

as soon as conservative surgical treatment fails to cure. 2. In ankylosis following acute rheumatic arthritis and acute traumatic arthritis with suppuration, resection is indicated in some instances.

For tumors involving the bones of the joint. A few (four) instances exist in which a part of the humerus has been removed for sarcomatous growths involving the joint.

Anatomy.—The anatomy of the shoulder joint is very simple. All the bony prominences in its vicinity can be easily felt. The groove between the pectoralis major and the deltoid, in which lie the cephalic vein and the acromiothoracic artery, are easily made out. The circumflex nerve and the posterior circumflex artery cross the humerus in a horizontal line one finger's breadth below the centre of a line drawn from the acromion to the deltoid insertion. These two structures usually pass just below the capsular attachment upon the internal surface of the anatomical neck, which point is opposite the so-called surgical neck of the humerus—the point above mentioned. The upper epiphysis becomes united to the shaft at twenty years. The deltoid muscle is so situated that the only place where it can be divided without injuring a portion of the nerve supply is close to the margin of the acromion process and of the spine of the scapula. This method of incision, recommended formerly by Nélaton, Neudörfer, Perrin, and Gurtl, avoids injury to the circumflex nerve and at the same time permits union of the muscle to the bones without atrophy of the muscular bundles. As a result, the humeral end is held in contact with the glenoid cavity or the border of the scapula in a firmer and stronger manner than can be obtained when atrophy of muscular fibres follows operation.

This method of entering the joint is not convenient for observation of all parts of the articulation, especially of the anterior portion. Another method of entering the joint is by means of incisions which traverse the deltoid muscle anteriorly. There are two of these incisions. One (Baudens, Maligne, and Langenbeck, "Esmarch's Handbuch" and *Archiv für klin. Chir.*, xvi.) divides the anterior fibres of the deltoid muscle and necessarily paralyzes the anterior fibres of this muscle. Its field of observation and manipulation is a direct and extensive one. The other anterior incision (Ollier, "Traité des Résections") passes nearer the interval between the pectoralis major and the deltoid muscles, paralyzes less of the deltoid muscle, and gives an operative field quite as good as that obtained by the Langenbeck incision. The posterior incision is anatomically the better one, but incisions must be made to expose diseased areas and to render possible a full inspection of other portions of a joint than those thought to be alone involved. For this reason incisions which traverse the anterior portion of the deltoid muscle have been selected by most surgeons as the best.

We will describe two methods of operation, one by the anterior incision, the other by the posterior incision. Both methods should be performed subperiosteally if possible, since the partial reproduction of bone greatly aids the function of the joint by giving a more perfect fulcrum for the muscles of the shoulder (von Langenbeck, *Archiv für klin. Chir.*, 1874, xvi., and Ollier, "Traité des Résections," t. i. and ii.).

Operation by the Anterior Incision.—The patient is placed upon the back with the elbow slightly raised from the side and the hand resting upon the iliac spine of the same side. An incision is begun at the outer extremity of the coracoid process, and descends over the deltoid muscle parallel to its fibres (i.e., slightly outward) for a distance of from 6 to 10 cm. (Ollier, *loc. cit.*; Hueter, "Gelenkskrankheiten," vol. ii., 587). The muscle is exposed in

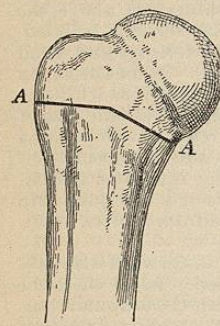


FIG. 4053.

this incision. The muscle is incised parallel to its fibres, and the capsule, the humerus, and the coraco-acromial ligament are exposed. The borders of the wound are now retracted and the bicipital groove in the humerus is noted. The capsule is divided longitudinally and externally to the sheath containing the biceps tendon. This division of the capsule extends above as far as the glenoid ligament. Below, the capsule and the periosteum are divided close to but external to the commencement of the bicipital groove in the humerus. With the rugine when one can, and with the knife when necessary, the periosteum-capsular attachment of the internal flap is separated along the external ridge of the bicipital groove, across the groove, and beyond the lesser tuberosity. To facilitate this work the arm is rotated outward, and as one approaches this tuberosity the head is made prominent in the wound by lowering the elbow during the act of rotation. In this manner, with good retraction, the capsule and the periosteum, or the capsule alone, may be separated beyond the insertion of the subscapularis muscle. After this is accomplished the arm is returned to its original position and the separation of the periosteum and capsule of the external flap is commenced.

With a retractor beneath the capsule, the flap is raised and the separation of the capsule and the periosteum over the tuberosities and below upon the shaft is commenced. This is facilitated by rotating the arm inward while it is slightly adducted and the elbow is lowered. This manoeuvre is continued until the attachments of the supra- and infraspinatus and teres minor muscles are passed.

