Olshausen and Littauer³⁷ in ovaries left behind after removal of the uterus; they seem to be a result of disturbance of circulation due to tying the uterine branch of the ovarian artery close to the cornu. They concern not the pathogenesis of fibroids but rather the treatment of the ovaries in hysterectomy which we have already considered. The changes seen in the ovaries in some instances may play a part in aggravating hæmorrhage or otherwise, but this question remains obscure.

LARGE VESSELS IN FIBROIDS: THE SOUFFLE.

The vessels in a large fibroid of old standing are often extremely dilated. Therefore a souffle may be heard on auscultation, which, of course, must not be confounded with the pulsations of the abdominal aorta audible through any solid tumour. In two quite recent cases the souffle was loud, transmitting in one a thrill to the palm of the hand placed on the surface of the tumour. In the other the sound as heard through the stethoscope simulated the souffle of pregnancy perfectly. The patient was a married woman, aged 30 years, but she had not been pregnant for ten years. She was extremely anæmic and much reduced in health from profuse floodings. The cervix was small and firm and for other reasons pregnancy was improbable, but I could well understand when I auscultated this case how in slightly different circumstances pregnancy might reasonably have been diagnosed. Thus the cervix might have been soft and a spherical outgrowth in the lower part of the tumour might have simulated a foetal head. The tumour weighed over four pounds and the veins were enormous. One ovary was left, but the case is too recent for drawing any conclusions about the effects of the preservation of ovarian tissue. There have been no troublesome after-effects up to the present.

I have dwelt on the souffle, but not solely as a curiosity. It means that there are big vessels and their existence implies increased risk of the hysterectomy. A big vein should be carefully tied on its proximal side. Clamping, invaluable as a temporary resource in the course of the operation, inflicts much damage on the tissues immediately surrounding the vein. Hence it is better to avoid clamping a big engorged vein on its proximal side, or if that be actually necessary the vein should be ligatured below the clamp and the tissue bruised by the instrument carefully trimmed away. The ligature should never be stout. No. 2 silk will answer well for a vein. Careless clamping, needless handling of structures on the proximal side of the line of incision, and stout ligatures not only increase the chance of inflammatory exudation, parametric abscess, and intestinal adhesion, but when vessels are large these practices naturally promote thrombosis and embolism.

An Address

ON

CERTAIN PRINCIPLES AND METHODS IN THE SURGERY OF THE PARALYSES OF CHILDREN.

Delivered before the Huddersfield Medical Society on Nov. 6th, 1902,

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MR. PRESIDENT AND GENTLEMEN,—The subject upon which I venture to address you is one which has interested me for many years and is well worthy of careful study. In these days, strange to say, when so much is written on every branch of medicine, the surgery of the paralyses of children has received but scant attention and that only in odd places and at odd times. There are many reasons suggestive of the explanation. To the general surgeon the subject presents many difficulties. It abounds in detail and demands a

patience that only enthusiasm can supply. Operations, if they are performed, only attain their purpose when followed by prolonged, intelligent, and carefully thought-out after treatment, and this involves not only a practical knowledge of the sequence of events but a very real faith in certain fundamental principles. Short of this faith the surgeon is half-hearted in his measures and the patient and friends lose that confidence which inspires hope. The surgeon, therefore, should know the theory of his subject and be able definitely to direct practically the mechanical details which are the accompaniment of all operative aid. What would we think of a physician who, having made a diagnosis, leaves his unfortunate patient in the hands of a chemist who is asked to administer what he thinks to be an appropriate drug? And yet this is not a travesty but the grim experience of hundreds of paralytic cripples in this country. They pay their consultation fees and are then despatched to the instrument-maker who is merely desired in the most general terms to fit on a suitable "appliance." Is it any wonder, therefore, that quackery abounds and that the unfortunate patient is, so long as money lasts, relegated to suits of armour bristling with screws and ratchets? The treatment of paralytic deformities is both mechanical and operative. The one is inseparable from the other and the surgeon who is not a mechanic is little better than the old orthopædic surgeon who, without any operative education, looked upon a complicated splint as the universal panacea. To the late Mr. H. O. Thomas belongs the credit of having preached the gospel of simplicity as applied to splints. In paralytic affections his only implement was a tenotome and yet so skilful was he in mechanical resource that he rarely failed to rectify the most obstinate deformity. From him I learned the value of rest in restoring power to over-strained muscular fibre and the immense importance of postural prophylaxis in relation to deformity. Since his death many important advances have been made on the operative side but the mechanical principles he enunciated are in advance of much of the teaching of the present day.

