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THE

Forcible Straightening of Angular Deformities of the Knee by Means of Special Mechanical Appliances.

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Reprinted from the Boston Medical and Surgical Journal of December 1, 1892.

BOSTON:
DAMRELL & UPHAM, PUBLISHERS,
283 WASHINGTON STREET.
1892.

S. J. PARKHILL & CO., PRINTERS
BOSTON

THE FORCIBLE STRAIGHTENING OF ANGULAR DEFORMITIES OF THE KNEE BY MEANS OF SPECIAL MECHANICAL APPLIANCES.[1]

BY JOEL E. GOLDTHWAIT, M.D., OF BOSTON.

THE angular deformities resulting from disease in, or about, the knee-joint, may be corrected in four ways:

Gradual traction with fixation.

Rapid forcible correction (brisement forcé).

Osteotomy, usually above the condyles of the femur.

Excision, either of the whole joint, or of a wedge-shaped piece from the lower end of the femur.

The first method applies to the deformities occurring in, and presenting for, treatment, during the acute or sub-acute stages of the disease. At this time the condition is due, chiefly, to a spasmodic contraction of the posterior muscles, and immobilization combined with light extension, will, in the majority of cases, be all that is required.

The third and fourth, or the bone operations, are reserved for those cases in which there is firm bony anchylosis.

Rapid forcible straightening is to be tried in those cases in which, after the acute symptoms have subsided, the joint is held in the malposition by fibrous adhesions. If these be slight they can be broken up with the hands, and the leg straightened with comparatively little difficulty. In a certain number of cases, how-

[1] Read before the Surgical Section of the Suffolk District Medical Society, November 2, 1892.

ever, in which the deformity has lasted for a considerable length of time, the adhesions become so firm that more force must be applied, and the force applied in such a way that the hands alone are not sufficient.

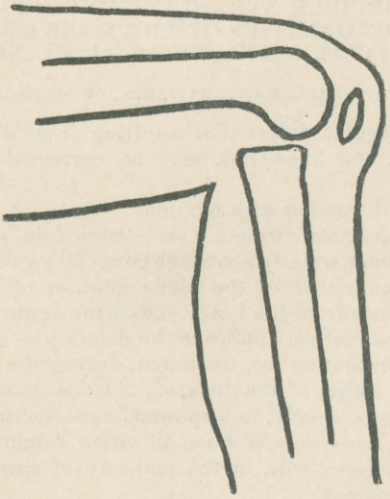

FIG. 1.

Two deformities are almost invariably present, that is, flexion, and luxation backwards of the head of the tibia upon the femur (Fig. 1). The correction of both of these is important. The former can be rectified with comparative ease, but in order to throw the head of the tibia forwards, mechanical appliances become necessary. (Fig. 2 shows the faulty apposition of the bones after the flexion alone has been overcome.)

It was to meet this condition that Dr. E. H. Bradford devised the instrument pictured in Figure 3. Its construction and mechanical principles are apparent. The plate *C* is forced forwards, carrying the head of the tibia with it, the counter-pressure coming upon the end of the femur by the straps *D*. After as much has been gained as is possible, in this way, the leg is straightened and the end of the femur, the straps *D*, still being the fulcrum, the head of the tibia is drawn forwards into its normal position.

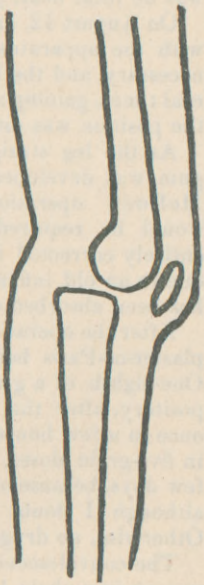

FIG. 2.

This appliance was first used upon a patient in 1887, by Dr. Bradford, and since that time six or seven cases have been treated in a similar manner, with such uniform satisfaction, that I have collected them and offer them for discussion to-night.