The arm is now allowed to hang to the side of the table in a vertical position, and when the retractors separate the flaps and the biceps tendon is drawn aside the head is pushed upward through the wound and presents itself to view. The capsule and the periosteum are now cleared from the internal surface of the shaft, and when they are sufficiently so the saw is applied. During the section of the bone the head is held firmly with the long-toothed forceps while an assistant grasps the arm and steadies it.

Gigli's saw or a bow saw (Helferich's) is usually preferred in making the section. The line of section is from within outward and from below upward for one-half the diameter of the bone. For the rest the section is more horizontal (Fig. 4053, A A). As much of the shaft of the bone must be saved as is compatible with removal of the disease. The section should be made just below the articular surface if possible. In such a section, the whole length of the humerus will act as a fulcrum for the del-

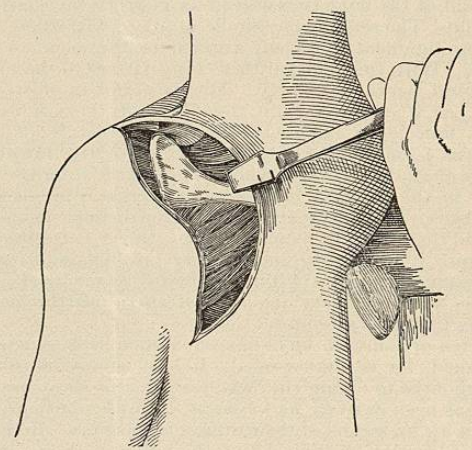


FIG. 4054.

toid muscle in elevating the arm, and a greater power will be retained than when the section is nearer or through the surgical neck.

The glenoid cavity is now examined and is curetted or

cut away with the chisel or cutting forceps. If this is necessary, the capsule and the insertions of the triceps and biceps muscles should be freed from the bone before its removal.

In cases of bony ankylosis, the line of union may be divided, and when the humerus is movable the resection may be completed as above described, or one may saw through the humerus first and subsequently extirpate the head from its capsular and muscular attachments.

In tuberculous diseases, much time must be spent in remov-

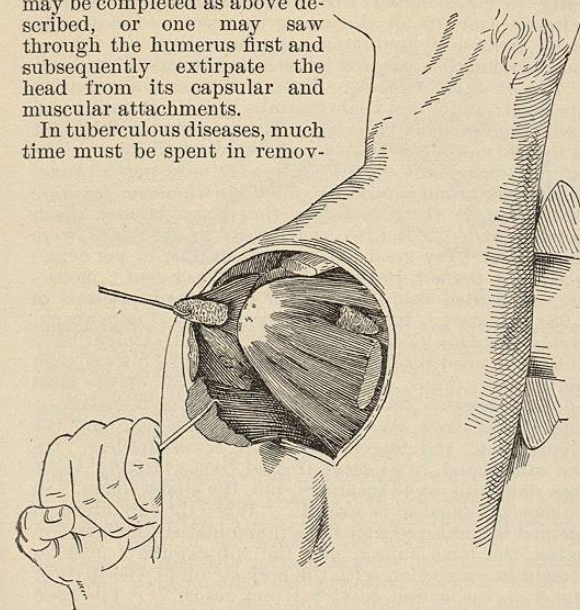


FIG. 4055.

ing the synovial membrane and clearing up the sinuses and the bursae involved. When oozing is present, these cases are best partially sewed and tamponed for several days, but when hemorrhage is fully stopped they should be sewed up completely. The same holds true for other infections and for tumors. When the hemorrhage has been checked, the capsule and the periosteum are sutured with catgut. The deltoid is held together by catgut sutures involving a few of its fibres, but sufficiently to close the opening. Drainage when required may be obtained by an opening through the capsule posteriorly. The skin is sutured with silk.

The position of the arm should be one of slight abduction, with the humerus pushed upward and backward and in contact with the glenoid cavity or the border of the scapula, where it is retained during the dressing by chromicized catgut sutures inserted before closing the capsule.

The Method by the Posterior Incision.—This method of incision is recommended at the present time by McCormac and Kocher. McCormac ("Surgical Operations," Vol. ii.) recommends it when the site of section in the humerus is to be above the tuberosities. Kocher believes that this method is advantageous in allowing perfect drainage and in preventing a forward dislocation so frequent after resection by leaving intact all that part of the joint and muscle attachment between the biceps tendon and the lower border of the subscapularis muscle. His method of incision, he believes, overcomes the interference with the exposure of the joint produced by the prominent acromion, and likewise avoids the danger of injury to the circumflex nerve, as it passes close to the humeral attachment of the capsule and the teres minor muscle. His method leaves the deltoid practically uninjured, so that its action in elevation of the arm suffers in no degree (Fig. 4054).