ACUTE INFANTILE PARALYSIS.

I will deal first with certain aspects of acute infantile paralysis viewed chiefly from its clinical side. We all recognise the great importance of this subject, if only from the fact that next to rachitis it is the most prolific source of deformity, a deformity which never disappears spontaneously. Whenever we meet with a paralytic deformity with shortened muscle or diminished joint movement it can be safely assumed that, either from lack of knowledge or from neglect, a condition has arisen which could quite well have been avoided. Joint malposition due to muscle shortening or contracture arises from insufficiently opposed muscular action or from faulty posture due generally to the influence of gravity. Either condition the surgeon's art should easily enable him to prevent. Provided we know in any given case the etiology of its deformity we must not be content to meet it half-way but should endeavour to prevent it from ever making its appearance. In a completely paralysed arm the deformity to prevent is one of extension of the wrist and elbow and partial flexion of the fingers. At the ankle it is extension and inversion or eversion; at the knee flexion; at the hip flexion, often with external rotation. The causation of these deformities has been often discussed, but of one thing we may rest assured and that is that the action of antagonistic groups is neither the sole cause nor even the most important etiological factor. This is evident when we note that deformities occur when paralysis of all the muscular groups is complete, and, furthermore, that when paralysis is incomplete the shortened or contracted muscles are sometimes found to be the paralysed ones. We must, indeed, look upon several factors as instrumental in the production of paralytic deformities, such as gravity, body weight, the shape of articular facets, and, to a lesser degree, unbalanced muscular action. To take an example: if all the muscles governing the foot are paralysed and walking is not attempted the deformity will be precisely that which any foot assumes when left unconsciously hanging during anæsthesia—that is, an equino-varus, the fixation and muscle-shortening being quite secondary. If, however, walking has been the habit there will be an equino-valgus or calcaneus in response to superincumbent body weight applied in the one case to the inner side of the foot or in the other to the back of the heel. Similarly if crutches.

³⁷ Note on a Specimen of an Ovarian Growth removed after Vaginal Panhysterectomy, *Centralblatt für Gynäkologie*, No. 39, 1902, p. 1025.

have been used and the knee has been allowed to swing flexion is the result, which is the position naturally assumed by a limb whether paralysed or not which is left a mere pendant to the pelvis. If, however, the limb be used for walking other deformities may occur—hyper-extension or genu recurvatum if the body weight falls on the heel and genu valgum when the body weight is brought to bear upon an everted foot. And so every deformity is produced in a manner which can be easily ascertained when we examine the patient and his habits, and I emphasise the matter because of its prophylactic bearings. In the limb not completely paralysed contractions of the more powerful groups of muscles act very harmfully on their opponents, and it is the recognition of this fact which constitutes the keynote to both the mechanical and operative treatment.

In the past we have all been too much governed by the pathology of the affection to do justice to its clinical aspect. Because certain groups of muscles have barely responded to stimuli and have remained inactive it is too often assumed that this is due to cell destruction in the motor area. This assumption, if correct, would render useless any effort on the part of surgery. What we have to recollect, however, is that the cell destruction is not so extensive as would appear and that the affection, so far as the majority of the cells are concerned, is a transient and a recoverable one. We have no time to consider the many interesting points in connexion with pathology, more especially its infective origin, but we must not be led astray by any reports made on the cords of children dead months and years after the onset of the affection. At this stage many secondary changes have occurred and we have yet much to learn concerning the changes and degenerations of cells secondary to muscular desuetude. Careful and extensive investigation of the cords of subjects months and years after the loss of limbs, and similar experiments on growing animals, would throw an interesting sidelight upon the cell changes found in poliomyelitis of long standing. Let me take as an example paralytic wrist-drop. This deformity is of slow growth and when untreated is never recovered from. The principles governing its treatment are so little understood that at the present moment there are thousands with crippled useless hands who have received neither hope nor help from whomsoever they have consulted. And yet the majority of such deformities are most amenable to treatment and do not even require the knowledge which the practice of a speciality involves. Let me for a moment allude to cases in order to add clinical weight to my remarks.

