

Pathology.—Sprains are of all degrees of severity from the trifling wrench, the effects of which quickly disappear, to the violence sufficient to produce a fracture or dislocation. A sprain is, in fact, a dislocation of greater or lesser degree in which the bones have returned at once to their normal relation. In severe cases, the ligaments, being inelastic, give way and are partially or completely divided or are detached from their insertions; the tendinous sheaths and contiguous muscles are often torn, sometimes at a considerable distance from the articulation, and tendons are frequently displaced or severed from their insertions. The blood-vessels in and around the joint may be ruptured, causing the joint cavity or the surrounding tissues to be filled with blood. The line of displacement in sprains usually takes the direction in which there is normally least motion; in the hinge joints it is, therefore, lateral. Through this unnatural motion, the synovial membrane is unfolded on one side, on the other it is compressed, crushed, and often torn (Sajous' "Annual"). The ends of the bones are contused and sometimes fractured. Common examples of the latter are found in the lower end of the fibula, the internal malleolus, and the lower end of the radius. To this the term *sprain fracture* is applied by some; others limiting the application of this term to those cases in which a ligament or tendon carries away a portion of the cortex of the bone to which it was attached. A fracture of the lower end of the external malleolus, complicating a sprain of the ankle, may be unrecognized and may serve to explain many cases of ankylosis following an apparently simple sprain of this joint (Callender). The articular cartilages are bruised, broken, or detached. The reactionary inflammation which affects these tissues, the increase in synovial fluid, the oedema of the soft structures, and the ecchymosis need only be mentioned.

Symptoms.—The first symptom is instantaneous and usually severe pain in the joint, accompanied by an impairment or total loss of function. The pain is characteristic of injury to ligaments, which are not sensitive to cutting, but react quickly to twisting, etc., a condition which may serve to protect articulations. Nausea and vomiting are often present even in sprains of minor degree. Swelling, due to extravasation of blood into the joint or periarticular tissues, and most noticeable where there is least resistance from ligaments, rapidly follows, obliterating the normal outlines of the joint. In mild cases the swelling may at first be very slight; it is often increased, however, by a subsequent synovitis. Evidences of inflammation soon supervene. Pain and tenderness continue, and after a few days indistinct crepitation may be noticed on movement of the joint, caused by a deposit of plastic matter in the contiguous soft tissue, the tendinous sheaths, or the articular cartilages. Pain and weakness may persist for a long time even after other inflammatory symptoms have apparently subsided; they result usually from incomplete union of the torn capsule, from overdistention of the capsule by synovitis, or from adhesions. Ecchymosis, due to extravasation into the soft parts, appears quite early; when due to blood in the joint cavity, it appears much later. Acute suppuration in a sprained joint is rare, unless the patient's general condition is greatly depressed. In slight sprains the pain and swelling quickly subside and the functions of the joint are soon restored; in severe ones, with involvement of the bones, cartilages, or contiguous structures, inflammation is increased and convalescence correspondingly delayed. Stiffness of the joint often persists after the inflammatory symptoms have subsided and sometimes there follow rigidity and wasting of the muscles.

Diagnosis.—As a rule the diagnosis is easily made. The gap in a torn ligament, especially a lateral one, may be seen and felt; and by the sense of touch a complicating fracture is usually detected with ease. Marked swelling often obscures the bony landmarks around a joint, and in such cases firm and continued pressure over these prominences will, by displacing the fluids in the infiltrated tissues, determine their situation; should they correspond in location and mobility to the sound side, the question

of fracture or dislocation may be dismissed. The swelling may be so great, however, that a complicating fracture may be difficult of detection, and when the fracture is incomplete or impacted a diagnosis is impossible. In this case the Roentgen ray is of great aid in diagnosis and should, when available, always be used; when it is not possible to employ the x-ray an anæsthetic should be administered. Epiphyseal separations in children resemble sprains closely and for their differentiation the x-ray or an anæsthetic is required.

Treatment.—The treatment of course varies with the extent of the injury, but there are certain indications common to all cases, the most important of which are the following: (1) check extravasation; (2) prevent and subdue inflammation; (3) relieve pain; (4) promote absorption; (5) obtain repair of the torn ligaments; (6) restore the function of the joint.