An incision is made, passing from the acromio-clavicular articulation over the prominence of the shoulder, along the spine of the scapula to its middle. From here the incision inclines in a curve downward toward the posterior axillary fold, ending about two fingers' breadth

before reaching it. The upper limb of this incision divides the tissue over the acromio-clavicular joint and the spine of the scapula, exposing each. The lower limb divides the tense fascia close to the posterior border of the deltoid muscle and exposes the muscle for a distance of from 2 to 3 cm. from the spine of the scapula. The muscular fibres of the deltoid muscle which are inserted into the spine behind this incision must now be divided. This is the only portion of the muscle which is divided and is deprived of action. The trapezius muscle is next separated subperiosteally as far as the acromio-clavicular articulation from the upper border of the spine of the scapula. Likewise, upon the lower border of the spine of the scapula, the deltoid insertion is separated subperiosteally as far forward as the spot marked by the junction of the acromion process and the spine of the scapula. At this point the spine is separated from the acromion process either with the chisel or, better, with the Gigli saw. (Fig. 4055). Care must be exercised not to injure the suprascapular nerve as it passes from the supra- to the infraspinous fossa. It is well also to make two drill holes before dividing the spine from the acromion process, so that they can be more easily sutured at a later date.

When this separation is completed, the acromion process with the attached deltoid muscle is luxated forward. The deltoid muscle is thus raised from the teres minor, the infraspinatus, and the supraspinatus muscles, to which it is but loosely attached by connective tissue. After the dislocation of the acromio-deltoid flap, the insertion and the muscular bellies of these three muscles which cover the humeral head are exposed (Fig. 4056). The elbow is now brought forward and the arm is rotated outward. Along the upper border of the supraspinatus muscle an incision is made from the margin of the glenoid cavity to the spine of the greater tuberosity, exposing the tendon of the biceps muscle in its whole length within the joint. The outward rotators are next loosened subperiosteally from the greater tuberosity, and, while still attached to the periosteum of the shaft, are retracted posteriorly. If one wishes, a small part of the tuberosity

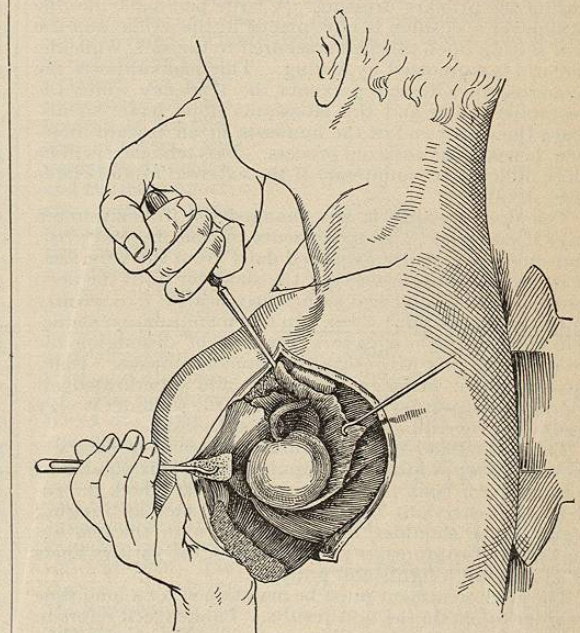


FIG. 4056.

may be cut away with the chisel, leaving thus a nucleus for the future development of a new tuberosity (Vogt's method). The biceps tendon is now loosened from the bicipital groove and is drawn forward. The insertion

of the subscapular muscle is seen at its attachment to the lesser tuberosity and to the spine of this tuberosity. It should be separated subperiosteally and drawn forward and inward. The circumflex artery and nerve are to be avoided at the lower border of this muscle. As soon as the head is thus freed, it can be easily protruded through the wound (Fig. 4056). After it has been removed, the glenoid cavity should be freely exposed and to an extent which is unattainable by any anterior incision. This exposure is best accomplished, after the head has been removed, by exerting traction upon the elbow while it is held in the position of adduction. The importance of the exposure of the glenoid cavity in tuberculosis of this joint cannot be questioned, and therefore this method has its specific application.

After the synovial membrane, the bursae, and the bones are removed, the capsule and the periosteum are sutured, and the wound is closed. If drainage is necessary, the capsule should be incised below the border of the teres minor, and care taken to avoid the circumflex nerve and artery as it emerges beneath the muscle. These are easily recognized, however, since the field is so well exposed. After this is accomplished, the spine of the scapula and the acromion should be sutured. The trapezius and the deltoid are sutured over the acromion or spine of the scapula if necessary; if it is not thought necessary, they are left unsutured. The skin should be sutured separately.