CASE 1.—Some 15 years ago a youth, 19 years of age, came to me with loss of power in his arm and a typical wrist-drop. He gave the history of what he called a "tooth" stroke when he was two years old. He had no power of voluntarily extending his hand and the wrist could only be extended by the surgeon when he exercised considerable force; as the wrist became extended the fingers flexed. He had but slight movement of the fingers, just enough to enable him to hold a stick while the wrist was acutely flexed. For reasons which I will explain later I was able to tell him that even at this period, 17 years after the onset of the affection, his hand could be made quite useful. In less than two years he was able to flex and to extend his wrist and to perform movements of considerable nicety with his fingers.

CASE 2.—A young woman, 23 years of age, who had been the subject of poliomyelitis 20 years previously, presented herself with a contracted hand which could only be extended by moderate force. When forcible extension was adopted the wrist could only be extended by permitting flexion of the fingers. Advice had been sought from several neurologists and massage and the battery had been unanimously recommended. For some years all treatment had been discarded and the only attention paid to the hand by the patient was in endeavouring to keep it out of sight. After carefully examining the muscles I assured her that treatment would ultimately prove very satisfactory. Again, in less than 18 months she was enabled slowly but with considerable precision to flex and to extend her wrist and to move her fingers separately.

It is needless to multiply cases, but to many of us such results would seem incredible until the explanation in all its simplicity were vouchsafed. These two cases had remained untreated because muscles powerless from desuetude were mistaken for muscles paralysed from cell destruction. To begin with, perhaps the whole arm was paralysed; then the strong group of flexors recovered; later the extensors. The flexors, however, having first got well, overpowered the

extensors and, aided by gravity, became shortened or contracted while the extensors were stretched out and lengthened. This, then, is the secret of the prolonged disability—a group of muscles placed at mechanical disadvantage had become impotent from desuetude. Well, then, how is the surgeon to know the case where he can assuredly, as I did, give a confident prognosis? The test is simple. He asks the patient to move his fingers in the direction of extension. The patient says he cannot. The surgeon then grasps his wrist and still further forcibly flexes it. The patient is then asked to extend his fingers from their new position. If he succeed ever so little a favourable prognosis may be given. Should he fail then treatment is of no avail. The treatment is based upon Thomas's theory of muscle shortening and consists in a recognition of the mechanical principles governing the production of contractures. In the paralytic wrist one group of muscles is lengthened and another is shortened by posture and treatment must be directed to the reversal of these conditions. In other words, we must slowly stretch and lengthen the flexors and place the extensors in such a position that their structural shortening will ensue. There is no opportunity at present to enter fully into methods, but when I state that the wrist and fingers must be placed in hyper-extension for very many months the principles of treatment will be sufficiently appreciated. The test of recovery consists in the power of the patient voluntarily to extend his fingers from the splint upon which his hand rests. I have dwelt at some length on this aspect of the question because the principle underlying it has received but scant allegiance and furthermore because it influences our every effort whatever joint or limb be affected. We must not attempt to treat a weakened set of muscles without first rescuing them from being overstretched and we must carefully note that we can but restore to action elongated muscles by maintaining them in a slackened posture. There are many analogies in confirmation to which I could draw your attention, but I will confine myself to the consideration of only one or two. We all know that congenital club-foot is not a paralytic affection; we are also conscious that apparently after treatment has resulted in rectification a so-called recurrence is frequently chronicled. Why should that be? I am quite sure that I can give you the explanation. It is due entirely to the fact that the extensor muscles have not sufficiently recovered to resist the action of gravity—in other words, the patient is unable to hold the foot at right angles. A recurrence, therefore, merely means the formation of a paralytic deformity exactly as it occurs in poliomyelitis where the extensors of the toe are affected. It can be prevented by keeping the foot over-corrected until the extensor muscles have, as the nautical expression goes, "taken in their slack." When a talipedic foot can be voluntarily raised to above a right angle a recurrence cannot possibly occur. Here, then, is an admirable confirmation in a non-paralytic case of impotence from desuetude. You will note, therefore, that we have clinical data which will enable us to say whether or not a paralytic drop-wrist is recoverable, and we know that the severity of the contractions and the duration of the disease do not contra-indicate a favourable prognosis. As an aid to prognosis we may note that the structural shortening of the flexors is a more serious impediment to recovery than the long duration of the disability.

