

JAY (F. W.)

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Fixation in the Treatment of Fractures  
and Osteotomies, with a Report  
of a Case.

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BY F. W. JAY, M.D.

COLUMBUS MEMORIAL BUILDING, CHICAGO.

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Without attempting to depreciate the mechanical value of unabsorbable material as a means of direct fixation of the bone fragments in operations performed for the cure of fracture, the writer believes that bone repair is accomplished more rapidly and satisfactorily in the absence of foreign bodies from the bone. He is further convinced that in many cases in which some form of direct fixation of the fractured ends is required, a comparatively readily absorbable material will suffice. Consequently this case, an ununited fracture of the femur of one year's standing, in which some immediate mechanical support was required to retain the bone ends in apposition, and in which sutures of chromicized catgut met the requirements perfectly, is reported.

From the conditions found at the operation, and the methods adopted to secure fixation and union, some points of practical value may be gathered.

Histological research has demonstrated facts in regard to bone growth and bone repair, that should indicate to surgeons operating for the cure of fractures the value of details in the operative procedures which will greatly aid the *vis medicatrix naturæ*, and in the use of material of but temporary mechanical value we must carefully carry out all procedures that will aid nature's resources, in the accomplishment of bone repair. The case also demonstrates the operative procedures necessary to faithfully carry out in operating with absorbable material, which will enable

the temporary fixation to serve its purpose, and without which it is valueless.

Each detail of an operation performed for the cure of an ununited fracture, may prove of decisive value in obtaining union; and it was by the minor steps in the operation, as they are by some regarded, that union was effected in this case. As Senn says: "Brilliant operators are not always the best surgeons. The best results in surgery follow the one who is the most painstaking in following out the minutest details."

Considering the periosteum, or its inner layer, the cambium, and the endosteum as the two principal regions of bone, in which are found myeloid tissue with its bone-producing cells, or osteoblasts, the proliferation of which is to accomplish definitive union of fractured bones, (Virchow, C. O. Weber, Gurlt, Billroth, Volkman, Senn), we have in this case some points of interest and value demonstrated.

While definitive union between fractured bone ends is accomplished by proliferation of the osteoblasts of the compacta, as well as of the periosteum and marrow, the latter are regions in which are found bone-producing cells that are in a condition to respond more quickly to the requirements of repair by the early production of callus. These regions are the seat of osteoblasts in a constant and physiologic state of proliferation at the time the fracture occurs, and lose no time in initiating the process of repair. Kraft asserts that karyokinetic figures can be seen in the nuclei of the bone-producing cells of the periosteum twenty to thirty hours after the occurrence of fracture. Hence it is in these regions that we look for that early callus production that will allow of the use of such temporary fixation material as catgut. That such a process can take place promptly only under aseptic conditions is positive, as the method of repair of bone wounds is subject to the same division as the healing of any other tissue, *e.g.*, healing by primary and secondary intention,

considering healing by secondary intention where the proliferating cells are compelled to combat infected and suppurating surroundings.

As this was the second operation performed for the cure of this fracture and a buried wire suture had been used in the first operation, which had been performed six months previous to the one reported, the condition of the bone in which this wire suture was found may demonstrate the tendency of *aseptic*, unabsorbable foreign substances in bone to expedite or retard the process of repair.

The word *aseptic* is italicised because, in regarding the action of unabsorbable material in bone, we shall consider the material used as being absolutely aseptic in aseptic tissue and not influenced in any way by the action of bacteria.

I consider the most thorough antiseptic precautions necessary when catgut is to be used for the direct fixation of bone fragments, although should supuration occur at the seat of fracture it is a question if an unabsorbable foreign body when infected has not disadvantages that may overtop its mechanical virtues. In this paper we shall consider materials from their influence when aseptic. I believe in the ability of a conscientious and painstaking surgeon to prevent infection, and consider catgut in these cases a blessing to humanity made possible by antiseptic surgery. The possibilities of even aseptic foreign bodies in bone to determine subsequently the localization of bacteria floating in the circulation is worthy of serious consideration from the influence which such bodies possess to vitiate the surrounding parts, and thus establish a *locus minoris resistentiæ*.

The fact that chromicized catgut was used for the direct fixation of the bone ends, and the more permanent fixation accomplished by the external dressing, and not by more decided means of direct fixation; such as bone or ivory pegs or wire sutures, etc., and less substantial external support, as extension, is, I think, suggestive.

