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HINTS ON THE DIAGNOSIS AND TREATMENT OF CLUB-FOOT.

BY BUCKMINSTER BROWN, M. D.

THE theory has been advanced by an English surgeon that talipes is always due to paralysis of certain muscles or sets of muscles. This theory, adduced dogmatically and without proof, has never been directly impugned or controverted. It has been adopted to some extent in this country by those of little experience, or who have neglected, in making their diagnosis, simple and obvious methods by which certainty on this point can be reached. Upon this hypothesis Mr. Barwell has founded a treatment, tedious as respects the time required, complicated in its application, and unsatisfactory in its results. This system, as is well known, consists of the application of various adhesive straps with elastic attachments, which are placed as nearly as possible over the origin and insertion, and are to follow the course of the supposed paralyzed muscles. In this way an endeavor is made to supply the place of the muscles referred to by the introduction of an artificial elastic force. The impossibility of successfully imitating nature, the disadvantage under which the power is used, the waste of force, the crowding together of bones in unnatural relation to each other, the alternative of the plaster slipping and losing any efficient hold on the parts to which it is attached, are objections to this mode of treatment which are sufficiently obvious.

Other methods have been devised, founded upon the same basis, which are but varied forms of that above described. In addition to these drawbacks we have the length of time which is confessedly required in cases of congenital varus, even in the hands of the contriver of the method; and the imperfection of the result as shown in the cases which he has cited. That this treatment is complicated is evident; that it is tedious and unsatisfactory as compared to other measures, which he disapproves and would supplant, no other evidence is needed than the author's record.

A glance at the only cases of varus, an account of which he has given in his work on this subject, four in number, will be sufficient.

In the first case, — whether congenital or non-congenital is not stated,

—the plasters were applied in July, 1864. In June, 1865, eleven months afterwards, the foot, as seen in the photograph, is still inverted, with a rising at the medio-tarsal joint and of the internal border of the foot and a crowding downward of the toes, while the heel lightly touches the ground, giving evidence that the contraction of the tendo-Achillis has not been overcome. Thus much is plainly visible to an eye accustomed to these photographic representations.

The length of treatment in the second case is not stated. The photograph taken after one month's treatment shows the condition of the foot but little changed from that represented in the first picture of the same foot.

The third case is one of infantile paralysis, existing three years, patient five years of age. Treatment by plasters commenced March 14, 1864, and ended June 5, 1864, nearly three months; but the case was still kept under observation as late as March, 1865. The ætiology of this case removes it from the class we are considering. Such feet are generally put into position with comparative ease, and whether they remain so depends upon the recovery or not of muscular power. In a certain number of such cases the muscles do regain their strength, and it often suffices simply to return the member to a normal shape, thus relieving the extension of the affected parts to effect a cure.

The fourth case had been previously operated upon. Treatment by plaster commenced April 13, 1864, and in July, the date of the last record, the case was not cured.

Contrast such results as these with the success attained by combined operative and mechanical surgery in the hands of those who have used and not abused these methods.

Surgeons who have from time to time published their experience in such cases, and with it photographic or other representations, and whose patients have been seen by considerable bodies of men, members of the profession, are tempted to consider this question (the best method of treating talipes) as settled by these results, and do not deem it requisite to produce new cases to reinforce principles which have been abundantly proved. Where perfection or a near approach to it has been continually reached in the treatment of talipes, where after treatment the feet are normal in shape, motion, and usefulness, it would seem unnecessary to reiterate principles thus enforced, and which the most extensive experience has approved. The average length of time required to obtain these results by the method indicated, in skilled hands, is three months. In some instances sixty days is sufficient; in others the period of treatment may need to be extended beyond the time I have mentioned. After the cure is completed steel supports, in a majority of cases, are not required, and should not be permitted.

The theory referred to nevertheless has, as we have said, gained some foot-hold, apparently because it has never been shown to be erroneous,

and systems of treatment have been founded thereon which are an injustice alike to the patient and to the physician. The primary principle upon which the processes referred to are based can be proved correct or otherwise by the use of very simple expedients when making our diagnosis. This principle, as already stated, is that the loss of balance in muscular action is caused by paralysis or debility of a certain set of muscles. In varus it is declared that the abductors are in fault, that these are congenitally paralyzed. The cases of congenital varus in which this loss of power is present are very infrequent. They are in truth exceptional instances. This statement can be easily demonstrated by a careful examination. Children born with varus are often, perhaps generally, strong, robust, and healthy.