In illustration of the value of preventing a pull upon paralysed muscle, you may be interested in an experiment which I made some months ago. A relative in whom I was much interested was attacked by paralysis of the facial nerve, probably due to effusion into its sheath. For several weeks only a slight improvement was manifest. I therefore fixed on his face an apparatus so designed as to draw the angle of his mouth on the paralysed side well up towards the ear. In less than a fortnight he had so far recovered as to be able to dispense with it, feeling very grateful for its manifest help. A similar instrument tried upon a second case when the paralysis had lasted four months with but little abatement, acted almost as a charm and was worn for a month—only because the patient feared a recurrence from too prematurely discarding it.

An interesting confirmation of this principle occurred in two cases of paralysis of the shoulder girdle when all the muscles above those governing the hand were affected. The arm lay helplessly by the side and even the hand responded but imperfectly to the will. The elbow was flail-like and quite uncontrolled by any group of muscles. Such an arm is

obviously of but little use to a patient, having to be lifted by the opposite arm. It struck me that it would be advisable if possible permanently to fix the arm at an angle so calculated that the hand might be brought into contact with the face and neck. Arthrodesis of the elbow I knew to be an unsatisfactory operation and I decided, therefore, to make the fixation by means of skin incisions. The arm was first brought to an angle of 45 degrees, and I judged by the relative position of the arm to the forearm how large a piece of skin it was necessary to remove. The elbow was next extended and a diamond-shaped incision was mapped out and the skin removed. The upper angle of the wound was next attached to the lower and the bare surface of the lower triangle lay in juxtaposition to that of the upper triangle. A scar was thus formed sufficiently firm to hold the elbow flexed. In two out of seven cases which I operated upon interesting phenomena followed. Paralysis was thought to be complete in the biceps and brachialis anticus, but some months after the arm was flexed flexion power was restored to the elbow. This power was brought about by the postural release from strain cast upon the muscles and still further elucidates the question we are discussing.

I trust that I have been able to impress upon you the importance of not confusing muscles which for years have been useless with muscles which are positively paralysed. It is this confusion which has hindered both physician and surgeon from accurately gauging in these cases the potentialities of recovery. Treatment must be obviously conducted with a view of preventing, or of correcting, structural shortening of muscular groups. This in the hand generally means hyper-extension of the wrist, in the elbow flexion, and in the knee extension and a rectangular fixation of the ankle.

TENDON TRANSPLANTATION.

Considerable assistance has been afforded to paralytic children by the recent introduction of tendon transplantation and the revival of arthrodesis. Tendon grafting consists in attaching a healthy tendon either to a paralysed one or to the periosteum and, so to speak, changing the sphere of its action. It is quite a mystery how an amicable arrangement between mind and muscle is brought about, for a muscle hitherto directed to evert the foot is now asked to invert it and by the intervention of some law of adaptation it obeys. What interesting possibilities in connexion with the nervous system this suggests. Already I have operated upon over 50 cases and without entering into any details it may be interesting to chronicle my experiences.

The operation in my hands has been most successful where one muscle or one group of muscles has been paralysed. This is exemplified in paralysis of the peronei or of the tibiales. In one case reinforcement comes from the extensor proprius pollicis and tendo Achillis; in the other from part of the tibialis anticus and again the tendo Achillis. Transplanting the peroneus longus into the tibialis posticus or the converse is sometimes disappointing because of adhesions by the way and the angular direction which the healthy muscle is forced to take. The operation should not be performed with the object of strengthening partially paralysed muscles or muscles weakened by elongation. In such cases our opportunity comes for testing the value of what I have stated regarding the mechanism of shortened muscles. If any operation be called for, lengthening of the shortened tendons and shortening of the lengthened ones are clearly indicated. Again, in flail-like joints tendon splicing is of no avail, because superincumbent body weight is too fatal an antagonist. Another most important point is to employ the nearest available tendon, if it be sufficiently strong, rather than one from a distance, and, where it is possible, the selection should be made of a reinforcing muscle the line of which is parallel to the reinforced. Take, for instance, a talipes calcaneus where we would by preference strengthen it by the aid of the peronei, or in paralytic valgus where we can with advantage command the services of the extensor proprius pollicis. In analysing my failures I ascribe perhaps the principal share to a want of success in preventing the reinforcing tendon from taking a tortuous route. Another cause of failure may be avoided if the operator makes a point of completely correcting—or, better, even over-correcting—a deformity before transplantation is performed. For instance, a girl walks with paralytic valgus and has done so for years. The foot cannot be placed in inversion without the application of great force. If transplantation of a slip of the Achilles tendon is to be effective the foot must first of all be kept inverted by