What served to retain the fractured ends in this case until union was accomplished will not establish any surgical rules, yet the fact that such means did serve, and serve perfectly, must be of some value and indicates a rather ideal method to adopt in suitable cases.

#### HISTORY OF CASE.

A maiden lady, 28 years of age, of good previous health, sustained Oct. 14, 1892, a fracture of the right femur, at the juncture of the upper and middle thirds. She was taken to her home and treated by Buck's extension and long-side splints for eight weeks. As there was no union at this time, her physician advised the forcible rubbing of the bone ends together, as a means of expediting union. She, however, desired to obtain hospital care, and was admitted to one of the large hospitals of the city Dec. 6, 1892. Here extension was applied and retained until April 24, 1893, during a portion of which time she was subjected to a thorough administration of iodid of potassium. As union had not been accomplished at this time, more radical treatment by means of an open operation was advised and consented to. The operation was performed April 24, 1893. The ends of the fragments were denuded and freshened, and one wire suture was introduced through the fragments, the ends of the wire buried, and wound of soft parts sutured. Buck's extension was applied. Primary healing of wound of soft parts. Patient stated that she felt motion at the seat of fracture on the third day following the operation. The use of extension and long-side splint was continued until her discharge from the hospital July 31, 1893. She returned to her home with very great and free mobility at the seat of fracture, completely bedridden. No further treatment was employed until October, 1893, at which time Dr. Milton Jay, by whose kindness I report the case, being called to see the patient, advised another radical attempt to secure union by open operation. The operation was performed at her home, Oct. 2,



1893. After a thorough preparation of the surroundings of the patient, and the site of the operation, an incision eight inches in length was made in the line of cicatrix, present as a result of the first operation, and the seat of fracture exposed. There had evidently been no attempt at callus formation, as the ends of the bones were conical in shape. They were considerably separated, freely movable, and covered by cicatricial tissue. The upper fragment was abducted and firmly ankylosed at the hip joint. No attempt was made to produce motion at the hip joint, as the immobility of the upper fragment would prove a strong factor in aiding fixation; and if the upper fragment was brought to its proper axis, a recurrence of the abduction would in all probability occur. It was better treatment to bring the entire limb into a line with the upper fragment and restore the motion at the hip joint after union of the fracture. A wire suture was found in the exposed end of the upper fragment in a perfectly aseptic condition, it having pulled through the lower fragment. It was easily removed, as the bone surrounding it was extremely osteoporotic. In denuding the ends of the fragments, the tissue in immediate contact with the bone was stripped back from the ends of the bone but not removed. It was found that the cicatricial tissue covering the lower end of the upper fragment was but loosely attached to the exterior of the bone, and its separation caused no hemorrhage from the bone; in fact, the bone appeared avascular, and a fear was expressed as to the viability of the upper fragment, or, at least, its lower two inches. This fear was intensified when the medullary cavity was exposed. The marrow was found pale, granular and avascular, as no hemorrhage was excited by removing fragments of it. The tissue surrounding the lower two inches of the upper fragment presented no appearance of active healthy periosteum, but resembled this membrane converted into cicatricial tissue, and its capacity to produce callus by proliferation of the osteo-

blasts of its inner layer was doubtful. On sawing through the upper fragment, the vessels of the bone were found pervious, as hemorrhage was excited and the bone was therefore viable; but with the little prospect of active cell proliferation from either periosteum or endosteum of the upper fragment, the accomplishment of bone repair and union of the fracture appeared hardly possible. It was believed that the proliferating capacity of the structures in the interior of the upper fragment, in the condition in which they were found, would not be sufficient to produce new bone; but that by curetting the medullary tissue from the cavity, until more active tissue was exposed, a growth of granulation tissue would occur, and that this new tissue would contain active proliferating osteoblasts. By the growth of this granulation tissue into the medullary cavity of the lower fragment and its union with the apparently healthy medullary tissue in this part of the bone, with the subsequent laying down of new bone, union would be greatly facilitated. The medullary cavity of the upper fragment was therefore curetted for a distance of three inches from the exposed end until healthy and vascular tissue was exposed. With the loss of bone from two operations permitting of the greatest mobility and the small surface of bone in apposition, inactivity-atrophy having greatly diminished the diameter of the bone, it would have been impossible to have retained the fragments in apposition without some means of direct fixation.

The bone sutures in this case, were of chromicized catgut, carefully prepared and reliable, of moderate size and used double.

The bone was drilled and sutures passed through a drill-hole into the medullary canal, out at a corresponding drill-hole in the other fragment and tied.