A child is brought for examination. We find the usual appearances of this deformity, perhaps in the third degree. The tendo-Achillis is strongly acting upon the os calcis, as in typical cases; the plantar fascia and probably the flexors of the toes are tense. The tibialis anticus operates upon the bone in which it is inserted, assisting the abnormal action of the last named, and also lifting the inner side of the foot. The extensor longus and the adductor pollicis may likewise offer resistance. If the patient is fat, it is difficult and perhaps almost impossible to feel a decided tenseness of the tibialis posticus. We however judge from a peculiar rising of the internal edge of the foot near the calcis, causing a slight crease or wrinkle, that the last-named muscle is in fault. In truth, this peculiar appearance can be accounted for in no other way but by the agency of this muscle; it is not present in all cases, by any means, but when present it is a sure indication. We then feel carefully near the lower end of the tibia and behind the malleolus, and if we have *tactile sensitiveness* well developed we shall find that on rotating the foot with the heel in the contrary direction to the distortion there will be a feeble, scarcely perceptible rising of the adipose tissue and skin against the finger, which can only be caused by a tightening of the deep-seated cord. This may not be sufficient to demand division, but in making our decision we must take into consideration the depth of this tendon beneath the surface. Otherwise we may be deceived, and find afterwards that our diagnosis in this particular was erroneous. It is evident that certain ligaments and abducting muscles are longer than they should be. Is there paralysis of these muscles which has destroyed the balance of power, or is the distortion due to some other cause?

If the child is of an age to understand, we tell him to turn out his foot. He probably will not at first fully comprehend what he is desired to do. If only one foot is affected, we begin with the well foot, and teach him what we would have him do. We adduct the foot, and, placing a finger two or three inches from the outer margin, tell him to turn it towards the finger, at the same time performing this motion for him.

We then place a finger at about the same distance from the inner margin, giving the same direction, and likewise adducting the foot. In like manner, the finger is held above the dorsum and below the sole. This done two or three times, the little patient will understand what is wished, and on being told to turn the foot in or out, up or down, will readily perform these motions. Beginning now with the other foot, it is manœuvred so far as possible in the same way, restricted within the narrow limits permitted by the deformity. It may be that the distortion is so extreme as to render the slightest movement impossible. But the exertion is all that is required. On being told to turn his foot towards the finger, generally, even in the worst cases, if the effort is made, a slight inward motion is perceived. If told to turn it out towards the same object, the attempt to comply with the request is answered by a play and tension of the abductor tendons. The fingers placed just above, behind, and below the external malleolus find the peroneus longus tense and vibrating, and uniting with its mates to perform the required action. The effort is for the most part null, but the evidence of non-paralysis of the abductor muscles is all sufficient. The same, with perhaps somewhat more extended motion, is the result of the effort at flexion or extension, or the bones may be so locked as totally to prevent this motion. The proof that we have not to deal with paralyzed muscles is conclusive.

If both feet are affected, the same process of instruction, though less easily inculcated and requiring more patience, will generally be attended with success. If it is an infant that we are to examine, it is equally important that in addition to learning what tendons are shortened we should ascertain if any are paralyzed; electricity will not always aid us in this case, neither is it required. If we watch the child in the free exercise of its limbs, kicking and stretching in its mother's arms, we can often detect a slight effort at eversion of the foot, evincing contractile power in the abductors. We may more certainly produce this motion by tickling the inner edge of the foot near the great toe, or the inner margin of the sole. This will rarely fail to cause an attempt, more or less strong, often very decided, on the part of the abducting muscles to draw the member away from the cause of irritation, and thus at once testify to their willingness to do their duty if the opposing forces were removed. In a large majority of cases a careful examination will reveal the fact that paralysis has no share in the ætiology of congenital varus. This rule is so universal that the exceptions are in my experience extremely rare. Upon the diagnosis in this particular must our treatment to a considerable extent be founded, and by it also will the prognosis be modified.

In *non-congenital varus*, however, this rule becomes much qualified. The loss of motor power in certain muscles from some cause after

birth is not infrequently the origin of more or less inward inclination of the foot.