Slight sprains need little treatment but a vast amount of care; indeed it is the slight, unheeded, and therefore untreated sprains that are most frequently followed by structural changes in the joint. Following a mild sprain the joint should at once be immobilized by a suitable splint or bandage and cold should be employed by means of the ice bag or Leiter's coil. Cold checks extravasation better than heat, which in the early stages tends rather to increase the bleeding; it also prevents inflammation, controls pain, and gives great comfort to the patient. To promote absorption and restore the function of the joint there is nothing as good as massage, which should be begun on the second or third day. It may at first cause pain, in which case only gentle stroking should be employed, beginning not over the tender and swollen joint, but on the healthy tissues above and below, and stroking in the direction of the returning lymph currents. During manipulation the limb should be kept in the most comfortable position and the greatest extent of the palmar surface of the hand should be applied. The first application should last for from ten to fifteen minutes, and kneading or passive motion, if painful, should not be employed. After massage return to the splint and cold for another twenty-four hours; then repeat the massage, keeping it up for at least half an hour (Cheyne). From this time onward the splint and cold may be discontinued; instead, pressure by means of cotton and an elastic or flannel bandage may be applied in the intervals between two successive massagings, which should be employed as often as once or twice a day. Passive motion may be begun with the massage as soon as the comfort of the patient will permit. When an articulation of the lower extremity is involved, the patient should go to bed; when the upper extremity is implicated, the limb should be held in a sling.

Severe sprains are governed in their treatment by the same general indications. Immobilization should be secured at once and continued for several days, depending on the severity of the case. Immobilization for more than a few days, as under the older methods, is objectionable because adhesions are apt to form, thus causing impairment of function, and because, when there is a tuberculous taint, proper conditions for a localized tuberculosis are established (Mumford). Adequate fixation of the joint may be secured by encasing it in cotton beneath a plaster-of-Paris, silicate of soda, or starch splint, the patient remaining in bed if the lower limb is involved or wearing a sling if the upper extremity is injured. To limit effusion and control the pain cold should be applied. For promoting absorption and restoring joint function massage is the most effective agent. The proper time to begin its application cannot be arbitrarily laid down. Lovett believes that severe cases should receive absolute fixation and rest for a few days, when there may be substituted an adjustable splint which can be removed every day and thus enable the surgeon to note the progress of the case. With the subsidence of acute symptoms massage should be begun, and it should be continued thereafter once or twice every day. In the intervals between the sittings, pressure by means of cotton and the adjustable splint, later by an elastic or flannel bandage,

may be applied. Alternating hot and cold douches lasting for a few moments will heighten the effect of the massage. *Passive motion* should be begun as soon as possible, but not until after it ceases to provoke pain; it should be practised with gentleness and care, the range being gradually increased and pains taken not to strain an injured ligament. Under this treatment a period of two or three weeks often suffices to put a joint, suffering from a sprain of average severity, in condition for careful use (Mumford). Treatment should be continued for three weeks more, however, and an elastic bandage may be worn with comfort and increased security for a further period of six weeks (Cheyne). The time to begin walking or using the joint, like the beginning of massage or passive motion, cannot be arbitrarily stated. It should be attempted with great care, and the trials should be made at frequent intervals but for very short periods of time. As the pain caused by these efforts diminishes, the use of the affected part may be increased.

When a *ligament has been torn across*, the case must be treated with increased caution. A splint specially designed to support the injured ligament should be applied and kept in position for about six weeks; this length of time being necessary for ligamentous repair. To prevent the formation of adhesions, massage and passive motion should be employed with great care, so as not to disturb the injured ligament. When a ligament has been torn from its insertion, or has carried away a cortical fragment of bone, the same treatment is applicable.

A large effusion of blood into the joint cavity indicates a severe injury, one liable to be followed by synovitis and perhaps by adhesions and ankylosis. If the effusion keeps on increasing after the first day, or fails to be readily absorbed, it should be aspirated under the strictest aseptic precautions. Afterward the treatment follows the usual course. "In these more severe cases three weeks' rest or more should be insisted on before the joint is allowed to be used" (Cheyne).

The patient should be given a light and properly selected diet, and his bowels should be made to act with regularity. In severe cases in which the pain has not been controlled by rest and cold, internal anodynes should be administered.

Strapping (Fig. 3045), a method of treatment particularly suited to sprains of the ankle and tarsal joints, was first recommended by Cotterell and Gibney. The latter describes the method substantially as follows: Ordinary rubber adhesive plaster is cut into strips one inch wide, and of two lengths, respectively twelve and eighteen inches. If the patient is seen early and before the swelling is marked, the joint may be strapped at once. After the examination is made, massage should be employed for five minutes, the foot being elevated and relaxed. Then, the foot and lower leg having been shaven, the first, a horizontal strip, is applied, in such a manner as to lie parallel with and just above the border of the sole, its extremities ending just behind the great and little toes respectively. The second, a vertical, strip is next applied; it should begin a short distance above the ankle on the side least injured and should end half-way up the leg on the side of greatest injury, where the ligaments need and therefore receive the greatest support. This second strip crosses the first at right angles, and lies parallel with the tendo Achillis. Then horizontal and vertical strips, each overlapping its predecessor one-half, are alternately applied; the vertical ones coming gradually forward, the horizontal rising, until the whole ankle is enclosed, leaving out the point of the heel and a strip on the front of the leg and the dorsum of the foot, a precaution which prevents circular constriction and strangulation. The strips are all drawn tightly, and just beneath the malleoli the horizontal ones are reinforced by being doubled. A gauze or flannel bandage placed over the strips will cause them to adhere tightly and will further strengthen and secure the articulation. The patient should put on his boot and stocking and begin to walk at once; indeed, he may walk rather freely, provided it causes no pain whatever or only a small amount. A cane usually affords