There were four of these circumferential sutures applied. The end of the lower fragment was made slightly convex from above downward to fit into a corresponding concavity made in the lower end of

the upper fragment, and when the sutures were tied, the bone ends were found to come perfectly into apposition with the limb abducted, into a line with the upper fragment.

The bone ends were in the apposition produced by a Fenwick's curvilinear osteotomy, which has been found efficient in preventing displacement, as well as having the advantage of sacrificing but a slight amount of tissue.

The atrophic and cicatricial periosteum of the upper fragment was stitched to the periosteum of the lower fragment, covering as completely as possible the break in the continuity of the bone. A most important detail in the operation is to provide a covering of periosteum for the line of fracture by suturing this structure carefully around the bone, thus incasing the space between the bone ends with an osteogenetic structure capable of filling the gap with new bone, as well as preventing the interposition of surrounding soft parts.

The slipping of the bone ends into a ferrule of decalcified bone, as advised by Dr. N. Senn, (*Annals of Surgery*, August, 1893) would prove a valuable aid to the reparative process, especially where it is found impossible to suture the periosteum over the line of fracture.

The wound of the soft parts was sutured from the bottom with several layers of buried catgut. This was done as carefully and thoroughly as could be, in order to obtain as early definite healing of the wounds of the soft parts as possible, especially in the immediate vicinity of the bone; the skin was sutured with catgut and a capillary drain of catgut applied in each end of the wound.

It will be evident that the incision in the soft parts was not only made ample, but that the bone ends were brought clearly into the wound and subjected to radical and thorough treatment. In operating for the relief of ununited fractures, the procedure must be most thorough and radical, being conservative

only to a rational degree. The treatment of the bone ends, in such a case as the one here reported should consist in an absolute subperiosteal resection and the bringing together of bone capable of initiating and completing the reparative process. If the bone is subjected to such treatment as this, the aseptic cases of ununited fracture in which union will not be accomplished are rare.

Jacobson—Ununited fractures of the femur: "The large number of failures after operations for this condition are well known. The difficulties which may be present during and after these operations are very considerable; among them, sufficient exposure of the fragments and keeping the wound aseptic are most prominent." He recommends the use of wire sutures, either temporary or permanent, and to treat the wound open to allow of perfect drainage.

Treves—As regards wiring the fragments, says: "So far as the long bones of the extremities are concerned, I think that this measure may very well be dispensed with. It is said that this wire excites the growth of new bone, but if it does it appears to effect its end at a great cost."

"As a practical measure, the wire is a delusion and a snare, so far, certainly, as the long bones are concerned."

Treves does not make use of any direct fixation of the fragments, but makes a subperiosteal resection of the bone ends, and the careful application of an efficient external dressing. This, I am sure, in many cases, providing the treatment of the bone ends is radical, and Treves certainly accomplishes this, will make the use of unabsorbable material unnecessary; but I believe that by the use of bone sutures of chromicized catgut, or some other resisting absorbable material, with the additional procedure of suturing the periosteum over the line of fracture, we have greatly aided the process of repair.

If the presence of permanent buried aseptic, unabsorbable foreign material, used for the direct fixation

of fractured bone ends, has a tendency, aside from the mechanical fixation, to expedite the reparative process in the bone, and the definitive union of the fracture, it must be due to the fact that the presence of such material in bone excites and retains a reparative process, and not a destructive one.

The presence of aseptic foreign bodies in bone must excite an osteosclerosis, and not an osteoporosis of the bone in order to *complete* the process of bone repair. All wounds of bone must heal by the formation of a bone cicatrix, of greater or less extent, and a bone cicatrix is formed of sclerosed bone. "But as soon as the fragments are fixed this union occurs, and ossification, running on to sclerosis follows."—*Green*.

Osteoporosis is an early step in the reparative process. "A rarefying osteitis begins probably immediately after the injury and results in a round-cell growth, which slowly eats away the walls of, and enlarges the Haversian canals."—*Green*. The value of this rarefying process in the early steps of bone repair is well demonstrated in the production of callus as a result of Brainard's drill operation.

