Fixation after excision of the knee / by H. Augustus Wilson.

Extracted from The American Journal of the Medical Sciences, March, 1893.

FIXATION AFTER EXCISION OF THE KNEE. 14.

By H. Augustus Wilson, M.D.,

PROFESSOR OF GENERAL AND ORTHOPÆDIC SURGERY IN THE PHILADELPHIA POLYCLINIC; CLINICAL PROFESSOR OF ORTHOPÆDIC SURGERY IN THE JEFFERSON MEDICAL COLLEGE; CONSULTING ORTHOPÆDIST TO THE PHILADELPHIA LYING-IN CHARITY, AND TO THE KENSINGTON HOSPITAL FOR WOMEN.

A patient with tubercular ostitis of condyles of the right femur with sinuses extending up the thigh, posterior displacement of tibia, and flexion, was confined in bed for a year. Excision of the necrosed condyles and of the sinuses leading thereto was performed, with removal of about one and one-half inches of femur and tibia. Three strong chromicized catgut sutures were employed to maintain an accurate coaptation, and a plaster-of-Paris splint, embracing entire leg, foot, thigh, and

Fig. 1.

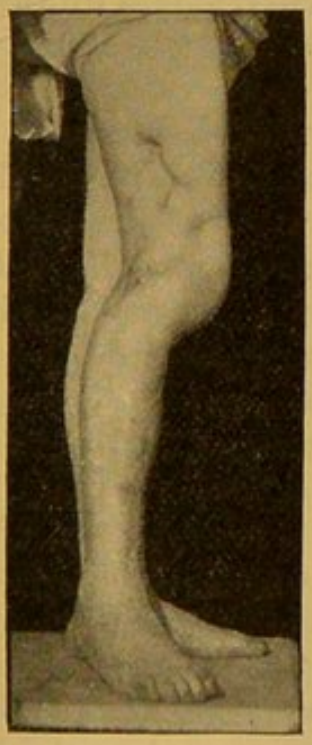
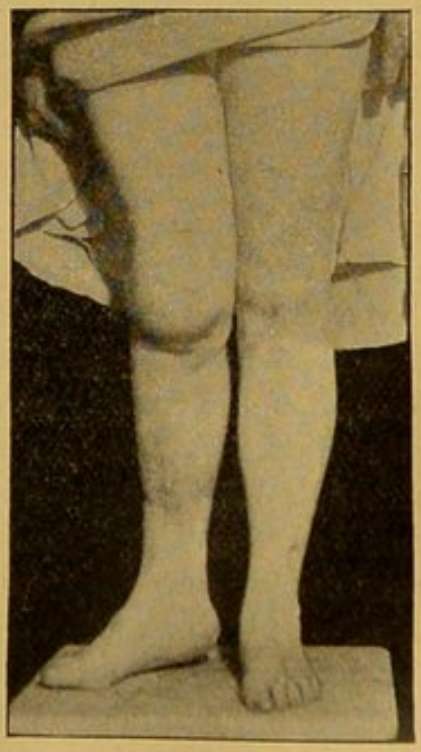


Fig. 2.



pelvis, was kept on for five weeks. When the fixed apparatus was removed the leg was perfectly straight, the wounds all perfectly healed, and there was apparently firm bony union. The patient was permitted to get up and go about on crutches without use of the affected leg, upon which a light rigid posterior apparatus of plaster-of-Paris was applied. Three months after the operation, the appearance of the knee being unchanged, she passed from my observation as cured, with firm bony union in a straight position. A year later I again saw the patient and learned that shortly after my last visit, *i. e.*, five months after the excision, she had

commenced to gradually use her right leg in walking with her crutches, and about four weeks later, or six months after operation, had discontinued the use of crutches altogether, all of which was contrary to my instructions. Upon examination, I found that the tibia had become displaced posteriorly, as shown in Fig. 1, and decided eversion of the foot and leg had taken place by rotation of the tibia, as shown in Fig. 2, but there was no flexion. The shortening was two inches. The patient declined further operative procedure in the hope that some form of mechanical apparatus would enable her to walk without fear of increasing deformity. Just here it will be of value to give brief notes of four cases that have direct bearing upon the one just read in showing the time at which patients have been able to walk.