The first case, a girl sixteen years of age, with the right knee flexed at right angles, as the result of an old Tumor Albus. The deformity had existed for nearly eight years, and during that time she had been about with a crutch, the leg being an encumbrance rather than of any use.

She entered the Good Samaritan Hospital, on my service, in the early part of August last, and at that time her condition was as is pictured in Figure 4. The right knee was flexed to a right angle, and the head of the tibia was subluxated. There was very little, if

any, motion possible, and the bony change was comparatively slight. On the outer side was an old cicatrix, evidently the remains of an old sinus. There was no local heat, pain or tenderness.

On August 12, under ether, the leg was straightened with the apparatus figured above. Much force was necessary, and the instrument had to be reapplied several times, gaining a little with each application, before the position was satisfactory.

As the leg straightened, quite a marked genu-valgum was developed, so much that it was thought a McEwen operation or supra-condyloid osteotomy would be required later on. This, however, has entirely corrected itself, showing that it was probably due to an old inflammatory deposit on one side, which has been absorbed or has readjusted itself.

After the operation the leg was done up in a circular plaster-of-Paris bandage, from the toes to the groin. One-eighth of a grain of morphia was given by suppository, after the anæsthesia, and this was repeated once in a few hours, for pain. The salicylate of soda, in five-grain doses, three times daily, was given for a few days, because of its effect in controlling joint pain, although I doubt if it was necessary in this case. Otherwise, no drugs were used.

The convalescence was uninterruptedly good. She was up in a chair in one week, and about on crutches a few days later. In four weeks from the time of the operation she was walking about upon a Thomas caliper knee-splint, without crutches, and two weeks later she was discharged from the hospital with a perfectly straight leg, and with a few degrees of motion in the knee-joint, which has increased somewhat since then. Figure 5 represents her condition at about that time.

At present the patient is wearing the knee-splint, and walks about comfortably without other assistance.

FIG. 5.

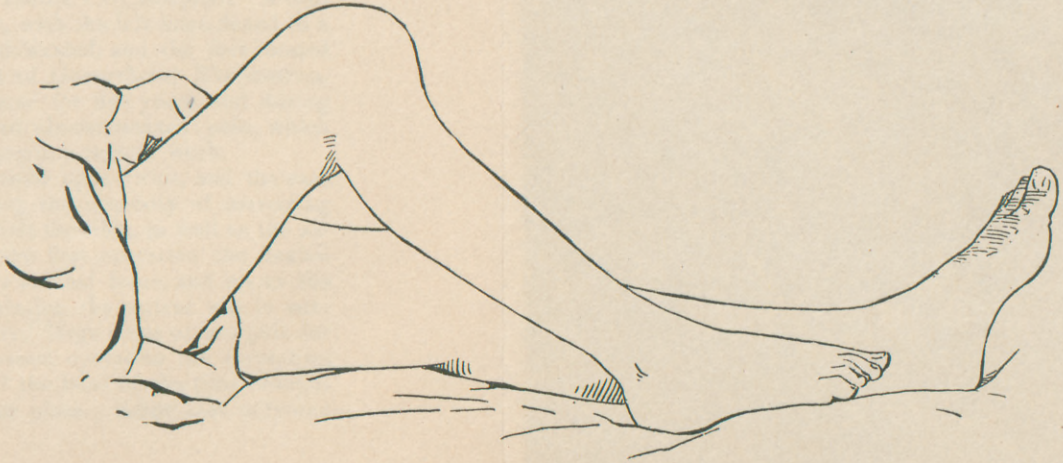

FIG. 4.

The other cases which have been treated in this way are as follows:

Case II. A patient of Dr. E. H. Bradford, at the Boston City Hospital. A young woman twenty-four years of age, with a right-angled contraction of one knee, as the result of Tumor Albus eighteen years before. The head of the tibia was dislocated backwards.

With the same appliance (Fig. 3) the tibia was forced forwards and the leg straightened. With the leg straight there was a marked knock-knee, which was corrected a few weeks later by osteotomy above the condyles of the femur. The patient was in the hospital for three months, and at the time of discharge could bear her whole weight upon the leg, but walked with the aid of one crutch. A year later she was walking about without any assistance, with the leg perfectly straight.