The use of *temporary* ivory nails to expedite union of fractures, as recommended by Dieffenbach, is a valuable procedure, from the fact that their presence in the bone excites an osteoporosis at the seat of fracture, increasing the vascularity of the part and initiating the reparative process. After they have served this purpose they are a hindrance to repair. The continuation of this rarefying process is, if not actually destructive, at least inhibitory to repair, and will prevent the laying down of new bone in the immediate vicinity of the foreign body. To obtain union, requires the perfect completion of the reparative process; not the simple production of osteoporosis, but the subsequent proliferation of osteoblasts, with the final deposit of lime salts around the new cells. "Prompt bone union does not imply that the osteoblasts at the seat of fracture should

undergo karyokinetic changes and multiply, but that the new tissue must be placed under the influences of favorable chemical conditions, which will enable it to be transformed into bone."—*Senn*.

In the case here reported, the wire suture has been present in the bone six months, in a perfectly aseptic condition, and the surrounding bone for a considerable distance was in an extremely osteoporotic condition, while the upper end of the lower fragment in which there was no wire suture was of almost normal density; the slight osteoporosis present in this fragment was simply that due to inactivity.

This suture should have been imbedded in bone scar, or osteosclerotic tissue, after six months influence, if such influence has a tendency to produce this condition in bone.

As far as the conditions found in this case are concerned they demonstrate what is true, that the presence of aseptic unabsorbable material placed in the bone to serve as direct fixation, when allowed to remain beyond a certain limit of time tends to prevent union by retaining in its immediate vicinity a condition of osteoporosis.

"The ends of the fragments are variously affected in accordance with the extent of the rarefying and productive processes which follow the injury; according as one or the other predominates the ends are diminished in size, sometimes to slender conical points or enlarged by the formation of irregular masses of bone on them.

"In a very few cases the rarefying process has gone so far that a large portion or even the whole of the shaft has gradually disappeared.

This tendency to excessive rarefaction, when present is a serious obstacle to the success of the operation undertaken to secure union, and it has seemed to some writers to be increased by the presence of metallic sutures binding the fragments together."—*American Text-book of Surgery*.

The osteoclasts, excited into activity by the pres-

ence of any foreign body in bone, produce the osteoporosis, although in any case where the material and its site remains aseptic the osteoclasts are sure to be conquered finally, and the material become encysted by the action of the osteoblasts, the battle has delayed union to a greater or less extent, depending upon the relation of the amount of the foreign body to the size of the bone. I believe this rather theoretical assertion to be of real practical value, although I realize that many surgeons at the present time use telegraph wire to retain the fragments of a fractured ulna in apposition.

While the ability of bone to encyst aseptic foreign bodies has been proven by clinical and experimental demonstration, I believe that these foreign bodies retain a condition of osteoporosis at their site for a longer time than is compatible with early, prompt definitive union, and although this is probably never sufficient in itself to cause non-union, it is at least an indication to use as fine a wire as possible, and as small an amount of it as will meet the mechanical requirements.

"The use of metallic suture and similar devices to maintain the fragments in contact with each other is rarely desirable, since sufficient support can usually be given by the external apparatus; the presence of the foreign body appears somewhat to retard bony union."—*American Text-book of Surgery*.

Now, if by any method we can make a readily absorbable material serve the mechanical requirements in any of these cases, such a method should be adopted. Although among the cases requiring direct fixation, we may find at the present time but few in which the surgeon believes such temporary means will suffice, I predict that the number will constantly increase. In describing the repair of recent fractures, Green says: "The ends of the fragments are actively granulating at the end of three days; on the tenth day the periosteum has united and covers the spiral-shaped enlargement of the external

callus." And while in ununited fractures the history of the case has already proven that there are factors present that have prevented this rapid and satisfactory callous formation, it is believed by the writer that these factors are local in practically every case, and that if the operation is made thorough, as regards the resection of the bone ends, and the careful suturing of the periosteum, such a process as Green described will follow in the great majority of cases of ununited fracture.

In regard to the etiology of delayed union and ununited fractures, I will insert here the classification as found in the syllabus of Surgery by N. Senn, after the "American Text-Book of Surgery:"

Defective production of callus.	{	Suppuration.
		Scanty covering of soft parts.
		In joints.
		Defective local and general nutrition.
		Lateral displacements.
General causes.	{	Longitudinal displacements.
		Rachitis.
		Syphilis.
		Pregnancy.
		Lactation.
Delayed union and pseudarthrosis.	{	Marasmus.
		Acute disease.
		Displacements.
		Interposition of soft parts or foreign body.
		Defect in innervation.
Local causes.	{	Defective blood supply.
		Inflammat'n of surface of limb.
		Loss of substance.
		Application of cold.
		Imperfect reduction.
Faulty treatment.	{	Imperfect immobilization.
		Circular compression.
		Early passive motion.
		Early use of limb.



