

the most part absorbed, and the crowns have become loose. While the above rule should be adhered to as far as possible, yet there are cases in which severe inflammation connected with the temporary teeth requires their premature extraction.

The Process of Extraction.—The process may be divided into three stages.

1. Seizing the tooth with the forceps.
2. Loosening its connection with its surroundings.
3. Removing the tooth from its socket.

The process of extraction and the instruments employed vary greatly with the different teeth in the mouth. A knowledge of the number, shape, and size of the roots of the teeth is necessary to insure success in their removal. To extract the teeth of the upper jaw, the patient should be placed with the head thrown well back, and the operator should stand at the patient's right side. With the left hand the lips and cheeks should be retracted and the upper jaw firmly grasped.

The upper central incisors are extracted with a forceps whose beaks are made to adapt themselves to the nearly conical neck of this tooth. The forceps should be applied with one beak at the labial surface of the neck of the tooth, and the other at the lingual surface. The beak of the forceps should be carried well up between the margin of the gum and the root of the tooth. When the tooth has been thus grasped, it should be gently but firmly rotated, in order to loosen it from its socket. A forward-and-back motion may with advantage be combined with the rotatory motion. When the tooth is felt to have been loosened, it should be removed by a steady pull in the direction of its long axis.

The superior lateral incisors are extracted in a manner similar to that of the central incisors, and with the same forceps. Inasmuch as their roots are somewhat compressed laterally, the rotatory motion is not so important as with the central incisors.

The superior canines are quite difficult to extract, owing to their very long roots. The upper incisor forceps are usually employed for the canines. The tooth should be grasped as high up on the root as possible. To loosen the tooth from its socket the rotatory motion must be combined with the forward-and-back motion. When loose, a straight pull in the line of its long axis is necessary for its removal. It must be borne in mind that the root of the canine is decidedly flattened on its sides, and therefore offers considerable resistance to rotation.

The upper bicuspid may be extracted with the upper incisor forceps; or they may be conveniently extracted with the alveolar bayonet-shaped forceps. The upper bicuspid should be grasped well up on the root and loosened by a side-to-side motion. Their roots being long and slender, great care is required to prevent their fracture. If the first upper bicuspid has a bifurcated root, it is often impossible to remove the tooth without breaking off the tip of one of the roots.

The first and second upper molars are extracted by a forceps whose inner beak is fashioned with a single concavity, it is thus fitted to embrace the inner buccal root of the first or second upper molar. The outer beak is divided by a longitudinal ridge into two concavities, while the tip of the beak is pointed in the middle. It is so made in order to embrace the two buccal roots of the first and second upper molars, and to conform to the depression between these roots. These forceps should be grasped in the palm of the hand, the thumb being brought into position between the angle formed by the two handles and the joint. The third and fourth fingers should be closed over the curve of the left handle. Owing to the divergence of the three roots of the upper first and second molars, considerable loosening is necessary before they can be extracted. This is effected by a side-to-side motion; as the outer alveolar plate is thinner than the inner, the main force should be applied in an outward direction. When the tooth is thoroughly loose in its socket, it can be removed by a downward and outward motion.

Upper wisdom teeth are not usually difficult to extract, as their roots are commonly fused together. In order to loosen them they should be turned firmly outward. By this movement their attachment to the socket can be readily broken up and the tooth removed.

In case the crowns of the upper teeth are badly decayed or entirely lost, the alveolar or root forceps should be used. With this instrument any root of the upper jaw can be extracted; the rules for the extraction of roots being substantially the same as those for teeth with crowns. It is necessary, however, to carry the blades farther up into the alveolus than when the crown is present. Great care should be taken not to crush the root by too firm a grasp. With the first and second upper molars it often happens that the three roots must be extracted separately.

In extracting the inferior teeth the patient should be situated much lower down than for extracting the superior teeth. The operator should stand at the patient's right side, oftentimes well to the back. The lower jaw should be grasped by the left hand, and supported from beneath by the palm and last three fingers, while the thumb and forefinger are placed within the mouth to retract the lips and tongue from the tooth to be operated on. The lower incisors, owing to the lateral compression of their roots, cannot be rotated in the process of loosening them. This must be accomplished by a forward-and-back movement.

