollender, A. R.: Scope of physical therapy in otolaryngology, Arch Phys. Therapy *23*:429-440 (April) 1936.
37. Hollender, A. R.: Physical Therapeutic Methods in Otolaryngology, St. Louis, C. V. Mosby, 1937.
38. Hollender, A. R.: Physical therapeutic procedures in otolaryngology: resume of twenty years' experience, Arch. Phys. Therapy *24*:88-92 (Feb.) 1943.
39. Hollender, A. R.: Office Treatment of Nose, Throat, and Ear, Chicago, The Year Book Publishers, 1943.
40. Hoover, W. B.: Lymphoid tissue of the pharynx, S. Clin. North America *31*:918 (June) 1951.
41. Huet, P. C. and Villedrouin, J.: Electrocoagulation in treatment of tumors of the oropharynx, Sem. hop. Paris *29*:2244-2249 (July 2) 1953.
42. Hunnicutt, L. G.: Hemorrhage in ear, nose and throat, Laryngoscope *60*:551-556 (June) 1950.
43. Hurd, L. M.: Bipolar electrode for electrocoagulation of inferior turbinate, Arch. Otolaryng. *13*:442 (March) 1931.
44. Hurd, L. M.: Diathermy: surgical and medical in otolaryngology, Laryngoscope *43*:730-739 (Sept.) 1933.
45. Hurd, L. M.: Critical analysis of methods of physical therapy in rhinolaryngology, Laryngoscope *45*:468-470 (June) 1935.
46. Imperatori, C. J. and Burman, H. J.: Diseases of the Nose and Throat, Philadelphia, J. B. Lippincott, 1947, Chap. 48.
47. Jaros, J F.: Electrocoagulation of turbinates, Arch. Phys. Therapy *14*:533-535 (Sept.) 1933.
48. Jaros, J. F.: Tonsillextirpy (Electrocoagulation), Arch. Phys. Therapy *17*:346-351 (June) 1936.
49. Kelly, H. A. and Ward, G. E.: Electrosurgery, Philadelphia, W. B. Saunders, 1932, Chap. 7.
50. Kovacs, R.: Electrotherapy and Light Therapy, Philadelphia, Lea and Febiger, 1938.
51. Lederer, F. L.: Diseases of the Ear, Nose and Throat, Philadelphia, F. A. Davis, 1942.
52. Malone, P. W.: Electrosurgical technique under local anesthesia, Arch. Otolaryng. *21*:93-94 (Jan.) 1935.
53. Marcotte, R. H.: Chronic granular pharyngitis, Ann. Otol., Rhin. & Laryng. *51*:406-413 (June) 1942.
54. McFee, W. D.: Modern treatment of accessible growths, Phys. Therapy *48*:529-535 (Nov.) 1930.
55. Meyers, J. L.: Present status of electrosurgical methods, Tr. Sect. Laryng., Otol., and Rhin., A. M. A., pp.123-129, 1932.
56. Moore, P. M.: The control of hemorrhage in otolaryngology, Cleveland Clin. Quart. *13*:153-163 (July) 1946.
57. Morrison, W. W.: Uses of medical and surgical diathermy in otolaryngology, Arch. Phys. Therapy *14*:230-236 (April) 1933.
58. Morrison, W. W.: Diseases of the Nose, Throat and Ear, Philadelphia, W. B. Saunders, 1938.
59. Morrison, W. W.: Modern physical therapy in otolaryngologic conditions for the general practitioner, Arch. Phys. Therapy *22*:457-461 (Aug.) 1941.
60. Morrison, W. W.: Personal communication.
61. New, G. B. and Erich, J. B.: Tumors of the Nose and Accessory Sinuses, in Jackson, C. and Jackson, C. L., Diseases of the Nose, Throat and Ear, Philadelphia, W. B. Saunders, 1945, pp. 72-81.
62. Niedelman, M. L.: Electrocoagulation of tonsils, Ann. Otol., Rhin., & Laryng. *48*:227-235 (March) 1939.
63. Portman, G. and Moreau, N.: La diathermie et ses applications oto-rhino-laryngologiques, Acta oto-laryng. *7*:471, 1924.
64. Quevedo, J.: Cavernous hemangioma of the pharynx, Ann. Otol., Rhin., & Laryng. *51*:785-790 (Sept.) 1942.
65. Rice, G. B.: Diathermy in otolaryngology, Eye, Ear, Nose & Throat Monthly *10*:241-244 (July) 1931.
66. Rice, G. B.: A consideration of some forms of physical therapy in otolaryngology, Arch. Phys. Therapy *12*:668-670 (Nov.) 1931.
67. Richardson, J. R.: Turbinate treatment in vasomotor rhinitis, Laryngoscope *58*:834-847 (Aug.) 1948.
68. Richardson, J. R.: Personal communication.
69. Savitt, L.: Survey of present status of electrocoagulation, Illinois M. J. *69*:127-130 (Feb.) 1936.