Case III. A patient of Dr. E. H. Bradford and Dr. Abner Post, at the Boston City Hospital. A man thirty-four years of age, with the left knee flexed to a right angle, the tibia subluxated, and the foot rotated outwards, as the result of Gonorrhœal Rheumatism. The deformity had existed for five years, and during that time he had suffered almost constant pain, which prevented him from doing any regular work.

The patient was operated upon twice, and the case is of interest as showing the necessity of correcting the position of the head of the tibia, as well as the angular deformity. At the first operation the flexion alone was corrected, by manual force, and up to the time of the second operation the patient was in constant pain, which required large doses of morphia for its control. At the second operation the correcting apparatus was used, and the head of the tibia brought forwards into its proper place. After that only one

dose of morphia was given, and in ten days of the time of operation, he left the hospital, walking with

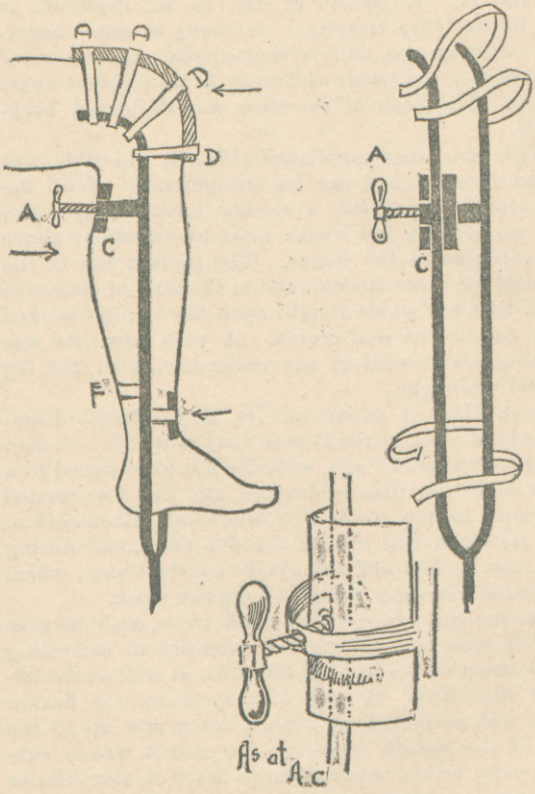

FIG. 3.

the aid of crutches, which were discarded a few months later, and a Thomas caliper knee-splint substi-

tuted to protect the joint. He still wears the splint, two and one-half years later, as a precaution, although without it he is able to walk perfectly well. The leg is straight, there is some motion at the knee, and the muscular development of the leg and thigh is very good, in marked contrast to the condition before the operation. He is entirely free from pain.

Case IV. A patient of Dr. E. H. Bradford, at the Boston City Hospital. A boy, nine years old, with right-angled contraction of the right knee, resulting from Tumor Albus, which had lasted for about five years. The leg was straightened by means of the correcting appliance, but before the deformity could be fully overcome it was necessary to divide the ham-string tendons which were firmly contracted.

In six weeks he was discharged from the hospital, wearing a Thomas knee-splint and using crutches.

There have been no unpleasant symptoms since the operation, and, at the present time, three years later, he is running about, wearing no apparatus, with a straight leg, and with some motion at the knee.

Case V. A patient of Dr. Abner Post, at the Boston City Hospital. A young girl, eighteen years old, with the right knee flexed to nearly a right angle as the result of an attack of Acute Articular Rheumatism a number of months before.

After a trial of several weeks in bed, with constant extension, without improvement, the leg was straightened with the same appliance as was used in the other cases.

At the present time, about seven months after the operation, there is considerable motion in the joint, and she is able to go about with very little difficulty.

Case VI. A patient of Dr. C. L. Scudder. A woman about thirty years of age, in which the deformity was due to articular rheumatism. The leg was

straightened in the same manner as with the other cases and a very satisfactory result obtained.