The lower canines, owing to their very long roots, are often quite difficult to extract. They are to be loosened by a forward-and-back movement, to which a slight rotary motion may be added. When loose, they are removed by being pulled straight up from the socket.

The lower bicuspid should be grasped well down upon the root and loosened by an in-and-out motion. The alveolar plate being much thinner on the outer than on the inner side, it will yield more readily outward. When loosened, the lower bicuspid is removed by being pulled straight up from the socket.

The lower molars are extracted by a forceps whose beaks are divided by a median ridge, and are terminated by a pointed tip; it is thus able to embrace the two roots of the lower molars, and to engage the depression between them. To extract the lower first and second molar teeth, they should be rocked from within outward till loose, using more force when turning them outward than in the opposite direction. When loose, they may be removed by an upward-and-outward pull. The lower third molar often gives great difficulty in extraction, owing to the curve of its roots, which hook backward toward the ramus of the jaw. It must be loosened by a side-to-side rocking. Owing to the backward curve of its roots it cannot be lifted from its socket by a force exerted directly upward.

Elevators are often useful; they are straight and curved levers, with which a tooth is pried out of its socket, a neighboring tooth being used as a fulcrum.

The extraction of the temporary teeth is performed after the same manner as that of the permanent teeth. The operation is, however, much simpler, especially if performed at a time when the teeth are about to be shed by nature. In the premature extraction of the temporary molars there is always the possibility of bringing away the crown of the developing bicuspid, which is located between the roots of the molar tooth. Diminutive forceps are made for the temporary teeth, but temporary teeth can be readily extracted by the root forceps made for the permanent teeth.

ACCIDENTS OF EXTRACTION.—In the extraction of the teeth certain accidents may occur; they may be unavoidable or due to unskillfulness or carelessness. The following are the more common:

Fracture of the Tooth.—This often happens, and is due usually to an excess of force, or to misdirected force, or to an insufficient grip upon the tooth. Cases occur, however, in which fracture of the tooth is unavoidable; this is especially the case when the roots are misshapen and locked into the jawbone. When the tips of roots are, as

the result of fracture, left in the maxillary bones, it is not always wise to remove them. Nature will usually expel them in due time.

Fracture of the Alveolus.—This occurs, to a limited extent, in every tooth extraction, and produces, as a rule, no troublesome symptoms. By unskillfulness, however, a large portion of the alveolus surrounding a tooth may be crushed or fractured, and necrosis sometimes ensues.

Fracture of the jaw may result from tooth extraction. The fracture may be in the upper jaw, or in the body of the lower jaw. It may or may not imply fault on the part of the operator.

Dislocation of the Lower Jaw.—This usually happens with people whose jaws are loosely hung, and are in the habit of slipping out of the socket. If this tendency is known to exist, it is well to apply a roller bandage over the head and under the jaw before operating.

Removal of the Wrong Tooth.—This accident happens, as a rule, only to inexperienced or careless operators.

Removal of Two or More Teeth Instead of One.—This may happen from a hypertrophy of the cement uniting adjoining roots below the gum. It may happen when the tooth to be extracted is overlapped by an adjoining tooth. It may happen also by the slipping of an extracting instrument, whereby a loose tooth is knocked out.

Laceration of the Mucous Membrane of the Gum.—This occurs to a limited extent in every extraction, but, through carelessness or unskillfulness, may be very extensive.

Falling of the Tooth into the Esophagus or Air Passages.—A tooth will sometimes escape from the grasp of the forceps and be swallowed. From this accident no serious results are to be expected. Cases are now and then reported in which a tooth falls into the larynx. This constitutes the most serious accident that can attend extraction. Such a tooth may be coughed up from the larynx, or it may enter the bronchial tubes, causing symptoms which are always serious and often fatal.

The inferior dental nerve has been crushed in the extraction of the lower wisdom teeth. In such cases a loss of sensation has occurred in the lower part of the face. Usually this passes away, though it may be permanent. In attempting to extract the roots of the upper bicuspid and molars they have been pushed into the antrum. When this happens, the opening into the antrum should be enlarged and the roots removed.