Sir William MacCormac prefers entering the joint between the teres minor and the infraspinatus muscles, clearing the infraspinatus, supraspinatus, and the subscapularis muscles and the biceps tendon forward, until the bone is free, and subsequently clearing the teres minor muscle with the capsule posteriorly. In some instances this is undoubtedly a good method of approach after the deltoid has been retracted forward ("Surgical Operations," part ii.).

After-Treatment.—The main point in the after-treatment seems to be the retention of the head in contact with the glenoid cavity or with the border of the scapula. This contact may be secured by the use of chromicized catgut, which lasts long enough to insure no slipping during the primary dressing. A large pad made like the Stromeier's cushion is now placed in the axilla, and the arm resting upon this pad is secured to the side, while the forearm is supported by a sling. This pad supports the humerus, fixes it, and prevents the tendency which the pectoralis major and the latissimus dorsi have, to displace the upper end of the humerus in an inward direction, beneath the coracoid process. This tendency will be more difficult to counteract if the external rotators have been divided.

The first dressing is not changed for from six to ten days if possible. The movements of the fingers, wrist, and elbow are gently exercised daily from the very first. It is useless to begin moving the shoulder until the deep parts of the wound are sufficiently healed, *i. e.*, usually in the second or third week. In this manipulation abduction must be made with care, for fear of dislodging the head and forcing it beneath the coracoid process. Daily application of massage, electricity, and superheated air (Sprague apparatus) to the muscles of the shoulder is very useful in preventing too extensive ankylosis.

The deltoid and the rotator muscles should be daily exercised by appropriate manipulations. This should be continued for from four to six weeks, after which the patient must carry out his own exercises, such as bringing a gun to the shoulder, lifting weights with the arm abducted, and appropriate exercises upon the various kinds of gymnastic weights and pulleys.

The after-treatment must be maintained for a long time in order to obtain the best results. Langenbeck refers to a case (*Archiv für klin. Chir.*, xvi., p. 393) in which the arm increased in strength for two years following the operation.

Results.—According to Culbertson, the mortality was as follows: For gunshot wounds (855 cases), 31.44 per cent.; for disease (116 cases), 15.84 per cent. According to Otis, the results were as follows: Out of 2,369 cases

of gunshot wounds, 577 of which were treated by the expectant method, there were 951 cases which were treated by excision, with a mortality of 36.6 per cent., and 841 cases which were treated by amputation, with a mortality of 29.1 per cent. The mortality for the 2,369 cases was 25.1 per cent. According to Souchon, the results, in cases of old irreducible dislocations, with or without fracture of the humerus, were as follows: In those treated by reduction, the mortality was 10 per cent., and in those treated by resection it was 12 per cent.

The Functional Result.—Usually flexion and extension are good; adduction is also usually good. Rotation and abduction are usually feeble. The tendency in this joint is toward ankylosis rather than toward a flail joint. The subperiosteal method (Ollier) gives the most perfect functional result, and should be practised whenever feasible. According to Gurlt ("Ueber Gelenkresectionen nach Schusswunden," Berlin), the results in 213 cases were as follows: Very good, almost perfect, in 1.87 per cent.; good, not perfect, but useful, in 42.25 per cent.; moderate, of limited use, in 47.88 per cent.; bad, useless, in 7.98 per cent. In the German wars (Langenbeck, *Archiv für klin. Chir.*, xvi.), conservative treatment gave at least as good results as the resections which were then performed. Thus, in 44 cases of resection of the head of the humerus, the results were good in 2 instances, while in 31 cases the shoulder hung like a flail, and the elbow, hand, and fingers were more or less useless. On the other hand, in 54 cases treated conservatively, there was ankylosis in 43 instances, but the elbow, hand, and fingers continued to be useful. "When the subperiosteal method is employed and the supraspinatus, the infraspinatus, the teres minor, and the subscapularis muscles remain in connection with the periosteum of the shaft of the humerus, a flail joint will not result." "The good results are obtained when the subperiosteal method is carried out." He reports 8 cases with excellent results. Wegner (*Charité Annalen*, 1901, Bd. xxv.) also reports an excellent result following resection of this joint for caries sicca (tuberculosis).

THE RESECTION OF THE LOWER EXTREMITY.—The small joints of the foot occasionally require resection. Corresponding joints in the toes are removed in the same manner as those in the fingers. As a matter of fact, resection of the toes is seldom done, since their deformations do not demand it.

Resections of the metatarso-phalangeal joints are performed in the same manner as in the hand. The incisions are placed to either side of the extensor tendon in the second, third, and fourth metatarso-phalangeal joints, to the inner side of the tendon in the first metatarso-phalangeal articulation, and to the outer side of the tendon in the fifth metatarso-phalangeal joint.