I am indebted to Dr. E. H. Bradford, Dr. Abner Post, and Dr. C. L. Scudder, for permission to report their cases.

The results obtained in these cases are of interest as contrasted with the results of other operations, which are performed in the same class of cases and for the same purpose, that is, to relieve pain and to enable the patient to be about, and at work, if need be.

In the first place, at least three of the six cases had been strongly urged to have the leg amputated, and that by surgeons of ability.

It needs no argument to show that from the present condition of the patients they are better off than with wooden legs.

Excision, which is done more commonly in these cases mutilates the leg. It causes noticeable shortening, invariably leaves a stiff leg, and furthermore, is an operation having a mortality rate, in young persons of 9.42%,[2] or a per cent. that is much higher where adult cases are included. Culbertson,[3] in an analysis of from 600 to 700 operations done upon patients ranging in age from five to forty years, found a mortality rate of 29.8%.

This is in marked contrast to rapid forcible straightening, which is a much more conservative treatment, and not only have there been no fatal cases thus far, but the amount of constitutional disturbance as a result of the operation, has been surprisingly slight, considering the amount of force that is required to accomplish the result. There has been but a slight elevation of temperature in any of the cases, and the pain has not been at all severe. The leg is not shortened as a result

[2] A. M. Phelps: New York State Society Transactions, 1886, p. 586.
[3] Bradford and Lovett: Orthopedic Surgery, p. 389.

of the operation, and recovery usually takes place with a somewhat movable joint.

Three objections to the operation have been offered: the danger of starting up a severe acute arthritis; the liability of fracture of some of the bones about the joint; and the danger of injuring the vessels and nerve in the popliteal space.

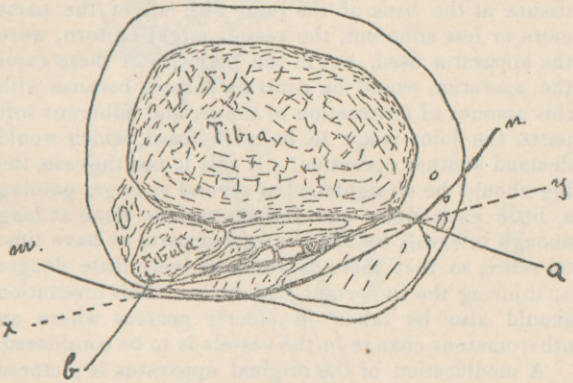

FIG. 6.

The first should be avoided by the selection of the cases, and by the judicious application of the force.

The second should not occur if the apparatus is properly applied and due caution observed in its use.

The third, or the danger of injuring the vessels and nerve, is not apt to occur because of the anatomical relations of the structures behind the joint. Through the kindness of Dr. Dwight of the Harvard Medical School, I have been able to study the relations of these structures from frozen sections and Figure 6 was drawn from a section made through the head of the tibia.

This shows very clearly the way in which the tibia and fibula, at *a* and *b* act as buttresses to protect the vessels from pressure even though the force be applied with a straight band as is represented by the dotted line *x*–*y*. The actual curved band of the apparatus, still further protects these structures from injury, as is shown by the line *n*–*m*.

In the case of former extensive destruction of the tissues at the back of the joint with all of the parts more or less adherent, the vessels might be torn, were the apparatus used, but in the majority of these cases the operation would be contraindicated, because with this amount of destruction of tissue, and adherent soft parts, the joint is apt to be anchylosed, which would demand another operation. If this is not the case, the leg should be straightened at several sittings, gaining a little each time, and the operations done at long enough intervals for the contracted parts to have time to relax, so that there is comparatively little danger of injuring the important structures. This precaution should also be taken in elderly persons where an atheromatous change in the vessels is to be considered.