By the simple means which I have indicated, with modifications in accordance with the exigencies of the case, we can attain a delicacy of diagnosis often of essential service; we can fix the deficiency upon a certain set of muscles, and often upon a single muscle. In addition to this, or rather previous to the examination, we may note the physiognomy, so to speak, of the foot. Whether the deformity is slight or severe, there usually may be observed a certain lack of firmness about the dorsal aspect; not by any means, however, the relaxed or flaccid appearance of a paralyzed member. Ligaments, elongated or shortened, are simply passive elements in the condition of the foot, although often offering obstacles to its restoration. The character of those instances of varus which arise from traumatism or from other similar causes is for the most part easily ascertained. In a case some time since under treatment, an acute inflammation, almost localized in the os cuboides, caused a swelling of that bone and its investments, and produced as perfect a varus in general appearance as any originating in contracted tissue. Such an instance is extremely rare, and perhaps stands by itself in recorded cases.

In *talipes valgus*, whether congenital or non-congenital, the rule in respect to partial or complete loss of power in a muscle or in a set of muscles may be reversed or much modified. There is generally a want of normal vigor. It may be simply a deficiency of nerve influence, which offers no appreciable impediment to the appropriate means of cure. In such instances, or even if limited paralysis is present, there is often complete restoration of normal subjection to volition.

Two cases occur to my mind where there was partial dislocation of the foot outward, the internal malleolus being displaced inwardly, with extreme flexion, the foot lying against the leg; in neither of these cases was there paralysis. The deformity was removed in early infancy, the child in one instance walking at the age of ten months. Sometimes the cause of a slight eversion may be traced to a single muscle. The tibialis anticus alone may be in fault, and the imperfect gait and splay, parrot-toed foot may originate in debility or paralysis of that muscle. If the eversion is more marked the posticus may also be implicated, and if still further advanced the extensor longus pollicis may also have suffered, and still others may be involved.

Valgus exists in every grade, from the simple debility or paralysis of a single muscle, with or without contraction of antagonizing muscles, and with a scarcely noticeable lameness, to that in which the internal malleolus touches the ground at every step. The peronei, if not originally contracted, in progress of time become shortened, and finally the extensor longus digitorum and tendo-Achillis.

Equinus, again, is a consequence more frequently of tonic shortening of the gastrocnemii than of deficient contractile power of the flexors. Where this coexists the foot does not retain its direct extension, but diverges either inward or outward.

Arrest of development, causing deficiency of the lower end of the fibula, or *ununited fracture*, or *enervation* consequent on spina bifida, have each, in my experience, given rise to the worst forms of valgus, in which the lower extremity of the tibia has borne the weight of the body in walking. The case of spina bifida is of interest as being one of the few cases where the patient has reached maturity. She walks by the aid of artificial support.

Likewise, varus or equinus may, by injudicious treatment, be converted into valgus or into calcaneus with an inward or outward twist.

Congenital calcaneus is generally due to a weakened or abnormally stretched triceps suræ from position in utero, or to disturbed muscular equilibrium from paralysis; more rarely to a spastic contraction of the antagonizing muscles.

In an address by Dr. W. J. Little, delivered three years since before the British Medical Association at their meeting in Edinburgh, that distinguished surgeon gives a history of tenotomy, and the steps by which this operation was gradually applied to the different shortened tendons in the treatment of congenital varus. After speaking of the influence exercised by the posterior tibial muscle in the production of the deformity, and the importance of its division in many cases, and of the severance of the tendo-Achillis, anterior tibial, long flexor of the great toe, and plantar fascia in appropriate cases, and of the accompanying mechanical treatment, Dr. Little says: "No improvements on these principles of treatment have been effected since that period (1839). Individual surgeons have acquired technical skill, or have introduced modifications in apparatus. Evidence in proof of this assertion is afforded by the cases and illustrations appended to my work of 1839, already quoted. It was then with justice triumphantly felt that as regards congenital club-foot a success never before reached in the history of orthopedic surgery had been obtained. . . . . Some tinge of enthusiasm may at that time have been pardonable."

Dr. Little then explains why the hopes then so justly entertained have not been fully realized, and refers to the fact that both in public and private practice patients constantly present themselves who have been only half cured, or not even benefited.

The neglect of the treatment after operation in cases where operation is required, and of that careful personal supervision and attention to the minutiæ of mechanical treatment, is the sufficient explanation of this disappointment and of these untoward results.