Of these joints, the metatarso-phalangeal articulation of the great toe is not infrequently resected for hallux valgus. As these cases are quite often complicated with a bunion which requires removal at the same time, this incision is a semilunar one. It extends from a point on the metatarsal bone, 2.5 to 3.5 cm. above the joint. It descends in a curve over the lower quadrant of the bunion until it reaches its mid-point, whence it ascends in a curve to the centre of the outer border of the first phalanx. This flap with the deep connective tissue is dissected from the bunion until its base is reached. The adventitious tissue and the bunion are now removed, after which the subperiosteal-capsular method is pursued in freeing the ends of the bones. When the periosteum and the capsule are loosened to beyond the centre of the articular surfaces, the ends of the bones may be made to protrude through the wound. (Fig. 4057.)

They may now be removed completely or partially as desired. Since it is very necessary to retain the sesamoid bones, the separation of the periosteum and of the capsule upon the inferior surface of the joint must be done with care. After removal of the articular ends of the bones they are placed in apposition and sutured with catgut if one desires an ankylosis. If a pseudarthrosis or nearthrosis is desired, no suture of the bones is made.

Ankylosis is obtained by maintaining the bones in apposition. Pseudarthrosis or nearthrosis is obtained when the ends of the bones are left within the capsule which is closed over them. Many deformities in hallux valgus, where the bunion and the deformity are not great, may be

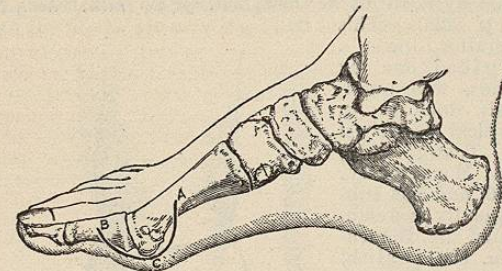


FIG. 4057.

corrected by a cuneiform osteotomy of the lower third of the metatarsal bone, and such an operation is to be advised in the minor cases of this condition.

Resections involving either the metatarso-tarsal, the tarsal, or the talo-tarsal joints, are rarely performed, because disease is scarcely ever confined to any one of these several joints. It is rare to have only one of the seven* articular synovial cavities of the foot involved.

Disease or infection from injury commencing in any one of these seven cavities soon spreads through the cancellous tissue of the bone to the neighboring synovial cavities, so that the process rapidly becomes a diffuse synovial, parasynovial, and periosteal one (Fig. 4058).

For this reason resections of single joints are rarely made on account of disease.

In injuries to these joints and in deformities congenital or acquired, resections of single joints can rarely be performed in even minor grades of the injury or deformity. We must look upon the foot as a whole and operate without regard to the joints, with the sole idea of removing the condition for which we operate.

There are several procedures which are applicable to injury or disease of this region: (1) Those of Bardenheuer and P. Bruns; (2) those of Wladimiroff-Mikulicz and Kümmell. For disease or injury situated between the bases of the metatarsal bones and the calcaneus and talus, Bardenheuer's method is especially applicable. In the majority of cases the involvement of the tarsal bones and the periosteal tissues is so great that an extensive exposure must be made in order to remove the diseased tissues completely. Where the disease involves the metatarso-tarsal, the talo-calcaneo-navicular, and the calcaneo-cuboid articulations, the method of H. P. Watson (Jacobson's "Surgery,"

*I. Between the first metatarsal and the internal cuneiform bones. II. Between the second and third metatarsal and the middle and external cuneiform bones which communicate with IV. III. Between the fourth and fifth metatarsal and the cuboid. IV. Between the three cuneiform and the scaphoid bones which communicate with II. V. Between the cuboid and calcaneus. VI. Between the navicular and the calcaneus and the talus. VII. Between the talus and calcaneus.



FIG. 4058.

vol. ii., p. 707) is not satisfactory and a more extensive exposure is required. It is here that Bardenheuer's method is most applicable.

Anterior Tarsectomy (Bardenheuer, "Mittheilungen aus dem Kölner Bürger-Hospital," 1-4).—An Esmarch bandage is applied. An incision is made through the skin, subcutaneous tissue, tendons of the extensor communis longus and brevis and proprius pollicis, and the cutaneous nerves, down to the bones from the first to the fifth metatarsal bones at their bases (Fig. 4059). From the extremities of this incision, two incisions are curved upward along the internal and external borders of the foot to beyond the medio-tarsal joint.