Hemorrhage after Extraction.—This is usually moderate in amount and of short duration. Such cases require no treatment. There are cases, however, in which the hemorrhage is so prolonged as to produce alarming symptoms, and in rare instances death has resulted. Great care should be taken in dealing with people having the hemorrhagic diathesis. To control hemorrhage after extraction the most successful method is to apply pressure to the bleeding parts. The bleeding usually takes place from the socket of the extracted tooth. The socket should be packed with cotton, lint, sponge, or any soft unirritating material. After packing the socket a compress of soft material, covering the socket and surrounding parts, should be superadded. Upon this compress a gentle pressure should be maintained, either by the fingers or by the opposing jaw. An effective method of applying pressure after the socket has once been plugged is to soften a piece of gutta-percha in hot water and mould it to the affected region. Enough gutta-percha should be used so that the opposing teeth or alveolus can be embedded in it by the closing of the jaws. Let the jaws be closed and a roller bandage passed over the head and under the chin, and firm and constant pressure is secured upon the bleeding area.

In severe cases care should be taken to keep the head upright and the extremities artificially warmed.

As styptics can be mentioned perchloride of iron, tannic acid, and preparations of the suprarenal capsule. Of these, perchloride of iron is the least valuable. Tannic acid is a reliable agent; the powder may be applied to the socket on a pledget of cotton. Preparations of the suprarenal capsule are especially valuable in arrest-

ing dental hemorrhage. Styptics can be used with advantage in connection with the use of pressure, as described above. Very severe cases of hemorrhage have been controlled by the use of the actual cautery. If this be used, it should not touch the parts, but be held just near enough to bake them. If the cautery touches the tissues, a fresh laceration is made by its removal.

In desperate cases of hemorrhage internal remedies are usually resorted to. They consist of tannic acid, gallic acid, and ergot.

General Considerations.—Haste in extracting should be avoided; the hand should never move faster than the eye can follow. The tooth should be under complete observation from the time it is grasped by the forceps till it is out of the mouth. The head of the patient should be firmly fixed, and under the control of the left hand or arm.

While considerable force is necessary to extract a tooth, the force should be so guarded and moderated as not to endanger surrounding parts. No jerks or sudden pulls are allowable.

The forceps should never grasp the crowns of teeth alone, as the crown will usually break off, leaving the root undisturbed, but should engage the tooth at its neck, or a little higher up if possible.

In extracting roots the beaks of the forceps should follow down between the root and its alveolus till a firm hold is obtained.

The cutting through of gum and alveolus with a root forceps is not a desirable procedure, but is allowable in certain cases.

An excellent substitute for a dental chair is a rocking-chair with medium high back, a pillow thrown over the back forming a good head-rest.

William Henry Potter.

TELANGIECTASIS; TELANGIOMA. See *Angioma*.

TELLURATES.—The tellurate of potassium and the tellurate of sodium are recommended as remedies for the profuse sweatings due to phthisis and other causes. They are given in doses of one-third to one-half grain daily. In some cases this quantity requires to be increased, but generally the second or third dose is followed by a cessation of the sweating. It is supposed to produce its effect by an inhibitory action on the nerves of the sweat glands. In some cases it causes a loss of appetite and nausea, and in some advanced cases the sodium salt has produced a profuse liquid diarrhoea which is very difficult to check. The most serious obstacle to its general use is the persistent garlicky smell which it communicates to the breath and to the perspiration.

Beaumont Small.

TENDON REFLEX. See *Knee-jerk*, and *Reflexes, Clinical*.

TENDONS AND THEIR SHEATHS, INJURIES AND DISEASES OF.—It is most unusual to find tendons diseased independently. Morbid conditions of the tendons are so commonly the result of disease in their sheaths that in most systematic treatises they are not separately described. Owing to their dense fibrous structure and an intrinsic blood supply that is far from abundant, they lend themselves more easily to disturbances of nutrition than to invasion by infectious processes. Arcoleo has shown experimentally (*Gaz. degli ospedali*, 1898, No. 151) that the intactness of the sheath is necessary for the perfect nutrition of the contained tendon; but, on the other hand, that the complete removal of the sheath is not followed by necrosis of the tendon.

The most frequently observed morbid conditions of tendons themselves have been in cases of the so-called "snapping finger" (*schnellender Finger, doigt à ressort*). This consists of a sudden interference with the movements of extension and flexion, or of either alone. It occurs always at the same period of the movement, and is overcome with a peculiar snap, either as a result of

great muscular exertion or with the assistance of the other hand. In some instances its nature has remained obscure, but operations for its relief have disclosed a nodular thickening of the tendon in quite a number of instances. It is, under these circumstances, probably most often of traumatic origin, but has on rare occasions been ascribed to tuberculosis, syphilis, and neoplasms. Operative removal has been almost invariably successful in its treatment; this may at times be accomplished without completely severing the tendon.