In a note referring to this subject we find the following remarks:—

"I should fail in my duty to the profession and to the public if I did not unhesitatingly here state that many of the most able surgeons, as well in the metropolis as in the provinces, have inflicted much injury by heedless tenotomy, that is, through having undertaken the treatment of these cases without sufficient previous study of the subject, through insufficient acquaintance with the mechanical aids requisite, or disregard of the teachings of their predecessors as to the value of manipulations and the mischief resulting from keeping a part too long *secured* in an apparatus. I will adduce a case in point: A parent lately brought to me a child, four years old, who had originally been affected with congenital varus of average severity. The family surgeon had fruitlessly cut the tendo-Achillis, and used a so-called Scarpa shoe. The distortion being unabated, and the child already walking in the position represented in Figure 1 of this paper, the family surgeon sent the patient, with a letter of introduction, to the senior surgeon of a metropolitan hospital, who admitted the case into his hospital, and, in addition to redivision of the tendo-Achillis, severed the anterior tibial, kept the patient three months in the hospital, and sent the child home wearing an apparatus similar to that previously employed by the family surgeon, with the foot apparently none the better when examined out of the apparatus.

"A few months more elapsed; the deformity and difficulty of walking becoming aggravated, the child was again sent to the metropolitan surgeon, who again took it into his hospital, repeated the operation, ordered an apparatus, again leaving the mechanical treatment to his house-surgeons and dressers. After the second stay in the hospital — this time of four months' duration — the parents removed the child and brought it straight from the hospital to my house. The case was as bad as a case of neglected varus of four years old can be, with the aggravation of several large cicatrices above the insertion of the Achillis tendon into the heel, two considerable (by comparison) scars over the anterior tibial tendon. The posterior tibial tendon did not appear to have been touched.

"By this paper I desire to show that such occurrences are not desirable or unavoidable. I do not exaggerate when I say that I have come across many scores of such cases with the same history. These are not cases of accidental failure of treatment, but cases in which all the principles of treatment, as laid down in this paper and in many previous writings of my own and of other authors, have not been followed, and in which the surgeon has neither attended to the details of treatment himself, nor placed the management, after operation, in the hands of competent assistants. . . . . The case (above referred to) has been restored to perfect form and movements, and will, I expect, need the aid of no supports or irons after three or four months."

This author further adds: —

"When we contemplate the perfection with which the worst forms of infantile congenital club-foot are, under favorable conditions, remedied at the present day, we may console ourselves for some disappointments, and be reassured that the subcutaneous method of Stromeyer has conferred great blessing on humanity, has increased the usefulness of our profession, and given it an additional claim to the regard of society at large."

That unfortunate cases arising from causes similar to those referred to by Dr. Little are not confined to the other side of the Atlantic my own experience abundantly testifies.

Amid the conflicting inventions of apparatus, splints, bandages, etc., the question may be asked, What is the best method of treating talipes after operation, or where operation is not required? Not by the gypsum or starch bandage certainly, nor in all cases and through the whole treatment by the tin splint, or the gutta-percha sandal, or the india-rubber muscles, or the Scarpa shoe, or the Sayre shoe, or the triple-screw apparatus. Some two, three, or four of these arrangements may be employed in the process of cure, but to no one should we confine ourselves in the treatment of a typical or severe case of talipes varus or valgus. Neither should any one of them be applied so as to produce pressure

upon the same spot, or have its action unchanged for any number of days in succession. It seems hardly possible that in cases the cure of which is so dependent upon constant daily change of position, upon manipulation, and in every way imparting tone to overstretched or weakened muscles, that retention in plaster-of-Paris bandages for six weeks without removal should be recommended and practiced as an improvement in the treatment of these affections. Yet this course is advised by a writer in a recent number of the *Edinburgh Medical Journal*.[1] This author says: "In slighter cases three or four bandagings" (six weeks each) "suffice to effect this" (bring the foot through the first stage). "In the worst cases six or eight may be required."

In the milder forms of congenital talipes varus, according to this author, a period is required of from four and a half to six months before the foot becomes changed into a talipes equinus, and in the severer cases from nine months to a year may be needed before the same result is reached. The sum and substance of this treatment may best be stated in the words with which the article referred to is opened: "The treatment of congenital club-foot (talipes equino-varus) is one of the most difficult, tedious, and disappointing undertakings in the whole range of surgery."

We need no other commentary on the method or methods of treatment which have terminated in so discouraging a conclusion, — a conclusion so decidedly the reverse of that cheeringly set forth in some of the sentences I have quoted from Dr. Little, and so completely at variance with that which has been the result of my own experience. On the contrary, I would assert that in the whole domain of surgery there is no class of patients the treatment of whom is in the large majority of cases so entirely satisfactory.