sufficient aid, and crutches as a rule should not be allowed, because the patient, depending on them, does not give sufficient motion to the injured joint. The foot should be flexed to slightly less than a right angle while the straps are being applied; this position is comfortable and permits the wearing of a low-heeled boot. The dressing should be removed and reapplied at the end of a week, and two or three dressings usually effect a cure.



FIG. 3045.—Cotterell and Gibney's Method of Strapping for Sprain of Ankle.

Gibney condemns the routine use of fomentations, plaster of Paris, and bandages. Strapping is applicable to both early and late stages of sprains, serving to fix the joint and limit effusion in the former, to fix the joint and promote absorption in the latter. In severe cases, complicated with fracture, blebs, etc., the application of strapping would of necessity be delayed for a few days, and even in the severe though uncomplicated cases, seen late, with much swelling, it might perhaps be better first to reduce the swelling by immobilization, elastic bandaging, and elevation. Under the treatment by strapping, patients are able to attend to business and the function of the part is completely restored much earlier than by other methods. It is applicable to other joints than the ankle. When both lateral ligaments have suffered equally, the vertical strips may begin and end at the same level. In severe cases, in which the swelling of the foot and toes is great and the whole ankle must be strapped, leaving no portion uncovered, it is necessary carefully to strap each toe.

Static electricity and *superheated air* are also advocated in the treatment of acute sprains.

Sequelæ and Prognosis.—Obstinate neuralgic pains, paroxysmal or continuous, and usually exaggerated by barometric changes, not infrequently follow a sprain. To relieve them, when all other methods have failed, it may be necessary to cut the nerve filaments supplying the joint. Stiffness more or less marked may persist for a longer or shorter period, but it usually yields to the treatment already advised. In rare instances, a joint may suffer at intervals of weeks or even months from attacks of acute or subacute inflammation, a condition referred to as "irritable joint." Counter-irritation, with immobilization, commonly affects a speedy cure. The prognosis will depend on the joint involved, the extent of the injury, the habit and physical condition of the patient, and the promptness and efficiency of the treatment. In the gouty and rheumatic, the joint inflammation is

generally tedious and chronic, yielding only to local, combined with constitutional treatment (with iodides, colchicum, etc.); while in scrofulous patients chronic osteitis, synovitis, or extensive destructive (tuberculous) disease of the joint may follow. Extensive hemorrhage into the joint cavity renders the prognosis more grave.

Ankylosis of a varying degree will follow in a certain number of cases; for its relief passive motion and massage combined with the use of superheated air may be employed. For the relief of the so-called false ankylosis, particularly that following traumatism, Gwyer strongly recommends the use of static electricity; but that it is as valuable as the measures referred to above is extremely doubtful. When the adhesions are very strong it may be necessary to "break them up" under an anæsthetic (*Brisement forcé*), after which the case must be treated as one of acute sprain—that is, by cold, massage, and passive motion; otherwise the adhesions will reform. It may indeed be necessary, in making the necessary passive motion, to administer an anæsthetic several times. When wasting of the muscles has occurred, faradism should be employed. Finally it may happen, despite all possible caution, that the joint remains weak and troublesome for a lifetime, ankylosis may persist, or destructive joint changes develop, causing great suffering, from which patients are relieved only by excision or amputation. When ankylosis is imminent, the position of the limb should be such as to make it as useful as possible after stiffness is complete.

Contusions result from falls or from blows with a blunt instrument. They may be divided into *direct* and *indirect*; the former are produced by violence acting directly on the joint; the latter by *contre-coup*.

Indirect contusions are often spoken of as *concussions*; those of the hip, for example, are caused by a fall on the foot or trochanter. The principal injury in this variety of contusion is found in the articular cartilages which have been more or less bruised. The other structures of the joint may be injured, however, and sometimes there results an impacted fracture.

Direct contusions are, of course, closely allied to contused wounds of joints (see contused wounds), the difference being largely one of degree. Here the chief injury is to the periarticular soft structures and the synovial membrane. In slight contusions there may be nothing more than a bruising of the periarticular tissues, with perhaps slight extravasation of blood. Severe contusions, on the other hand, may be associated with laceration of ligaments or synovial membrane, chipping or detachment of the cartilages, injury to the ends of the bone, fracture or dislocation, and an effusion of blood into the joint.