According to Lewis A. Stimson, "the causes of ununited fracture may be general or local. Among the former, are included general conditions and diseases which give rise to notable deterioration of the health, such as severe acute diseases, anemia, pregnancy and syphilis. Cases have been reported in which these affections have appeared to be the efficient causes, but they are so few that it must be admitted that the influence upon the healing of a fracture in general is very slight. Local causes are classified as follows: 1, unfavorable relations or conditions of the fractured part; 2, interposition of a foreign body; 3, defective innervation; 4, defective blood supply; 5, disease of the bone; 6, inflammation of the surface; 7, defective treatment."

Without commenting upon the causes of ununited fracture, I will make the assertion that the cases in which the essential factor is a constitutional one are very rare.

White and Wood report an interesting group of cases of ununited fractures in the *American Journal of the Medical Sciences* for January, 1893, and illustrate the use of an ingenious mechanical device for the direct temporary fixation of the bone ends, which should serve a most valuable purpose, especially in cases in which an open treatment of the wound was necessary on account of suppuration. They state that Hennequin, in a report of a series of unsuccessful cases of osteotomy and wiring for ununited fractures which he had published, attributed his failures to some constitutional condition interfering with repair. White and Wood state that Hennequin's report certainly illustrates the need of some more reliable and satisfactory method of fixation than the wire suture. This, they believe, will be found in the use of their apparatus.

I would say that in many cases absorbable material can not rationally take the place of unabsorbable and more decided mechanical fixation, and that the apparatus figured by White and Wood is ingeni-

ous and valuable from its mechanical virtues and the fact that it is of a temporary character, but I should attribute a certain number of Hennequin's failures, or any other series of failures, not to a constitutional factor interfering with repair, or to imperfect mechanical fixation of the bone ends, but to local conditions retarding or preventing union, conditions which he had not been able to overcome with even decided direct mechanical fixation, the use of which had perhaps led him to make use of insufficient external support. I believe that in selected cases the use of absorbable material for the direct fixation after a subperiosteal resection of the bone ends, with careful attention to the suturing of the periosteum, less reliance being placed upon decided means of direct fixation of the fragment, but extraordinary care in the external dressing, will be productive of better results.

Extension is out of the question when using absorbable material in a fracture of the femur, and in this case as the fracture was transverse, at the time of operation, and there was considerable loss of bone with very little inclination of the fragments to overlap there were no indications for its use. A plaster-of-paris cast was applied, encasing the entire limb, and the body to the armpits, and while hardening, the limb was abducted into a line with the upper fragment.

The catgut sutures in the bone would hold the bone ends in apposition until the cast hardened; they would be of effect until the periosteum and entire wound of the soft parts had united, and the drilling of the holes for the suture and the presence of the suture material itself would tend to excite a reparative process in the bone ends and would allow of such a process accomplishing early union of the fracture. The recovery in the case was uneventful. A fenestrum was made in the cast opposite the seat of fracture at the end of the third week, and the progress noted. There was not at any time much exter-

nal callus. Rotation of the foot was communicated to the pelvis at the end of ten weeks. The cast was removed at the termination of eleven weeks, at which time there was very little external callus perceptible. Another cast was applied, and allowed to remain five weeks, at the end of which time passive motion was begun at the hip and knee joints.

The fact that absorbable material answered so perfectly in this case may suggest the possibilities of such material as a means of direct fixation of the bone ends in operations of recent and ununited fracture, and the writer believes that the near future will find catgut more frequently used for the direct fixation of fractured bone ends, while the use of unabsorbable material will be less frequently adopted.

As regards direct fixation in osteotomies, we can best introduce what we have to say by quoting from an article by Dr. Wilson which appeared in the *American Journal of the Medical Sciences* for March, 1893, on "Fixation After Excision of the Knee Joint:"

"There is abundant evidence to prove that in many cases, notably those in which there was tubercular osteitis, primary bony union is rarely obtained until after months or years have elapsed, and often when it has apparently been accomplished it yields, resulting in subsequent deformity.

"This would indicate that temporary methods of fixation are inadequate and tend to the abandonment of catgut, which can exert retaining force for a comparatively short time only.

"Steel nails are of doubtful efficiency, because of the short time in which they are employed. They are usually removed at or about the fourth week, and are generally found to be loose, and therefore easily removed. (Italics my own.)

"These facts show that they could not have exerted any force. The same statements would apply to screws, gimlets, drills, dowels, or other methods which are removed during the course of the first treatment.