The starch bandage is open to the same objections as the gypsum.

The tin splint may be useful in the beginning or in slight cases through the entire treatment if the patient is an infant, employed as is done by the English surgeons, but its form should be frequently varied and the points of pressure constantly relieved. We may use a Scarpa shoe, and it is a most valuable instrument in certain stages of the treatment. It makes but little difference whether we have a hinge in the instrument to correspond with the medio-tarsal joint or not. It has of late been said that the prominent part played by this joint in the deformities in question, or the importance of a special action upon it, has been overlooked by previous authorities. This statement is a serious oversight; no surgeon who has ever cured a club-foot — by cured I mean cured in its fullest sense — can have done so without faithful regard to this point. Certainly from the commencement of my treat-

[1] An Improved Method of Treating Club-Foot. By Alexander Ogston, M. D., Surgeon to the Aberdeen Royal Infirmary. Edinburgh Medical Journal, December, 1878.

ment of this deformity it has received the attention which its importance demands.

There is no especial need of a joint, either with lateral or with combined rotary and lateral action, in the sole of the Scarpa, although such combinations are sometimes a convenience. The cup which retains the heel and ankle can well be brought sufficiently forward on the side of the convexity of the foot, and this, well padded, serves as a fulcrum for the medio-tarsal joint, and the spring at the side of the sole will then act powerfully to as good, or better, advantage as if there were such a joint in the instrument. The rotation movement is more easily applied if the sole is firm, that is, without the joints referred to, by means of narrow pads under the outer or inner edge of the foot, and a counter-pressure by the same means on the outer or inner edge of the dorsum. The action of the cross-straps does the rest. These simple appliances can be so changed and the degrees of pressure so varied that they are less irksome than other more complicated and less easily changed arrangements. The rotary and lateral action on the medio-tarsal joint is thus powerfully and equally produced, and the points of contact constantly relieved.

The triple-screw apparatus has always a lateral joint in the sole. This instrument is often of most important aid at certain stages of the treatment of even infantile cases of the severer grades. When the foot has been everted or inverted, rotated, and unfolded, the attempt at flexion at the ankle to the full extent of normal action is sometimes abortive. Then the gentle, graduated power of the screw is found most admirably adapted to our purpose, and facilitates and hastens our work. Perfect upward motion is thus obtained, and the member is now in a condition to go free of all incumbrance, excepting in the night, and in some instances for a portion of the day, when a retentive sandal may be worn, or a light Scarpa shoe.

In regard to the propriety or expediency of operative interference, again let pathological investigation and experience, backed by common sense, be the guide. In the majority of cases of varus of the third, and in many of the second, degree, my own experience confirms the united testimony of surgeons of the most extended orthopedic practice in regard to the value, not to say absolute necessity, of subcutaneous tenotomy. Without this we are simply thrown back to the ante-Stromeyerian period. The sufferer is deprived of the advantage to be derived from that great stride in the surgeon's art, and is relegated to the benefit to be found in mechanical appliances alone. The reasons given for abandoning surgery in such cases are inconclusive and in the face of a vast amount of unprejudiced experience. The abuse of surgery, and not its use, is to be avoided, and it is its misapplication and inappropriate or inattentive after-treatment which has produced fail-

ures and consequent opposition. Cases which demand the tenotome are generally sufficiently pronounced. The sensation imparted by the implicated tendon is to the experienced touch a sufficient indication. Where there is doubt, a trial of some extending apparatus or splint will settle the question.

The tibialis posticus is often overlooked, both in diagnosis and treatment, yet it is frequently an important element in the distortion, and its non-division the source of an imperfect result. The comparative difficulty and danger attending this operation has undoubtedly led to its omission in many cases where it was required. In the process of cure this tendon, not at first decidedly demanding operation, will sometimes offer resistance to further progress, and will need division. Likewise, in other instances, where, it may be, we have not considered it advisable to sever the tibialis anticus early in the treatment, we may find that restoration does not advance as rapidly as we had reason to expect, and trace the obstacle to this last-named muscle. In yet other cases, even after its division, disappointment may arise from too speedy union. In such instances, I have found that redivision will remove the check and give a renewed impetus towards cure. This course in respect to the anterior tibial is comparatively safe. The peculiar position of the posterior tibial in its connection with the ankle-joint renders such an alternative unlikely to occur, and under any circumstances, on account of its especial liability to contract adhesions, its redivision is unadvisable. But it is far better never to use the knife in the treatment of these affections than, after having used it, to neglect a single detail in the after-treatment, or fail to derive, by appropriate mechanical appliances, all the advantage afforded by the severance of the contracted tissues.[1] The after-treatment must never be intrusted to unaccustomed hands; success depends on constant, unwearied, personal attention.