With this exception, disease of tendons will almost invariably be found coincident with or consecutive to primary disease of the sheaths. Malignant growths, tuberculosis of articular origin, and acute suppurative processes frequently involve the tendon sheaths in their extension. These do not require separate description in this place.

In consequence of overexertion or traumatism, there is sometimes observed in the extensor tendons of the hand (less often in the leg) an acute, dry inflammation of the sheaths, *tenosynovitis acuta sicca*. It is apt to occur in persons whose occupations necessitate excessive use of a particular muscle or group of muscles, and especially if there is superadded to the accustomed amount a period of forced labor carried beyond the point of fatigue. The disease has been observed with a certain frequency in washerwomen, pianists, fencers, carpenters, and gymnasts, being in them localized at the wrist. At the ankle it occurs frequently in porters, and infantrymen, and still more often in women operating sewing machines. The prolonged use of the hand trephine has occasionally accounted for its appearance in the surgeon's wrist. A fibrinous exudate upon the surface of the tendon and its sheath gives rise to a rubbing or creaking sensation to the examining hand, whence the name "tenalgia crepitans." It has in some instances also been considered as the result of gonorrhoea or syphilis. Under these conditions, but also in their absence, a serous effusion may appear. When it does so, the crepitation is masked by it to an extent proportionate to the amount of fluid which has been poured into the sheath. Considerable pain and disability may be associated with it. It may be made to subside promptly by fixation of the part by splints, or, still better, by a plaster-of-Paris dressing, this to be followed in from ten to fourteen days by a course of massage and superheated air.

Acute suppuration of the tendon sheaths occurs most frequently in consequence of infected wounds, but may result by extension from phlegmonous processes without demonstrable traumatic origin. It is of especial frequency in connection with wounds of the fingers, when it is spoken of as thecal whitlow. We have here to deal with a most painful septic condition; redness, swelling, intense pain, and throbbing are present. The constitutional symptoms are, or may rapidly become, alarming, and unless incision of ample length is promptly made the tendon will be completely lost by slough; this being escaped, adhesion between the tendon and its sheath occurs, so that its function may be completely abrogated. Prompt and free incision with thorough drainage and preferably moist antiseptic dressing (1 to 5,000 sublimate), to be followed by elevation of the affected part, may be depended upon to avert these unfortunate terminations in the greater number of cases. For this reason such temporizing measures as poulticing, the application of cold, and incisions of very limited extent are to be avoided.

Chronic simple inflammation of the tendon sheaths may be considered as occurring very infrequently. To such an extent is this true that all chronic disease of tendon sheaths is ascribed by some writers to tuberculosis. It has been shown, however, that this is not justifiable, but that *chronic simple tenosynovitis* may occur as a dry, serous, or hemorrhagic inflammation. The dry form is characterized, like its congener of the acute variety, by crepitation upon movement of the tendon in its sheath. Gout and continuous overexertion have been held responsible for it. The serous variety has doubtless been looked upon as tuberculous by many, but is sometimes the result of trauma, rheumatism, or gonorrhoea. Blake

has reported a case (*Annals of Surg.*, xxxiv., p. 577) in which operation and subsequent careful microscopic examination showed its non-tuberculous character beyond question. According to Lejars, it is most frequently due to repeated traumatism, and must sometimes be regarded as a disease of occupation. It presents itself as a fluctuating swelling in the course of the affected tendon, the movement of which is usually interfered with or is productive of discomfort. It is frequently difficult to distinguish it from tuberculous hygroma (see below) without exploratory incision. Aseptic incision is, however, the treatment most likely to be successful. The hemorrhagic variety has, in the few reported cases, been the sequel of trauma. Juvara has reported three cases of such effusion into the sheaths of the radial extensors (*Rev. de Chir.*, June 10th, 1902). There was present an almond-shaped, fluctuating tumor which could be made to slip about by pressure. There was no crepitus to be obtained.