Symptoms.—Besides the local evidences of contusion there will be an effusion of blood into the joint, sometimes so marked as to make the joint tense. In the latter instance flexion of the joint occurs, because in this position the limb is most comfortable and the joint has the greatest capacity. Infiltration of the skin and an ecchymosis appearing early if the contusion is direct, much later if indirect, will be observed. Pain and disturbance of function will vary in proportion to the degree of injury inflicted.

The *diagnosis* will depend on the history and signs of a trauma of the joint, on the subsequent swelling from effusion into the joint, and on the pain, tenderness, and loss of function. When there is a suspicion of injury to the bones or cartilages, an anæsthetic should be administered, and in every case the x-ray will give valuable aid. The possibility of hæmophilia or scurvy having produced the effusion must be kept in mind.

In a healthy subject, the recovery from a slight contusion is usually rapid and complete; but if the subject is delicate or tuberculous, there may result tuberculous disease, or abscess of the joint, or the bones may necrose or a sarcoma develop. A non-tuberculous abscess is rare; it may result from infection in the superficial tissue and subsequent extension to the deeper parts and to the articulation, or it may be due to infection of the effused

blood by germs carried by the circulation. Tuberculosis of the joint is a much more common event. In the aged a contusion may result in a chronic arthritis with roughening of the cartilages, in calcareous deposits, or in absorption of the articular ends with shortening and loss of function. In severe contusions, associated with laceration of ligaments and synovial membrane, and characterized by effusion into the joint, the injury, if carefully treated, may result in absorption of the effusion and complete restoration; but often there is left behind a mass of fibrous tissue which interferes with motion and causes more or less ankylosis. If the articular cartilages have become detached and absorbed, the ankylosis may and likely will be bony. Severe contusions may also be followed by gangrene of the skin and subcutaneous tissues, or suppuration may develop in the joint.

Treatment.—Both slight and severe contusions must be treated with the utmost care. Rest and the application of cold were formerly widely employed, but rest, if too prolonged, is now considered harmful, since it permits the organization of the effusion into connective tissue and thus favors the production of ankylosis. Ice should be used only in the early stages to control the pain, and warmth may be more agreeable and quite as effective. The treatment of contusions is the same as that of sprains. Massage begun early, intermittent elastic bandaging, and passive motion, which promotes absorption, lessen the possibility of ankylosis and hasten recovery. The same rules govern the employment of massage in contusions as in sprains.

When the joint is overdistended by effusion, it may, under the strictest aseptic precautions, be aspirated; and when suppuration occurs, drainage and irrigation should be employed. A fracture complicating a contusion of joints must of course be treated by splints, but these should be removed every six or eight days (oftener in the later stages), and a new splint, changing the position of the joint, should be applied. Massage and passive motion should be employed when the splints are changed. If ankylosis is imminent, the limb should be placed in that position which is likely to make it most useful.

WOUNDS.—Wounds of joints are either non-penetrating or penetrating. The former are as a rule only serious when complicated by suppuration, which may subsequently invade the joint; they should be treated antiseptically, the parts being thoroughly immobilized. Penetrating wounds, on the other hand, are among the most serious of injuries, involving not only the usefulness of the limb, but often the life of the patient. They may be subdivided into: (1) incised, (2) punctured, (3) contused, (4) lacerated, and (5) gunshot.

Symptoms.—The symptoms vary according to the joint involved, the extent and nature of the injury, and whether or not infection has occurred. There are present, of course, the local evidences of a wound from which blood is escaping and usually synovial fluid. The latter may come from a bursa or tendinous sheath, but its escape in any quantity should be regarded as evidence of joint penetration; and since many of the larger bursæ are connected with the joint, it is well to assume that in every case in which there is an escape of synovial fluid the articular cavity has been invaded. When the wound is not too large and infection has not occurred, the borders of the wound soon adhere, the synovia ceases to flow, and the wound will heal without inflammation or permanent disturbance of the joint function; or a mild inflammation with a serous or sero-fibrinous synovitis may occur, but the symptoms soon subside. In infected cases the time at which the inflammatory symptoms appear will depend on whether infection has occurred at the time of the accident or later. In one group of cases the sides of the wound quickly unite, but on the third, fourth, or fifth day evidences of inflammation appear and rapidly increase; there are high fever and the constitutional symptoms of infection; the joint becomes tender, painful, and swollen, losing its normal outline; the skin becomes red and tense, and the site of the

wound is red, swollen, and even fluctuating. If the borders of the wound are separated, pus may appear. A second group of cases runs a more acute course, particularly those in which there is a large effusion of blood into the joint. In these the local and constitutional symptoms of suppuration appear within twenty-four hours, and unless the joint is freely opened and drained the results are most unfavorable; indeed, it may be necessary to resect in order to avoid the gangrene which may occur, accompanied by the constitutional evidences of sepsis. In still another group of cases the course is more sub-acute and the joint exudate, while large, is not strictly suppurative, but looks like cloudy synovia mixed with flakes containing pus cells. The most severe cases are those septic or gangrenous inflammations of the joint in which death occurs from septicæmia as early as on the fourth or fifth day (Tillmans).