Perfect union, free from adhesion, after division of the posterior tibial tendon may not be attained, and in some other instances such a result may be frustrated. But in those cases where this failure is most apt to occur, the complete integrity of the tendons is often of less importance than the obstruction offered by a permanently shortened and inextensible cord. Practically, where division has been skillfully performed, followed by appropriate treatment, the adhesions, if any, are so slight as not materially to impede muscular action.

Authorities are divided in regard to the period which should elapse after operation before extension is commenced. On this point my ex-

[1] As an instance of the importance which the author attributes to the observance of the minutest detail, he will mention that when the foot is undergoing its morning ablution it should, when in the water, be held firmly in the position it has gained while in the apparatus, and not be permitted for a moment while dressing to revert to its former malposition, if it is possible to prevent it.

perience has led me to a different conclusion and practice from that recommended by Dr. Little. In non-paralytic congenital varus, all the parts implicated, tendon, ligament, fascia, and even the skin, are adapted to the deformity. By extending immediately, we run no risk of proceeding too far. Impediments at once present themselves and prevent too rapid restoration. It is important to gain all we can during the first few hours, from the amount of freedom obtained by the operation, before the process of healing has commenced. So true is this that in most instances where I have been led from some accidental cause to defer the application of splint or apparatus, I have had occasion to regret the delay. If the extension is postponed only until the next day the pain it causes is greater than when applied at first. There is more soreness at the seat of the operation, and the part operated upon bears less willingly the new position. I therefore say without hesitation, in those instances to which I here refer, extend at once; there is less suffering, the tissues yield more readily, and on account of the obstacles already mentioned there is no danger of extending too much. The shortened, deep-seated tissues soon present obstructions to too rapid progress. The danger sometimes apprehended of tearing open the wound is in like manner obviated. In fact, this is an accident I have never seen happen after any subcutaneous operation, although undoubtedly it may occur from ill-judged extension. I am convinced that it is only in cases where there has been error in diagnosis that the mischief feared can result, and that it is observation of cases treated by less experienced hands than his own which has led Dr. Little to advise a different course.

The injuries arising from injudicious pressure are not here considered, as they are in all cases unnecessary and always to be avoided.

In cases of talipes caused by *paralysis*, however, the manner of dealing with the complaint as regards immediate extension should be very different. In a majority of such instances the paralysis has apparently occurred late in uterine life, or has supervened soon after birth. There is a general relaxation not found where the ætiology is different. There is then great hazard of too rapid advance in extension after operation. In those cases where section is needed, extreme caution is required to prevent too great elongation of the newly formed material. The state of the parts is so unlike that usually present in the class of cases previously referred to that restoration should be conducted slowly and with constant reference to the possibility of producing a form of talipes the reverse of that we are treating.

Observation teaches that in many such cases the operation and treatment by the introduction of new tendon of a certain length, thus permitting normal use, strengthens and develops fibrous tissues and increases the power and size of the limb. This in contradistinction to the treat-

ment by simple extension, which in the instances now under consideration stretches and proportionately enfeebles.

The propriety of operating in a certain number of this class of cases is undoubted. The resisting fibres are often stringy and inelastic. The attempt at stretching is far more weakening than division. In instances where simple extension is partly or entirely successful in restoring the form while the member is in the instrument, or for a short time after its removal, the debilitated opposing muscles are often unable to overcome the tendency to relapse. Experience has shown that the best and most permanent success attends upon those cases where structurally shortened muscles are lengthened by the interposition of new material carefully limited in its extent. This accurate measurement of the amount needed requires, undoubtedly, the exercise of a judgment familiar with the processes we are watching, and is often the source of anxiety during treatment. The perfection of the cure, however, which rewards the effort is such as can be gained in no other way.

The importance of manipulation, of active and passive exercise, of friction, of massage, and in some cases of electricity, cannot be too highly estimated, as affording most valuable aid during the course of the treatment, increasing the development and activity of the muscles and the usefulness of the limbs.