Swain speaks of a case of excision that ten months after operation sustained a fracture of femur two inches above excised knee. (Swain: *Diseases and Injuries of Knee-joint*, p. 102.)

Ashhurst, in *Encyclopædia of Surgery*, speaks of a case, aged eighteen years, who walked with crutches one year after operation without any support to resected limb. There was still slight flexion and extension at knee, but no lateral motion. Patient fell and fractured fibula of resected leg without injury to knee. Two months later, walked with a single crutch. One month more, walked readily with cane and sometimes not that support.

Ashhurst also refers to a case in which two weeks after operation bony union had begun. In two months, splint was replaced by a pasteboard gutter and patient was allowed to sit up. Five months after the operation the patient walked unaided, supported by soap plaster and bandage. And another, who five months after operation, walked without crutch, cane, or assistance. There was firm union at a slight angle.

Upon looking up the subject in text-books on surgery, I found great diversity of opinion as to the necessity for the use of internal fixation, the method of operating, the kind of external appliance to be used, and the length of time in which immobility should be maintained. The Jacksonian prize essay on "Injuries and Diseases of the Knee-joint," by William Paul Swain, published in 1869, gives in an appendix the brief notes of one hundred and four cases of excision of the knee for various conditions and by various operators. They were all treated without internal fixation, dependence being placed upon external fixation by an apparatus something like the Thomas splint. The notes do not always accurately state the ultimate position of the leg, but apparently have reference more to the comparative mortality of excision and amputation. The following table was extracted therefrom in the effort to show the results obtained by the use only of external methods of fixation, which were employed for periods generally of two, three, four, and eight months after operation.

	Cases.
Firm straight union was obtained in	21
Fibrous or cartilaginous union	6
Serviceable limb	5
Good union	14
Fair amount of union	1
Subsequent flexion occurred in	4
Posterior displacement of tibia	2
Ultimate position or condition of leg not definitely stated	15
No union	9
Death not always associated with operation	19
Reëxcision on account of flexion	4
Reëxcision for return of disease	3
Amputation on account of there being no union	3
Amputation for return of disease	5

A more or less serviceable leg was obtained in 37 cases out of 104.

J. D. Bryant reports 10 cases in which good bony union was obtained in 1 case in two months; 2 cases in three months; 2 cases in four months; 1 case in seven months; slight flexion was present after four months in 2 cases; slight motion existed three months after operation in 1 case; 1 case died of Bright's disease on thirteenth day. (J. D. Bryant: *Trans. Am. Ortho. Assoc.*, 1891, p. 314.)

Hoffa found 14 cases of slight flexion and 30 cases of severe flexion in a total of 130 cases of excision of the knee. (*Arch. f. klin. Chir.*, 1885, iv. 32.)

Dr. Phelps reports 8 cases in which the results are here given: One case was wired, but flexor tendons were not cut; result, leg flexed. One case, reëxcision of the above; result, firm straight leg. One case cut hamstring tendons; result, firm straight. One case, four months after, firm straight. One case, nailed and wired, cut hamstrings; result, firm straight. One case, nailed and wired, cut hamstrings; result, firm straight in seven weeks. One death from ether. (A. M. Phelps: *Med. Record*, July 31, 1886.)

In 36 cases collected from various sources by Dr. A. M. Phelps (*Med. Record*, July 31, 1886), the results were as follows: Bony union seven weeks later, 1; bony union where the treatment was continued for 180 days, 1; fibrous union eight weeks after operation, 1; good, 2; good one year later, 1; firm union, 1; patient walked six miles, not stated how soon after operation, 1; useful limb, 5; cured, 1; walked well three months later, 1; one year later firm union, walked with ease, sixteen months after excision flexion to right angle (Morgan: *Brit. Med. Journ.*, July, 1879, p. 317); indefinite, 4; not stated, 4; recurrence, 1; no union, amputation, 1; subsequent relapse, amputation, 2; amputation, abscess cavity, 1; amputation for condition not stated, 1; no union, 4; death, tubercular miningitis, 1; death, shock, 1.

Roberts (*Modern Surgery*, p. 524) says: "Patients can walk in eight to ten weeks. No brace is required unless bony ankylosis does not occur." The difficulty of being sure that bony ankylosis has been obtained is so great that it would appear to be advisable to obtain, if possible, a greater assurance that the case will not relapse.