Diagnosis.—In extensive wounds the diagnosis, as a rule, can be made by inspection, and the cartilages and other internal structures of the joint may be seen and felt. In punctured and small incised wounds the diagnosis is based on the history of the case, the character of the agent producing the wound, and the escape of synovial fluid. The agent producing the wound should, when possible, be examined to determine its physical properties, the probability of its having penetrated, and whether or not a piece may have broken from it and remained in the joint. The synovial fluid, as pointed out, may come from the joint, a tendinous sheath, or a bursa; if the last is one not connected with a joint, the fluid will escape only in small quantity. Probing to determine whether or not a wound has penetrated is allowable only under the most rigid aseptic precautions; even then it is conceivable that germs may be carried from the surface wound into the joint. Often the wound has already closed when the case is first seen, and one must await developments. At the first sign of inflammation, local or constitutional, an examination of the blood for leucocytosis should be made and some of the exudate in the joint should be drawn off, for purposes of examination, by means of a sterilized hypodermic needle.

Treatment.—All wounds of joints should invariably be treated with the strictest aseptic precautions. In a fresh case, if the wound is a small, incised, or punctured one, and the flow of synovia warrants the belief that septic influences have not as yet gained admission to the joint, then the wound and neighboring skin should be thoroughly cleansed in a strong antiseptic solution, a copious dressing should be applied, and the limb immobilized. Some surgeons recommend the immediate suturing of the wound under such circumstances, which course will be the more rapidly followed by repair; but it is evident that the wound should be closed only when it is certain that there is no infection. In the absence of this assurance, it is better to dust with iodoform and lightly pack the wound. When no infection has occurred, repair is rapid and the joint functions are not impaired. If, at a later date, the constitutional and local symptoms (fever with swelling of the joint and pain) warrant the belief that an acute suppurative inflammation has developed, then the joint cavity should be freely opened, carefully drained, and irrigated with a 1 : 2,000 bichloride solution. It should be dressed antiseptically, immobilized completely, and thereafter washed and redressed often enough to keep it clean; or else continuous irrigation may be established. Often this treatment is followed by a rapid abatement of the inflammatory symptoms and perfect mobility of the joint may be secured. If, when the patient is first seen, suppuration has already been established the same treatment may be adopted: that is, incision, drainage, which can scarcely be too free, and irrigation, either intermittent or continuous. In some cases, after incision, gauze packing may be employed. In certain cases, in spite of disinfection and drainage, severe constitutional disturbances occur. If the suppuration is so extensive that drainage of the joint presents great difficulties, then resection may be indicated; if systemic infection is threatened, it may be necessary to resort to ampu-

tation or disarticulation to remove the focus of infection (Tillmans). In extensive wounds which communicate with the cavity of the joint and leave little doubt that septic influences have gained admission, the joint should be irrigated thoroughly, foreign bodies should be removed, and the joint drained. The wound, if incised, should be loosely sewn, two rows of sutures being employed, a deep one of catgut which closes the rent in the synovial membrane, and a superficial one of suitable material closing the other structures. Contused and lacerated wounds should also be loosely sewn after their edges have been trimmed. When there is much laceration, however, and particularly when this is coupled with infection, it is well to pack the wounds. Cold, to lessen the inflammatory processes in a wounded joint, may be applied by placing ice bags outside of a wet antiseptic dressing, or an ice-cold antiseptic fluid may be used for continuous irrigation. When ankylosis is likely to follow, the position of the limb should be such as to make it most useful. Excision or amputation may be necessary when a wound is followed by disorganization of the joint structures.

Prognosis.—The gravity depends on the joint involved, the size and character of the wound, the age and condition of the patient, but mostly upon the occurrence of infection. Since the introduction of aseptic and antiseptic methods, the prognosis of penetrating joint wounds has improved greatly. When no infection has occurred, the cases usually run a very mild course and recover without any loss of function. Even in large wounds, if infection can be prevented, repair may take place without diminution of the usefulness of the joint. Even when suppuration has been established, the prognosis for life is good if the drainage and antiseptics are thorough, and in some cases the joint recovers its functions. As a rule, however, the joint is more or less damaged and the usual sequel of a continued suppuration is a more or less complete ankylosis. In certain cases death results in a few days from septicæmia; in others the course is more tedious, death resulting from pyæmia and exhaustion from prolonged suppuration and suffering; erysipelas and tetanus, though rare, are sometimes seen. "It should always be kept in mind that the risk is due not to the fact that an articulation is involved, but to the liability of infection and the difficulty, once infection has occurred, of preventing its spread."