mechanism until all strain on the inner aspect of the foot has been removed. I would further urge that if tendon is to be spliced by tendon let it be done as near its insertion as practicable so as to avoid as much as possible a yielding of the paralysed section which we know is apt to occur. Whenever the tendon can be transplanted into periosteum I am convinced it should be done, care being taken to secure a really firm hold of the tissue. When attached to tendon a neat splice should be done; many failures are due to clumsy bulky excrescences which encourage adhesions and otherwise obstruct the easy gliding of the tendon. Finally, the proximal part of the reinforcing tendon should be fixed into the paralysed tendon, so that it be maintained as tense as possible, otherwise we have to face the problem of a slack tendon which cannot do its work.

If these practical points be remembered by surgeons and a watchful eye kept upon the first attempts at walking in order that body weight be correctly exercised on the tarsus, tendon transplantation cannot fail of a good and lasting reputation.

ARTHRODESIS.

There is another class of case which has interested me greatly—I allude to those paralytic patients with joints either hopelessly flail-like or sufficiently so as to demand unceasing mechanical attention. The difficulty and expense connected with the purely mechanical treatment of these cases, extending as it does over the whole of a lifetime, are an effective barrier to the poor of our cities. The recognition of this fact induced me to urge at the meeting of the British Medical Association of 1894 a revival and extension of operative procedures which for years had remained in abeyance. I allude to the operation of arthrodesis which aims at transforming a flail limb into a member as rigid as the splint which it is desired to discard. In a large majority of the so-called paralyses of the lower limb the psoas and iliacus muscles are unaffected and all mechanical means are therefore based, if they are to be of real use, upon the integrity of the muscles. The knee and ankle are kept fixed and the psoas muscle is destined to carry the leg, splint and all. In consequence these weakly paralytic patients easily tire of the weight of their supports and therefore lose the opportunity which presents to strengthen their only pair of muscles of progression.

The operation consists in opening the joint with a sharp gouge peeling the cartilage off the whole articulation in the case of the ankle, and gouging the bone in the case of the knee, keeping the joint completely at rest for some weeks subsequently and for a long period fitting the limb with a simple apparatus which will enable the patient to walk without throwing a strain upon the newly-fixed joints. An excision is more than the case requires and involves a greater sacrifice of tissue than an already shortened limb can spare. To expose the knee I make an incision across the front of the joint, covering fully half its circumference, and curved so as to pass below the lower end of the patella. The flap is turned up and all the vessels are ligatured. I next remove the semilunar cartilages and with a sharp, short-bladed knife or gouge peel away the cartilages and the underlying layer of bone, so as to leave a raw surface over the whole of their extent. The crucial ligaments I generally leave intact. The structures are then carefully reunited by deep and superficial sutures, no drainage-tube of course is employed, and the wound is well covered with sterilised absorbent wadding.

The operation may be carried out in the ankle-joint in one of two ways, according to the circumstances of the case. In old cases where the foot is deformed and assumes the equinovarus variety the astragalus is well to the front. In such I force the foot into a position of extreme equinovarus and make an incision in front of the external malleolus following the line of the ankle-joint and dividing all structures down to the astragalus, generally only severing the peroneus tertius tendon. The other tendons are held aside and the articulating surface of the astragalus is exposed. With a gouge or knife several grooved portions of the articulating cartilage are removed. If complete bony ankylosis of the ankle be desired it will be necessary to gouge bone. If a fibrous ankylosis be wished it will be sufficient to peel off parts of the cartilage. The ankle is kept extended while some pieces of the articulating surfaces of the tibia and fibula are removed. A few vessels are tied, the foot is placed in its normal relation to the leg, and a suture or two close the wound. A pad of wood-wool tissue is applied over all and this being firmly bandaged the procedure is complete. In other cases the astragalus is more easily approached from

behind and in such the foot is firmly flexed on the leg and an incision down to the bone is made along the external border of the tendo Achillis. The posterior ligament is now freely divided and the gouging takes place as in the former operation. No serious mishap has occurred in any of my series of over 100 cases. Every wound but three has healed by first intention; and, contrary to expectation, those cases where trophic changes were most marked healed as readily as those whose nutritive conditions were nearer normal.