Note Morgan's case (*Brit. Med. Journ.*, July, 1879, p. 317) where, one year after excision the union was firm and the patient walked with ease, but four months later the leg became flexed to a right angle.

J. C. Schapps (*Brooklyn Med. Journ.*, July, 1892, vol. vi. p. 65) reports a case in which Wyeth's drills were used and a posterior steel splint. Splint was removed at end of four weeks. Two to three weeks later union was apparently firm. Eighteen months after the operation the limb was very much flexed, but there was no motion. Osteoclasis was done and plaster-of-Paris splint used for ten months. Thirteen months after osteoclasis and two and a half years after excision, patient was doing well.

Another case of a boy that left the hospital four months after excision, through error discontinued use of splint. Sixteen months after excision, leg was flexed a great deal. Osteoclasis and plaster-of-Paris were resorted to. Seven and one-half months after osteoclasis, or one and one-half years after excision, the leg was again flexed as greatly as before. Steel brace applied for eight months. Two years after excision the limb was reported firm, with flexion. (J. C. Schapps: *Brooklyn Med. Journ.*, July, 1892, vol. vi. p. 65.)

Gerster (Gerster, *Surgery*, ed. 1888, p. 287) records a case in which two nails were used, which were withdrawn on the twelfth day. Eight months after the operation the patient is said to have recovered.

Ashhurst (*Encyclopædia of Surgery*) records a case in which there was firm union nine and one-half months after excision. Two weeks later, with a splint on, walked readily with crutches. Two and one-half months later both splint and crutches were dispensed with. Seven years later, or eight years after excision, the limb was contracted at a right angle and immovable. The contraction had been coming on for two years.

Moullin says: "Union is fairly sound in a successful case at the end of six weeks, and the patient may then be allowed to get about on crutches, the limb being protected with a poroplastic casing or with Thomas's knee-splint. Some appliance of this kind must be worn for several years; in the case of children until the period of youth has ceased." (Moullin: *Treatise on Surgery*, p. 595.)

Later, even after years have passed, the osseous union sometimes yields and causes serious deformity. (Moullin, p. 595.)

Treves says: "The after-treatment is of the most importance, is tedious, and often surrounded with difficulties. There is a tendency to displacement, and notably to a displacement of the tibia backward." (Treves: *Manual of Operative Surgery*, vol. i. p. 692.)

"The limb must be kept upon the splint until it is sound. This period will vary from six weeks to three months. Complete recovery can usually not be expected until six months have elapsed." (Treves, p. 693.)

After the splint has been removed, a light leather support, strengthened with a strip of steel at the back, should be applied; and in the case of children, Mr. Jacobson advises that such a support be worn for three or more years. (Treves, p. 693.)

Erichsen says: "The result of the operation will mainly depend on the care taken in the after-treatment." (Erichsen's *Surgery*, vol. ii. p. 270.)

Swain remarks: "Throughout, one great object must be kept steadily in view, viz., *the perfect immobility of the limb*. At the end of one month to six weeks, retentive apparatus should be removed, and the limb placed in some other support."

The results obtained by the employment of external methods of fixation, as given in Swain's table of 104 cases, would appear to clearly indicate the necessity for the employment of internal fixation, in connection with efficient splints, that perfect coaptation may be obtained and maintained with less dependence upon the volition of the patient. The problem is, therefore: Which of the many methods employed offers the greatest assurance of permanent coaptation and prevention of relapse?

There is abundant evidence that in many cases, notably those in which there was tubercular ostitis, 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 clearly indicate that temporary methods of fixation are inadequate and tend to the abandonment of catgut, or even chromicized catgut, which can exert restraining 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. These facts show that they could not have exerted any force. The same statement would apply to screws, gimlets, drills, dowels, or other methods which were removed during the course of the first treatment.

Gerster (*Surgery*, ed. 1888, p. 287) reports a case where five nails were used. On the third day the dressings were changed, and four nails were found to be loose and were therefore withdrawn. Two and one-half months later the last nail was withdrawn. Four months after the operation, patient walked without crutches or stick, but used a silicate of soda splint. The union was not perfect.