Incised Wounds are caused by a sharp or cutting instrument. The character of these wounds is influenced by the condition of the cutting edge, by the cleanliness of the instrument, and by the size of the incision. They are less likely to be infected than the contused or lacerated varieties, and as a rule it is not only possible but advisable to close them by sutures.

Punctured Wounds are caused by the agents producing punctured wounds elsewhere; they are less dangerous, as a rule, than the lacerated, but more dangerous and more difficult of diagnosis than the incised. The severity of a punctured wound depends on the size and condition of the agent causing it and on the force expended. A small polished agent, free from septic matter, may cause little disturbance, but a blunt, rusty, or contaminated one is almost certain to be followed by inflammation. The diagnosis is rendered more difficult by the tendency of the punctured wound to close and shut off the escape of the synovia. Evidences of synovitis coming on in a few days would be almost certain evidence of contamination. When there is any question as to the character of the fluid in the joint, it should be withdrawn by a clean aspirator and examined.

Contused and Lacerated Wounds are usually caused by direct violence. They may be slight in degree, involving only the superficial tissue, or extensive, accompanied by compound fracture or dislocation and even by complete crushing and disorganization of the joint. Owing to their nature and the character and degree of violence producing them, these wounds are accompanied by symptoms of great gravity and by pronounced shock. In the non-penetrating wounds there is usually a certain amount of exudate in the joint, etc. Their treatment is, there-

fore, the treatment for lacerated and contused wounds elsewhere (antiseptics, suturing) plus the treatment for sprains (immobilization of the joint with elastic pressure, etc.). In the extensive and penetrating cases the shock must be carefully attended to, and until reaction is established the local treatment is antiseptics, control of hemorrhage, and immobilization. If there is a complicating dislocation or fracture, it should be attended to at once if possible. After reaction has taken place, an anæsthetic should be administered, the temporary dressings removed, and the joint cavity thoroughly washed out first with a 1 : 2,000 bichloride solution, and later with one of only 1 : 8,000, all foreign bodies being removed from the joint cavity or the soft tissues. Drainage tubes are then properly placed and the torn edges of the wound, having been trimmed to remove the devitalized portions, are closed by catgut; the whole is covered with gauze and immovably fixed. When laceration is so extensive that the wound edges cannot be apposed, it is better to pack the wound. Where laceration of the soft parts is extensive and complicated by crushing of the bones, it may be necessary to resect or even amputate.

DRAINAGE OF SPECIAL JOINTS.—The importance of thorough drainage of all suppurating cavities is empha-

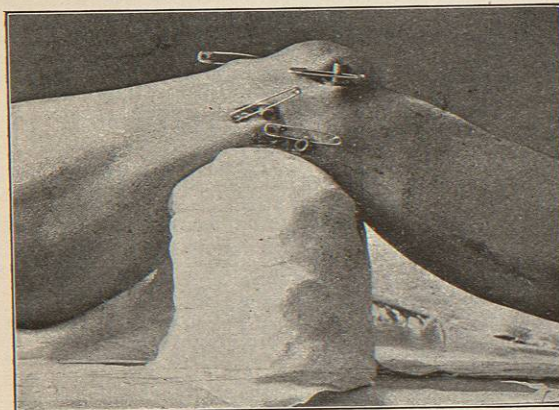


FIG. 3046.—Draining Knee-Joint in Slightly Flexed Position, with Drainage tubes in place.

sized in the case of joints which are drained with difficulty owing to their anatomical peculiarities. The same rules, however, govern here as elsewhere; namely, to drain at the most dependent portion and in accordance with the laws of gravity; in addition, care must be taken that all pockets of the joint cavity are effectively drained.

The *knee*, the articulation most frequently in need of drainage, has a very extensive and irregular synovial membrane. The most dependent portions of its synovial cavity, in the recumbent posture, are the cup-shaped depressions in which the condyles of the femur rest. The synovial membrane also forms a short cul-de-sac beneath the quadriceps extensor tendon above the level of the patella. Still higher, reaching often to a finger's length above the patella when the leg is extended, is found a large synovial bursa which usually communicates with the joint cavity by a large opening, which may, however, be much constricted or entirely closed. There are other bursæ that may communicate with this joint: one beneath the outer, a second beneath the inner head of the gastrocnemius, and a third between the tendon of the popliteus and the outer condyle, but as a rule these are small, rarely involved in suppuration, and do not require separate drainage. Flexion of the knee relaxes the lateral and posterior ligaments, permits a slight separation of tibia and femur, draws down the synovial

bursa beneath the quadriceps, also draws down the patella and applies it with more or less firmness, depending on the degree of flexion, to the articular surface of the femur, thus dividing practically the main cavity into two parts, a small one above the patella, communicating with the synovial bursa, and a larger one below and behind. Neither subdivision can during flexion be drained effectively by way of the other. Extension, on the other hand, brings the femur and tibia in close apposition, tightens all lateral and posterior ligaments, but relaxes the anterior structures, permitting the patella, the upper cul-de-sac of the synovial membrane, and the synovial bursa to recede farther up the anterior surface of the thigh.