Tuberculosis of the tendon sheaths is by all means the most frequent of the chronic conditions affecting these structures. It is, however, less often primary than secondary. In this latter case it usually occurs by extension from a bone- or joint-focus. This is frequently observed at the wrist and ankle. As a primary condition it is, however, far from rare, and is frequently found in individuals showing no other predisposition to tuberculous infection. For this reason, and because its course may be extremely chronic and unaccompanied by great disability, its real nature is often not appreciated, and is considered rheumatic.

Three forms are usually described, but should not be considered as pathologically distinct, as they are frequently found in combination. The first form may be described as the *tuberculous hygroma*. This presents itself clinically as an effusion of serous character, found most often at the wrist and hand, where, being constricted by the annular ligament, it is also known as compound ganglion. In its symptoms it does not differ materially from simple serous chronic tenosynovitis. Its progress usually is quite slow, and it may be objectionable to the patient solely on account of the deformity which it causes. Upon incision there is found in addition to the serous exudate a formation of miliary tubercles upon the lining of the sheath. If in addition we find the so-called "rice bodies," we are dealing with the second form. These may vary greatly in size and number. Usually this is in inverse proportion. These bodies derive their name from their resemblance in size and color to grains of boiled rice. They are frequently smaller, however, and, on the other hand, the writer has removed from the palmar sheaths a number of the size of large cherries. For this reason they were easily palpated before incision was made. This is, however, not usually possible, for the reason that abundant serous distention is often present, and because such large size is exceptional. There is commonly imparted to the examining hand a characteristic sensation akin to crepitation, but to be distinguished from it. The fluid may be sufficient to make these bodies impossible of recognition without incision.

The formation of *fungous granulation tissue* upon the serous lining of the sheath and even upon the tendon itself is the distinguishing mark of the third variety. This tuberculous tissue is identical with that found in "joint fungus," and gives rise to doughy, elastic swellings of the sheaths. It is distinctly less benign than the preceding forms, inasmuch as the tubercles are actively disintegrating. The peritendinous structures are, therefore, soon involved; caseation, liquefaction, and the formation of fistulae are apt to be observed in rather rapid development. Secondary involvement of neighboring joints may occur. This variety, in contrast with the other two forms, causes marked disability from the first, and is frequently very painful. If the disease is allowed to progress, the contiguous structures may suffer to a great extent; the swelling becomes very great, and amputation may become necessary as a last resort. On the

other hand, if employed before such extensive spread has occurred, radical operative measures are almost invariably successful if sufficiently thorough. Treatment by

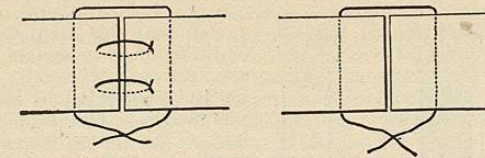


FIG. 4632. FIG. 4633. Suture of Divided Tendons.

iodoform injections has not proved satisfactory in this country, although much lauded by some European authors. In the hygromatous form, evacuation of the rice bodies and fluid with scraping of the sheath is, as a rule, all that is required. In the fungous form it is best to remove all infected tissue, and, therefore, to practise the complete extirpation of the tendon sheath. This is usually followed by complete restoration of function if aseptic healing is obtained.

Beck (*N. Y. Med. Journ.*, p. 705, 1901) has described a chronic inflammation of the tendons and tendon sheaths of the hand characterized by the formation of granulation tissue and chalky deposits; he has named this *tendovaginitis proliferata calcarea*.

INJURIES OF TENDONS.—*Dislocation of tendons* occurs as a rather uncommon accident, and in most of the reported cases the peroneal tendons were concerned. After a traumatism to the foot, usually of the kind spoken of as sprain, great disability of the foot is observed, and the tendon of the peroneus longus, with or without that of the brevis also, is found to have slipped from the groove behind the external malleolus, and may be felt as a prominence in front of it. The replacement by manual pressure and retention by means of a crescentic pad and adhesive strips are easily accomplished. In most of the reported cases, however, recurrence of the luxation has occurred, and on this account operations of narrowing the sheaths or deepening the bony groove have been successfully done. Shaffer (*Fitzhugh, Trans. Am. Orthop. Assn.*, 1902) holds the accident to be due to a shortened condition of the gastrocnemius and peroneal tendons. In three cases cure was obtained by stretching these by means of his traction shoe.