These incisions also extend through to the bone, dividing the tendons of the peroneus tertius and of the tibialis anticus. If necessary, these lateral incisions may be prolonged upon the metatarsal bones, the U-shaped incision being converted into an H-shaped one. This flap as marked out is dissected from the periosteum and the ligaments of the bones until it can be reflected above the level of the medio-tarsal joints. Here it is best to enter the joint, dividing the ligaments upon the anterior and lateral surfaces, when, if the forefoot is firmly held and depressed, the plantar ligaments holding the calcaneus and scaphoid and the calcaneus and cuboid can be divided. This division frees the tarsus, and allows, as in Lisfranc's amputation, an easy separation of the tendons of the tibialis posticus, the peroneus longus, and the less important muscles from the tarsus as far as the bases of the metatarsal bones. At this point a blunt retractor is passed between the bones and subjacent tissues, and the bases of the metatarsal bones are sawn at the distal side of their articular surfaces. The articular surfaces of the calcaneus and of the talus are now sawn off (Fig. 4060). The disease involving the muscles and the sheaths of the tendons is next removed. The vessels are ligated, the Esmarch bandage is removed, and the sawn extremities of the bones are apposed and sutured with chromicized catgut. If the disease is not thoroughly removed, or if

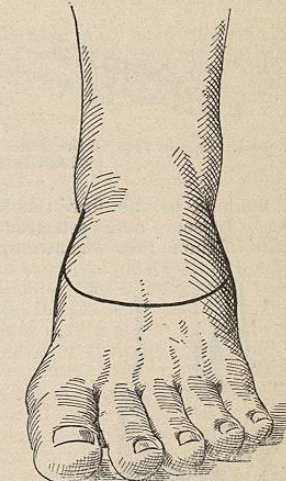


FIG. 4059.

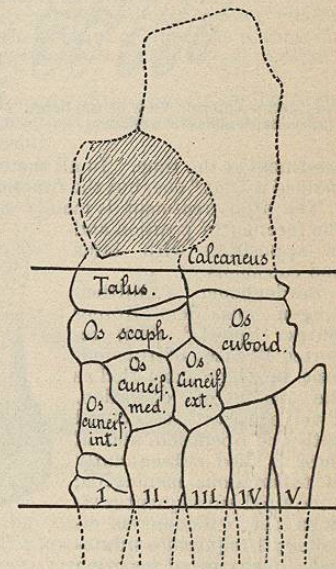


FIG. 4060.—Diagram illustrating Bardenheuer's Operation.

one so desires for any other reason, the wound may be packed until granulation appears, when a secondary suturing is done.

In this operation the tendons are rarely sutured. It has been found that in healing by granulation the fibrous cicatrix unites the tendons so that motion in the toes is often good. It is, however, advisable that the tendons be sutured whenever the wound treatment allows it. If possible,

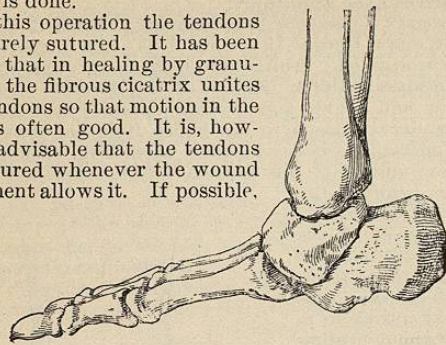


Fig. 4061.—Lateral View of the Bones after Bardenheuer's Resection of the Tarsus.

the tendons to the first toe should be sutured in all cases. In some cases sensation has returned though no suture of the nerves was attempted.

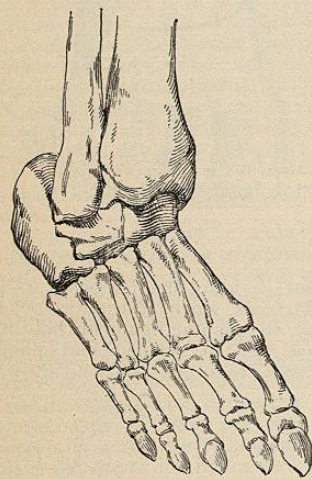


Fig. 4062.—Anterior View of the Bones after Bardenheuer's Resection.

treatment at the time. In all the cured cases the foot remained a "flat" one, but the functional results were good. The after-treatment is mainly devoted to maintaining the forefoot in position and in apposition with talus and calcaneus.

Bardenheuer ("Mittheilungen aus dem Kölner Bürger-Spital," 1886) reported 17 cases of tuberculosis, in which none died as the result of operation. Twelve cases were cured with one operation, and of these 3 died subsequently of tuberculous meningitis; 3 required subsequent revisions before a cure was effected; 1 required amputation. One case of resection was due to loss of substance from injury; a cure resulted. (Figs. 4061, 4062, and 4063.)

Tibio-Calcaneal Resection.—The statistics of Audry ("Sur les tuberculoses au pied," *Revue de Chirurgie*, 1890) show that tuberculous



Fig. 4063.—View of Cicatrix after Bardenheuer's Resection of the Tarsus.

disease involves the ankle, the talo-calcanean, and the talo-calcaneo-navicular joints in fourteen per cent. of the tuberculous in the foot, and that unless amputation be performed at the ankle (Syme's or Pirogoff's) some method must be found by which all of these joints can be opened and resected. Such a method has been elaborated by P. Bruns in 1890 (*Beiträge zur klin. Chir.*, No. 7, p. 223). This operation, made a typical one by Bruns, was previously done in an atypical fashion by Textor, 1852, and Mulvaney, 1866, and has subsequently been elaborated by Heidenhain, Helferich, Cramer, Küttner, and Kummer.