The best drainage, then, can be obtained in the following way (Fig. 3046): Flex the leg slightly, permitting the hamstring tendons to recede backward and inward, thus uncovering the posterior aspects of the condyles of the femur; make an opening on either side of the patella into the joint cavity; through these openings carry a grooved director, or blunt-pointed scissors curved on the flat, backward beneath the corresponding lateral ligaments to the most dependent part of the condylar pouches; cut down upon the end of the director or scissors, making a free opening, and carry tubes from the anterior to the corresponding posterior openings; dress and fix the leg in the slightly flexed position by some form of splint. The most dependent point of the inner pouch is reached by passing the probe backward and obliquely upward; the outer one is reached, by passing it almost directly backward. The synovial bursa beneath the quadriceps always needs a separate drain, whether it communicates with the general joint cavity or not, except in those rare cases in which it is separate and *not* invaded by the suppuration. The lowest part of this bursa is on the outer side where it extends backward to the intermuscular septum attached to the external condyloid ridge. Here the drainage tube should be placed; it may be a single tube entering the bursa only, or crossing and emerging at the opposite side. When the bursa communicates with the joint cavity by a constricted opening, the latter may be dilated with benefit. In the extended position, the drainage tubes are squeezed by the lateral ligaments, or, if the tubes cross the joint cavity, by the bones; the posterior ligament being taut also interferes with drainage of the posterior pockets. When ankylosis is feared, however, one may be compelled to adopt the extended position; then one of the following methods, or some modification will serve the purpose: (a) In mild cases, incisions on both sides of the patella and short drainage tubes; in severe cases, the bursa beneath the quadriceps to be separately drained (Esmarch); (b) by carrying a tube into the joint to the inner side and opposite the lower part of the patella, backward through the intercondyloid notch and the popliteal space to the outer side of the vessels (this is the only situation in which a tube can traverse the joint without compression); (c) another method recently recommended is to locate short tubes at either side of the patella in front and a third one well back in the joint, crossing from side to side. The last is, however, impossible unless the joint has been disorganized by suppuration or injury. Glass tubes are recommended by Tillmans.

The *ankle* is best drained by through-and-through drainage placed at the posterior part of the joint. The *hip-joint* can be drained in front of or behind the great trochanter. The *shoulder-joint* is most superficial and can be most readily opened from in front, but in the recumbent posture a drain may be placed posteriorly, or through-and-through drainage may be established, great care being exercised to avoid wounding the circumflex nerve. The *phalangeal* joints should be drained on their dorsal surfaces, or at the side, owing to the location of the flexor tendons and their sheaths in front. The *wrist*, the *carpal*, and the *tarsal* articulations are compound, possessing more than one independent synovial membrane. They should, as a rule, be drained from their dorsal surfaces, great care being taken to avoid

opening a synovial cavity not involved in the suppuration. The location of wounds, or the point at which suppuration processes "point," may in some degree modify the location of a drain.

GUNSHOT WOUNDS OF THE JOINTS.—Gunshot injuries of joints are practically complicated wounds, exhibiting the peculiarities of the contused and lacerated varieties and often combined in severe cases with extensive compound comminution of the articular ends of the bones. When a rifle ball of the regulation size passes through a joint, the bony, cartilaginous, and ligamentous structures are more or less disorganized and even the contiguous vessels and nerves may be seriously injured or destroyed. Modern projectiles, made wholly of or covered by steel, of small calibre and great velocity, are liable to pass clear through a joint, leaving only a small tubular wound. Because they are small, smooth, and hard, they retain their shape and are not likely to carry in pieces of clothing or leave fragments of themselves in the wound. Lead bullets change their shape, become deflected, and, at short range particularly, are likely to break into several pieces, some of which may remain in the wound; for these reasons the leaden bullets take more devious courses, produce relatively more comminution, and are more liable to carry infection. The wounds found in civil practice are, as a rule, made by small hand fire-arms (pistols, revolvers, etc.) carrying usually the leaden bullets of small calibre; these wounds are generally small and not accompanied by extensive comminution. If the missile is "spent" or propelled by insufficient force, it may produce a contusion only, or it may lodge in the joint cavity, or become more or less deeply embedded in the articular end of one of the bones.

Gunshot wounds may be extra- or intra-articular. The former involve the soft tissues over the joint and are only serious because of the possibility of a suppuration extending and involving the articular cavities. Intra-articular wounds open the capsule and are generally accompanied by injury of the bone, cartilage, and synovial membrane.