Dislocation of the long head of the biceps has been described in a few cases, but on anatomical and experimental grounds there is cause for doubting the possibility of this.

Subcutaneous rupture of tendons occurs rather frequently and may be due to unusually violent muscular action. In some cases it would appear that a pathological condition of the tendon or the neighboring structures was to blame. The rupture usually occurs near the union with the muscle belly or at the bony attachment of the tendon. It is ordinarily felt as a sudden snap with disability, due to loss of function of the affected muscle. Often the gap in the course of the tendon can be felt, and the muscle itself is more prominent than usual on account of its contraction. Although fixation of the limb in such a position as will tend to approximate the torn ends often secures satisfactory healing, it is not wise to depend upon this in the case of important muscles, but rather to approximate and suture the ends through an incision. The tendons most frequently torn are those of the biceps brachii, the plantaris (tennis leg), quadriceps extensor, ligamentum patellae, and tendo Achillis.

Open wounds of tendons occur very frequently, and especially about the wrist and hand. They may be incised or lacerated. When incompletely divided, union will occur without injury to function. When completely divided, retraction of the muscular end takes place; the ends become adherent to the sheath, and union between them does not occur. Exception to this must

be taken in the case of certain operative wounds, such as tenotomy of the tendo Achillis and other tendons of the foot.

Division of the tendons calls for the approximation and union of the ends, and is especially important in the hand, where the usefulness of the member may depend upon it. The muscular end is often difficult to find, and may necessitate considerable enlargement of the wound to make such union possible. Centrifugal wrapping of the extremity with an elastic rubber bandage will occasionally bring the proximal end to view, thus avoiding the necessity of extensive incision. Suture should be done with silk or catgut (chromicized). The sheath may often be sewed over the tendon. As the sutures tend to tear out, one of the methods illustrated here may be employed to prevent this (Figs. 4632 and 4633).

When secondary suture must be done, *i. e.*, after the external wound has healed, it may be extremely difficult or even not feasible to find the proximal end. In this case tendon transplantation has been done (*vide infra*). The proximal end having been found, it may be impossible to approximate it to the distal sufficiently to make ordinary suture practicable. In this event tendon lengthening may be done by splitting the distal end, as shown in Fig. 4634, or a bridge of silk or silkworm gut may be made, uniting the ends and serving as a framework upon which new tissue is afterward formed. Silk will usually be found preferable for this purpose.

Operations on Tendons.—In addition to those above described, operations on tendons are done for a variety



FIG. 4634.—Lengthening of Divided Tendon.

of conditions. The most frequent of these by far is tenotomy, simple division of a tendon. This may be open or subcutaneous. The open operation consists in making an incision parallel with the tendon; the tendon is then divided upon a grooved director in the open wound. The method is one of choice when it is necessary to avoid important structures (*e. g.*, the peroneal nerve in division of the biceps femoris), or where the anatomical situation makes complete division of tendons or muscles not feasible by the subcutaneous method. The muscular variety of wryneck may serve as an example of this; likewise the adductors of the thigh in cases of spastic infantile paralysis. Otherwise, on account of its simplicity and the ease and certainty of the healing process, the subcutaneous method will be chosen. It may be done from within outward or from without inward. The former is the method of choice. The tenotome is a knife with a short blade (1.5 to 2.5 cm.) at the extremity of a long shank (2 to 2.5 cm.), and may be pointed or blunt. The length of the blade should equal the width of the tendon to be cut. An assistant holding the part so as to put the tendon on the stretch, the operator feels for the edge of the tendon and inserts the tenotome behind this with the flat of the blade parallel to the tendon. The tenotome is then pushed through until its point is felt on the opposite side. The edge is then turned toward the tendon, and the

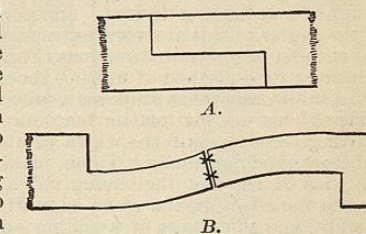


FIG. 4635.—Lengthening of Tendon. (Plastic tenotomy.) A, Incision to be employed in dividing the tendon; B, mode of suturing the divided ends.

The edge is then turned toward the tendon, and the