Bibliography

70. Schenck, H. P.: Chronic infections in the pharynx, Pennsylvania M. J. *41*:578-581 (April) 1938.
71. Schmidt, W. H.: Physical therapy in otolaryngology, Pennsylvania M. J. *42*:1330-1334 (Aug.) 1939.
72. Shahinian, L.: Chronic vasomotor rhinitis: treatment by submucous diathermic coagulation, Arch. Otolaryng. *57*:475-489 (May) 1953.
73. Shahinian, L.: Personal communciation.
74. Silvers, L. J. G.: Immunologic aspect of electrocoagulation in rhinolaryngology, Arch. Otolaryng. *21*:527-535 (May) 1935.
75. Silvers, L. J. G.: Control of pain in electrosurgical tonsillectomy, Arch. Phys. Therapy *16*:671-673 (Nov.) 1935.
76. Silvers, L. J. G.: Physical therapy as a solution to problems of otolaryngology, M. Rec. *144*:234-236 (Sept. 2) 1936.
77. Silvers, L. J. G.: Electrosurgical tonsillectomy, New York State J. Med. *37*:952-954 (May 15) 1937.
78. Silvers, L. J.: Physical therapy, in the field of otolaryngology, M. Rec. *152*:427-431 (Dec. 18) 1940.
79. Silvers, L. J.: Physical therapy in otolaryngology: a digest of recent developments, Dis. Eye, Ear, Nose & Throat *1*:360-364 (Dec.) 1941.
80. Sinskey, H. L.: Turbinate shrinkage by high frequency, Eye, Ear, Nose & Throat Monthly *11*:268, 1932.
81. Sinskey, H. L.: Eradication of polypi by high frequency current, Eye, Ear, Nose & Throat Monthly *14*:160-162 (June) 1935.
82. Spencer, F. R., in discussion of Goodyear, H. N.: The etiology and treatment of hemorrhage of the nose and throat, J. A. M. A. *107*:341 (Aug. 1) 1936.
83. Sponsler, M. B.: Some practical points in the use of electrosurgical measures in the upper respiratory tract, Ann. Otol., Rhin., & Laryng. *39*:743-752 (Sept.) 1930.
84. Sullivan, J. J., Jr.: Electrocoagulation: use and abuse in nose and throat surgery, Pennsylvania M. J. *36*:768-773 (July) 1933.
85. Tyler, J. E.: The place of electrocoagulation in laryngology, Clin. Med. & Surg. *42*:128, 1935.
86. Waddington, J. E. G.: Office electrosurgery, Am. J. Phys. Therapy *9*:100-102 (July) 1932.
87. Wahrer, F. L.: Physical measures in diseases of the eye, ear, nose and throat, Arch. Phys. Therapy *12*:111-114 (Feb.) 1931.
88. Wahrer, F. L.: Electrosurgery and the tonsil problem, Arch. Phys. Therapy *15*:605-607 (Oct.) 1934.
89. Wahrer, F. L.: Electrocoagulation of tonsils, J. Internat. Coll. Surg. *17*:224-226 (Feb.) 1952.
90. Wahrer, F. L., cited by Adin, L. E. and Singleton, J. D. (1).
91. Wahrer, F. L.: Personal communication.
92. Wolf, H. F.: The Practice of Physical Medicine, New York, Wilcox and Follett, 1947, Chap. 8.
93. Zerzan, G. F.: Electrocoagulation of tonsils, Arch. Phys. Therapy *16*:345-346 (June) 1935.

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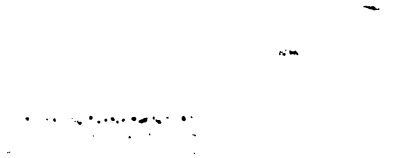

Fundamentals and Techniques of Minor Electrosurgery

A Review of the Literature with Bibliography