The course and effect of bullets are of great variety, but, for practical purposes, it may be assumed that a bullet has taken one of the following routes: (1) It may have passed through the cavity of the joint without injury to its bony or cartilaginous structures; (2) it may have entered the joint and remained loose in the cavity; (3) it may have entered the joint cavity and become embedded more or less completely in the head of a bone; (4) it may have passed through or remained in the joint after having fractured the bone; (5) it may have passed through the bone without having fractured it—tubular wound of bone;—(6) it may have caused a more or less extensive comminution of bone structure; and, finally (7), it may have destroyed the vascular or nervous supply to the limb below the point of injury.

Symptoms.—Shock is sometimes severe, particularly when there is extensive comminution; in many cases, however, it is absent or very mild. The pain as a rule is not great. Locally, there will be noticed the opening or openings caused by the bullet, from which there escape blood and synovial fluid. There will also be distention of the joint with blood (hæmarthrosis) or serum, loss of function, and crepitus, and the presence of bony fragments may be detected by manipulation. The escape of synovial fluid may, of course, come from a wounded bursa.

The *diagnosis* must be largely based on the symptoms. Probing to locate the ball should, as a rule, not be attempted, or it should be employed only under the strictest aseptic precautions. The porcelain-tipped probe of Nélaton, the electric probe of Graham Bell, the "telephone" probe of Girdner are all valuable aids, but the Roentgen ray furnishes the safest and most scientific method of locating a bullet or diagnosing a complicating fracture. A count of the white blood corpuscles may help to decide the question of beginning suppuration even before the other symptoms warrant opening the joint.

Treatment.—Severe shock must be treated by stimulants, etc., and if the loss of blood has been great, it may

be necessary to resort to venous or subcutaneous transfusion of salines (see *Shock*). The local operative treatment must be carried out under the strictest rules of asepsis. Great laceration of the soft parts, extensive comminution of bone, injury to the main vessels or nerves, combined or separately, demand amputation as a rule. Amputation, when the vascular supply is sufficient to prevent the death of the parts and the nervous supply ample to provide for the continuation of one or more functions of the limb, may often be delayed, at least for a short period of time. Less extensive injuries than those described may demand an atypical resection at once or at some time in the future.

At the present time, even quite extensive gunshot injuries of joints are treated by the expectant plan, which means: (1) rigid antiseptics; (2) the removal of loose fragments of bone and the bullet, particularly if the latter is easily found, is free in the joint cavity, or is so superficially embedded in the bone as to interfere with joint motion; (3) the introduction of drainage and irrigation of the joint; (4) the application of an antiseptic dressing; and (5) fixation of the limb by some form of splint. This is practically the treatment of a lacerated wound. Should the wound pursue a favorable course, we may hope for recovery with more or less impairment of the joint and possibly with complete ankylosis; if suppuration occurs and continues, amputation or excision may be performed later. In anticipation of the possibility of ankylosis, the limb should be kept in the position in which it would be most useful.

The gunshot wounds seen in civil, as well as many of those observed in modern military practice, are small and not accompanied by extensive comminution of bone. The *expectant treatment* as applied to them consists of sterilizing the wound superficially and the skin in its neighborhood, applying a copious antiseptic dressing, fixing the joint by a plaster-of-Paris or some other form of splint, and waiting. If no infection occurs, the splint may be removed after a few weeks and massage with passive motion begun. Infection, as evidenced by pain, rising temperature, increased leucocytes, etc., will demand the removal of the splint and the exploration and drainage of the joint. Hidden hemorrhage, a reasonable certainty of infection, etc., make it necessary even in these small wounds to explore at once, draining and irrigating the joint.

Complications and Prognosis.—A shot wound of a joint, however trivial it may appear, is never without danger. Pyæmia and septicæmia are the most common and fatal complications, and erysipelas and secondary hemorrhage claim their share of victims. The more extensive the injury done to the bone, especially the cancellous tissue, the greater the danger from blood poisoning. Thorough attention to the details of antiseptics and good drainage have already reduced, and will still further reduce, the frequency of septic complications. Ankylosis, caries, and necrosis are also common sequelæ of gunshot wounds.

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JOINTS, MOVABLE BODIES AND DEFECTIVE CARTILAGES IN.—I. **MOVABLE BODIES.**—The expression "joint derangement" is yet sometimes applied to the manifestations attendant on either of the conditions named in the title of this article and to such other enigmatical phenomena as not infrequently are witnessed in articulations. We are disposed to regard this expression as an antique form of words illustrative of a deficient knowledge of the special causes giving rise to the manifestations prompting its use. Later knowledge is narrowing its limits, and soon, we believe, will banish the phrase from surgical writings. The so-called derangement is due not only to the direct result of injury and disease of the component parts of the articulation, but also not infrequently to the presence, in joints, of the products of various histological processes that unaccountably happen elsewhere in the body in tissues similar to those of joints. The existence in a joint of a movable body was first recognized by Ambrose Paré in 1558, who then de-