A modification of the original apparatus is pictured in Figure 7, which has the advantage of being adjustable, so that by moving the arch *a*, upon which the power is applied, nearer to, or farther from, the knee, it can be used upon a child or an adult. The application of the power in front instead of behind, is more convenient and more easily managed. The screw *b*, working in the arch *a*, raises the cross-bar *c*, to which the posterior band *d*, is attached by means of the steel loops *e*. The counter-pressure comes upon the end of the femur by means of the leather pad *f*, and to a less extent upon the strap *g*. The apparatus as applied is shown in Figure 8. I am indebted to Dr. Bradford for suggestions in perfecting this apparatus.

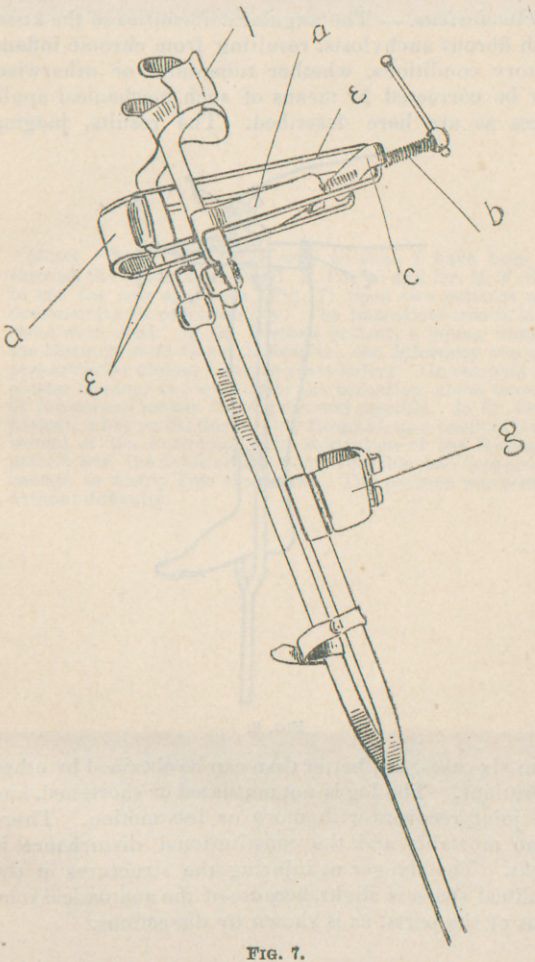

FIG. 7.

Conclusions. — The angular deformities of the knee, with fibrous anchylosis, resulting from chronic inflammatory conditions, whether tubercular or otherwise, can be corrected by means of such mechanical appliances as are here described. The results, judging

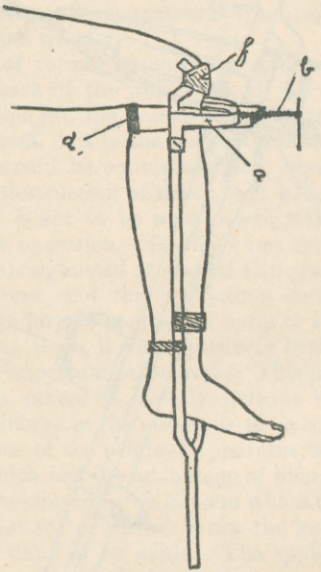

FIG. 8.

from six cases, are better than can be obtained by other operations. The leg is not mutilated or shortened, and the joint recovers with more or less motion. There is no mortality and the constitutional disturbance is slight. The danger of injuring the structures in the popliteal space is slight, because of the anatomical relations of the parts, as is shown by dissections.

NOTE. Since this paper was written, I have been able, through the kindness of Dr. C. B. Porter and Dr. M. F. Gavin, to use the new appliance (Fig. 7) upon two patients and to demonstrate its practicability. The immediate results in both cases were good. In Dr. Porter's patient, a young woman at the Massachusetts General Hospital, the deformity was due to peri-articular disease fourteen years before. On removal of the plaster bandage one week after the operation, about two-thirds of the normal motion in the joint was possible. In Dr Gavin's patient, a boy at the Boston City Hospital, as a result of a septic wound of the knee-joint with separation of the ligamentum patella and the anterior ligament, the tibia had dropped back enough to nearly free the femur. The position was corrected without difficulty.

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