In four cases in which I have used steel nails, three 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 cancel-

lous structure. In experiments upon a cadaver I found that nails, screws, or dowels did not prevent motion, but upon lifting the leg by the thigh the weight of the leg produced a 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 only, appeared to be just as efficacious. In the same cadaver I employed stout wire at four points, through holes drilled in the compact structure, 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 cannot agree with Treves, that primary union is apt to be hindered by the use of metallic sutures, and that their presence excites carious action. I have seen cases where the wire sutures were *in situ* two years after an excision, and Bryant (THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, 1892, vol. ciii. p. 116) 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.

Methods of operating with the view of more accurate fixation are numerous, and those most in use are Volkmann's, Fenwick's, and Neuber's. The patella plays an important part in Volkmann's and Neuber's methods, by its union to the tibia and femur acting like a splice, and where the patella is sound, its use is of advantage. Fenwick's method of dovetailing the femur and tibia by curvilinear incisions is more difficult of execution than straight incisions, and has a tendency to leave pockets between the sawed surfaces. It affords an effectual bar against either rotation or posterior displacement of the tibia, but will not prevent flexion. Phelps resorts to Fenwick's method, supplemented by section of flexor muscles, and his table of eight cases already quoted shows recovery with firm straight legs, but I have not been able to learn as to the length of time after operation that the cases were recorded.

The use of the patella is urged and discouraged by equally good authorities.

Treves says: "With regard to the patella, no good can result from its retention. If partially diseased, and the morbid parts be removed, there is still a fear of the mischief reappearing and extending. If apparently sound at the time of the operation, it may, if left, become attacked by destructive inflammation during the healing process.

"The retention of the bone and of the patellar ligament does not assist in retaining the femur and tibia in position, inasmuch as the

ligament becomes loose and relaxed when the limb is adjusted upon the splint.

"Since firm ankylosis is aimed at after the operation, the quadriceps muscle is of little value, and it has not been shown that the retention of the patella has increased the usefulness of the limb."

Golding Bird preserved the patella, but sawed it through transversely to reach the joint, and after the excision, united the two fragments of the bone with sutures.

Experience with traumatic transverse fractures of the patella has not shown subsequent bony union in a sufficient number of cases to give confidence as to its being of great use after division in the operation of excision of the knee.

Reidinger, like Neuber, would saw off the posterior surface of the patella, freshen the corresponding surfaces of the femur and tibia, and hold in contact by two steel nails driven straight in through the patella, one going into the femur and the other into the tibia. (*Centralbl. f. Chir.*, 1887, p. 440.)

Swain says that he has frequently seen severe spasm of the muscles of the thigh pull the femur up and render the adjustment of the limb most difficult; this seems to indicate that in transverse section of the patella there would be great difficulty in holding it in place, and this would complicate the operation upon the tibia and femur.

To avoid the disadvantages of transverse incisions through the patella, the longitudinal section was resorted to in order to have the unbroken restraining force of the patella and its attachment to the tibia to prevent flexion.

Treves says: "The method by a longitudinal incision is difficult and tedious; a small space is provided, a good view of the interior of the joint cannot be obtained, the removal of all the diseased tissue is less surely effected, and good drainage cannot be provided for unless a special drainage incision be made."

From what has already been said about the doubtful efficiency of the patella, the longitudinal incision offers no advantages over other methods. The supposed action of the flexor muscles in the production of flexion or posterior displacement of the tibia has led to their division as a part of the operation of excision. It is still a matter of dispute as to whether posterior displacement of the tibia is produced by the action of the flexor muscles, or whether it is an anterior displacement of the femur produced by the action of the extensor muscles of the thigh. I am inclined to the view that the latter is the predominant factor, depending upon the efficiency of the splint.

Erichsen has never found it necessary to divide hamstring tendons, and believes it complicates the operation. (Erichsen's *Surgery*, vol. ii. p. 270.)

Swain (*Injuries and Diseases of the Knee-joint*, 1869, p. 76) directs attention to the fact that the simple division of tendons in contracted knee-joints, where the tibia is dislocated backward, is sometimes of little use, as the contraction is found more in the fascia and deep tissue in contact with the posterior capsule than in the tendons themselves.