The indications for this operation are the same as those for Pirogoff's amputation: namely, disease involving the talo-calcanean, talo-navicular, and talo-crural joints, with foci within the bones. Its advantage rests in the fact that it preserves the forefoot and gives a more useful member than is obtained by an amputation.

The method is as follows: An Esmarch bandage is applied. In order to obtain sufficient exposure an incision is made from one malleolus to the other in a broad curve over the dorsum of the foot in the neighborhood of the metatarso-tarsal joints (Fig. 4064). This curved dorsal incision, first made by Houssey (Heyfelder, "Resectionen," 1861) and subsequently used by Bardenheuer in

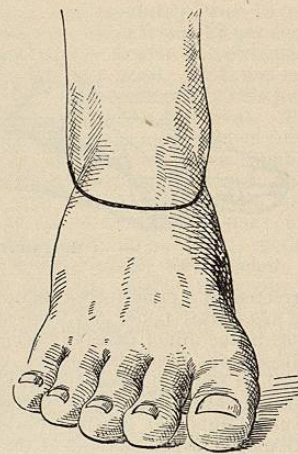


Fig. 4064.

his excision of the tarsus, is no disadvantage because of the division of the tendons and nerves. The flap thus marked out is deepened, passing above the peroneal tendons on the outer side and dividing upon the dorsal and internal surfaces the peroneus tertius, extensor longus digitorum, proprius pollicis, and tibialis anticus tendons, together with the branches of the anterior tibial and musculocutaneous nerves and the dorsalis pedis artery. This flap is dissected from the bones until the anterior tibial margin is reached. The talo-crural joint is opened by a transverse incision which divides the anterior fasciculi of the lateral ligaments. The foot is pulled forward and depressed, when the middle and posterior fasciculi of the lateral ligament are divided as close to the astragalus and os calcis as possible. With further depression, the posterior ligament of the ankle-joint is divided transversely, exposing the flexor longus pollicis tendon. The talo-navicular and the calcaneo-cuboid articulations are next entered and the superior and lateral capsular bands divided. If the astragalus

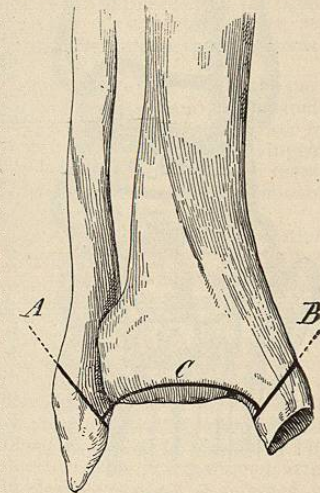


Fig. 4065.

is now cleared upon its lateral surfaces and the knife is passed into the sinus tarsi and carried from before backward and toward the sustentaculum tali, the interosseous ligament will be divided. The astragalus is now held only by a few unyielding capsular fibres of the posterior talo-calcanean articulation and can be easily removed. The navicular, calcanean, and cuboid bones, the tibia and the fibula, are now inspected for disease, and if they

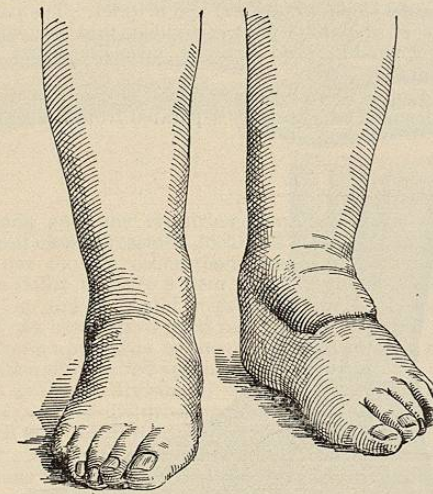


Fig. 4066.

are involved they should be treated as follows: The tibia and fibula are sawn so as to preserve their mortise shape. This is usually accomplished by cutting away the articular end of the tibia with the chisel or gouge, preserving its hollow shape, and by sawing the malleoli obliquely, leaving a small projecting edge beyond the surface of the tibia (Fig. 4065). The superior surface of the calcaneus is made to fit accurately the space between the malleoli. This will not infrequently require a removal of the sustentaculum tali. The calcaneo-navicular and the inferior calcaneo-cuboid ligaments are now divided or separated from the inferior surfaces of the cuboid and scaphoid bones, so as to allow a vertical section with the saw. After this section, the anterior surface of the calcaneus is sawn in the same plane. The tendons, their sheaths, the ligaments and the muscles are next inspected, and if involved by disease they should be removed, after which the calcaneus is apposed to the tibia and fibula and to the cuboid bone. These bones are held in apposition by catgut sutures. The scaphoid bone will be seen to rest against the anterior margin of the tibia. The Esmarch bandage is now removed. The hemorrhage is controlled. The tendons, the nerves, and the deeper tissues are sutured to one another as far as is possible. As regards this point it may be said that most surgeons do not suture the several tissues to one another, but while no bad results may follow the adoption of this course, yet the time required for healing is undoubtedly lessened by a perfect apposition of like tissues. In the face of severe infections, the wound is left open and is packed until granulation appears, when secondary suture is made.