"In four cases in which I have used steel nails four inches long, I have found that *there was absolutely no resistance to their easy removal, and that they were simply loosely imbedded principally in the cancellous matter.* (Italics my own.)

"In experiments on the cadaver, screws or dowels did not prevent motion, but upon lifting the leg by the thigh the weight of the leg produced great separation.

"Rotation of the leg broke loose the attempted fixation, and they appeared to be perfectly useless without efficient external support, and the employment of the latter appeared to be just as efficacious.

In the same cadaver, I employed stout wire at four points, through holes drilled in the compact tissue, and found that the objectionable movements were entirely absent although great force was exerted.

"If the wire suture is efficiently used, it would appear to be the method promising the best ultimate results, but its success depends upon its long-continued use.

"I can not agree with Treves, that primary union is apt to be hindered by the use of the metallic suture, and that their presence excites carious action.

"I have seen cases where the wire sutures were in two years after an incision, and Bryant says that he has not removed the wires in any case, unless trouble was caused by them and this rarely occurred.

"The accurate approximation of the tibia and femur, secured by metallic sutures, *naturally permits of less dependence being placed upon the external fixation apparatus,* but should not tend to its disuse." (Italics my own.)

I quote from Dr. Wilson's paper at some length because I take exceptions to his conclusions.

I do agree with Treves that the primary union is apt to be hindered by the use of metallic sutures.

I would never allow decided means of direct fixation of the fragments to take the place of decided external support, but always place my reliance on the

nature of the external dressing, and make use of such means of direct fixation of the fractured ends as would be productive of the earliest possible bony union.

The only guarantee against later deformity is the absolute and perfect repair and complete ossification of the bone ends, which is accomplished best in the absence of foreign bodies, and if this is not accomplished, wire sutures will never prevent such deformity taking place.

Dr. Wilson reports in his paper a case of excision of the knee, in which he used internal fixation of chromicized catgut, and applied an efficient external dressing of plaster-of-paris including leg, thigh and pelvis, which was allowed to remain five weeks.

At this time, as apparently bony union had occurred, the patient was allowed to walk about, using a light posterior apparatus of plaster. Six months from the time of resection there was found a backward displacement of the tibia.

Dr. Wilson doubts the value of catgut as a means of internal fixation in these cases, and he suggests the use of wire sutures. I attribute the occurrence of post-operative deformity in the case he reports, to the fact that the apparent bony union present at the time the primary cast was removed was not yet complete. I must defend the manner in which this operation was performed, and attribute the latter deformity to some other cause than the use of catgut. I believe with Dr. Wilson that an important point in preventing such an occurrence is the prolonged use of an external support; but I do not believe as Dr. Wilson does, that wire sutures will prevent such late displacement taking place. I attribute the late deformities in these cases to the too early removal of substantial external support. In the case reported by Dr. Wilson, five weeks was too early a date to discontinue the plaster cast. Some of the late displacements take place as a result of an epiphyseolysis, or continuation of the osteoporosis from incomplete removal of the tubercular foci.

"The use of direct means of fixation of the resected ends in resection of the knee joint is being gradually abandoned. If the hip is well supported by a circular plaster-of-paris splint, or a posterior suspension splint, accurate apposition of the sawn surfaces and perfect immobilization of the limb are maintained almost to perfection, rendering the use of fixation nails or sutures unnecessary. The use of proper mechanical support should not be dispensed with until the resected ends have been united by an osseous callus, which will require, according to the age and general condition of the patient, from six weeks to three months."—*Senn's Tuberculosis of Bones and Joints.*

In arthrectomies and joint resections for tubercular affections in which Tilings' most valuable suggestions can be carried out, *e. g.*, temporary resections of those portions of the bone extremities to which important muscles and joint structures are attached; which can after the completion of the removal of the diseased tissue be replaced and fastened to the bone, catgut will serve a most excellent purpose. In the knee joints the patella is cut across transversely and later united with catgut sutures; at the elbow joint the olecranon is sawed with the insertion of the triceps and at the ankle joint temporary resection of the malleoli; at the hip joint the trochanter is temporarily resected and after the completion of the resection of the head of the femur the trochanter is united to the end of the bone, thus saving the attachment of important muscles, as well as securing a center of bone growth for the upper extremity of the femur; an important factor in the prevention of the shortening that follows removal of the epiphysis during the period of bone growth. In all these operations chromicized catgut will meet the fixation requirements.