Gross says: "One of the most annoying occurrences to be guarded against is the tendency which the tibia has to be drawn outward and backward by the action of the flexor muscles of the thigh," and recommends subcutaneous section of tendons of the offending muscles. (Gross: *System of Surgery*, ed. 1872, vol. ii. p. 1099.)

Phelps, already quoted, regards the division of the hamstring tendons as an essential feature of the operation of excision.

The restraint afforded by the posterior ligament of the knee-joint is, I believe, of doubtful value from its naturally relaxed condition after the excision of the bones, to the amount of one to two or more inches.

Treves believes that in the majority of instances it is possible to leave the posterior ligament undisturbed. (Treves, p. 687.) And Moullin says that if the posterior ligament has been preserved, the bones are fairly secured without anything else. (Moullin, p. 594.)

In all of the operative procedures more or less reliance is placed upon the splint, according to the operator's views of the efficiency of the methods employed for securing internal fixation. The character of the external support is also directed from the same standpoint, and the forms of splints are more numerous than the methods of operating and producing internal fixation.

Heath recommends "a simple straight splint, reaching from the foot to the back of the thigh, with a foot-piece, which is all that is necessary for the treatment, and may be either iron or wood." (Heath: *Minor Surgery and Bandaging*, p. 265.)

Treves says: "Such a splint should be provided as will allow the bones to be kept in good position, will permit of free inspection and examination of the wound, and will not interfere with dressing and drainage." (Treves, p. 692.)

Bradford and Lovett recommend a perineal crutch (in the form of a Thomas splint), which shall prevent bearing any weight on the leg until several months after the operation. (*Orthopædic Surgery*, p. 394.)

"In general, however, plaster-of-Paris forms the most satisfactory splint put on over a heavy antiseptic dressing." (Bradford and Lovett: *Orthopædic Surgery*, p. 393.)

Moullin speaks of the necessity of having the splint arranged so as to have the limb entirely out of the patient's control. (Moullin's *Surgery*, ed. 1891, p. 595.)

This would appear to be the clearest description that could be given

for a splint, no matter of what material it should be constructed. I have seen splints in use that appeared to be all that could be desired, but upon further inspection it was found that the patient could readily move the femur in almost any direction. While this motion was limited, it was sufficient to retard the union or to produce some of the displacement referred to in cases where firm approximation was not obtained by internal fixation. In an adult it might possibly be safe to depend upon the patient to keep the leg still during the daytime, but irreparable damage could occur at night.

It is clearly apparent that the length of time the splint is used is of great importance, and yet upon this subject writers vary greatly.

The *American Text-book of Surgery* (p. 1134) recommends that "immobilization should be maintained for two, or, better, three months, and a posterior splint should be worn for many months longer."

Erichsen says: "If a useful limb can be preserved to the patient, it can matter but little if a few additional weeks be devoted to the procedure by which it is obtained." (Erichsen, vol. ii. p. 271.)

Treves urges that "The after-treatment is, on the whole, of more importance than the operation itself." (Treves, p. 681.) And this I have found warranted by a review of the cases already given, and as well in 10 cases operated upon by others that I have seen years after the excision was performed. In 5 cases there was a resulting flexion; in 3 there was posterior displacement of the tibia; in 2 there was marked rotation of the tibia. In all of these patients there was, six months after the operation, perfectly straight legs, and the union firm enough to bear the weight of the body.

In 2 cases the deformity began at seven months after excision; in 3 cases the deformity began at one year; in 2 cases the deformity began at one and a half years; in 1 case the deformity began at two years; in 1 case the deformity began at two years and three months; in 1 case the deformity began at three years.

It was impossible to obtain more definite information from these patients, but I have reason to believe that their statements are accurate.

As the knee is stiff, or designed to be, there can be but little objection to the prolonged use of a steel apparatus that would weigh, say five or six pounds at the most. The slight annoyance from the use of such a brace would be more than compensated for by the assurance of having a permanently straight and useful leg. Its use would act as an indicator of any yielding of the knee, and would direct attention to the necessity of avoiding its use in walking, or to its being given still greater support.

Conclusions.—The following statements appear to be warranted:

That metallic bone-sutures will secure the most efficient internal approximation.

That they should never be removed unless some serious conditions demand it.

That the entire leg should be kept free from the patient's control by external splint for from four to six weeks.

That the most important element in the treatment is the prolonged use of a rigid brace.