The after-treatment consists in absolute rest and elevation of the foot for from three to five days in an immovable splint, which holds the foot at right angle to the leg. At the end of ten days any deviation of the foot can be corrected with ease.

This operation can also be performed by a posterior curved incision which exposes the malleoli. The incision is deepened and is carried through the tendo Achillis, after which the joint is opened, the malleoli are sawn, and the talus is extirpated. The operation is completed as in the operation by the anterior incision.

The time required to obtain healing by first intention (5 cases) was from 28 to 48 days; for cases healing by sec-

ond intention, 35 to 60 days (2 cases). If recurrences take place (2 cases) the time is naturally more extended, i. e., 84 to 397 days—an average of 210 days (Küttner, *Beiträge zur klin. Chir.*, ii., p. 749). The mortality from the operation is nil.

The Final Result of Operation.—The shortening in the leg is usually from 1 cm. to 1.5 cm., and that of the foot about 1 cm. The appearance of the foot after operation is seen here (Figs. 4066 and 4067).

The function of the foot is good. It allows use all day and requires only an ordinary shoe.

The pseudarthrosis between the calcaneus and the fore-foot gives elasticity to the gait, which is wanting in artificial limbs.

The talo-calcanean resection is to be preferred to amputation, either Pirogoff's or Syme's, because it preserves the foot. It is preferable to the Wladimiroff-Mikulicz resection because it is easier of execution and requires no subsequent prosthetic apparatus.

Posterior Tarsectomy.—(Kümmell, *Centralblatt f. Chir.*, 1893, No. 47; *Verhandl. der deuts. Ges. f. Chir.*, 1889, i., 57.) When disease involves not only the ankle-joint but the medio-tarsal and tarsal joints as well, one of three things must be done: either an extensive atypical resection (Kümmell and Cramer), or a Wladimiroff-Mikulicz resection, or an amputation at or just above the ankle-joint.

A priori, it may be thought that a removal of the calcaneus, talus, tarsal bones, the malleoli, and the articular surface of the tibia would give a bad functional result. This is not the case, however (Cramer, *Verhandl. der deutschen Gesellschaft f. Chir.*, 1895, i., 16). The extensive removal of these bones, leaving a foot formed of a part of the tarsus, the metatarsus, and phalanges, gives a better result than the equinus position of the foot seen in the Wladimiroff-Mikulicz resection. It is true that the foot is shortened, but a foot with a sole is better than the equinus of the Mikulicz operation, because a movable foot is obtained and because the pressure-bearing surface is a natural one and greater in area than is obtained by the Mikulicz resection.

Indications.—Tuberculosis involving the ankle-joint, the calcaneus, talus, and tarsal bones, with fistulae. In children and in young adults the operation is indicated. In adults who have tuberculosis elsewhere and are not holding their own against the disease, and in the old and anemic, amputation is preferable. No matter whether the fistulae are upon the dorsum or upon the plantar surface of the foot, the operation with the dorsal incision is equally indicated.

The incision for exposure of the bones is similar to that used in the P. Bruns method. The removal of the talus is similarly carried out; after which the bones of the tarsus are removed *en masse*, as is recommended in the Bruns method. This removal of the tarsus is often complete, so

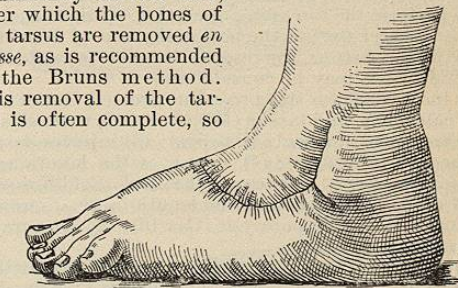


Fig. 4067.

that the section of the bones includes the bases of the metatarsal bones. The lower ends of the tibia and fibula are removed with a transverse section, unless the calcaneus can be partly saved, when the section is similar in shape to that recommended in the preceding resection. No matter how little of the calcaneus is saved, the resulting shortening and the functional result are much improved. After removal of the diseased bone the bases of the metatarsal or tarsal bones are apposed to the anterior sur-