In talipes calcaneus where the paralysis is not complete, a deformity often accompanied by pes cavus and for which Willett's operation of shortening the tendo Achillis is performed, I recommend a modified arthrodesis. It gives distinctly satisfactory results. Willett's operation is rarely successful, for the moment we try to put a weakened tendo Achillis shortened by operation against body weight exercised during locomotion it can only have one result and that is a fresh and speedy yielding of the tendon. If, however, Willett's operation, *plus* excision of cartilage, be performed we shall obtain considerably better results, for on opening the joint from behind we can shorten the tendo Achillis and remove sufficient cartilage to limit the action of the ankle to about 20 degrees. The same procedure may with benefit be applied where in addition to an elongated heel tendon the tibiales have been completely paralysed, producing a deformity of calcaneus-valgus with difficulty rectified manually. I may mention in connexion with arthrodesis of the ankle that one sometimes fails in young children to secure sufficient fixation, and for some months I have removed the upper half of the astragalus and the inner malleolus of the tibia so that the tibia may fall with greater stability on a good square surface. The result is very satisfactory and in a completely flail-like ankle is, I think, more suitable than the recent operation described by Whitman of New York of complete removal of the astragalus, an operation I have performed on four occasions.

Before leaving the subject of poliomyelitis I would desire to draw attention to another class of paralytic patients who are the subject of fixed deformities. The hips are flexed and so are the knees, while the ankle is generally extended. If the little patient be made to lie down marked lordosis of the spine occurs. There has never been any attempt at walking, save perhaps a swinging, crutch-supported gait. Power may be found in one sartorius and in one psoas muscle. Can such a case be made to walk and, if so, how? If we determine to try we will first divide each tendo Achillis and place the ankles in rectangular splints. We will next excise a V-shaped wedge from each flexed knee, the wedge being sufficiently large to allow of the easy extension of the limbs. For a few weeks the limbs are retained in this position and a splint similar to a double Thomas's hip is prepared. The correction of the hip deformities must next be commenced. This must be prosecuted very vigorously. Of all flexion deformities paralytic flexion of the hip is most intractable and generally the shortened structures are on the outer side of the thighs. A bold incision must be made and the fascia and every constricting band divided freely until several degrees of flexion are overcome. The patient is then kept upon his double Thomas's splint and for weeks if necessary until the lordosis disappears. This is not assisted by recourse to femoral osteotomy, an operation of very little use in paralytic hip. As soon as the back is straight we place a pair of calliper splints on the little patient and crutch-aided let him learn to walk. I know of no sensation more delightful to myself as a surgeon than that I experience when I see one of these crawling little cripples standing erect before me.

Time will not allow me to delay longer over spinal paralysis and I have therefore given you but a brief practical *résumé* of surgical methods as they appeal to me, endeavouring to enunciate principles in regard to the behaviour of muscles which must always influence, and sometimes govern, us in the line of treatment we adopt.

ON CEREBRAL PARALYSIS OF THE SPASTIC TYPE.

From spinal to cerebral paralysis is not a long step and yet what a different field it is to explore. The patient in a spinal case is generally bright and happy, entering into the spirit of our treatment often with intelligent appreciation, while in a cerebral case he is uninviting, irritable, and almost always dull, perhaps the most neglected object within the radius of our art. In the short period still at our disposal I desire to point out certain lines of treatment which offer us great encouragement to persevere in our efforts

on the behalf of such patients. This year I have already written on the spastic type of palsy and I must beg your kind indulgence while I repeat the conclusions forced upon me in the consideration of a large number of cases. Although it is quite impossible to discuss fully so complex a subject as cerebral paralysis I should like to indicate certain types of the affection where surgery may with advantage be employed. For descriptive purposes cases may be grouped under three headings: (1) infantile hemiplegia; (2) cerebral diplegia; and (3) spastic paraplegia. My own experience would lead me to the conclusion that cerebral diplegia is the commonest group, but of 859 cases which I have collected from various sources 510 were hemiplegic, 30 were monoplegic, 142 were paraplegic, and 157 were diplegic. The diplegic and paraplegic groups are congenital affections whilst infantile hemiplegia is usually acquired. Infantile hemiplegia generally appears before the fourth year and is most commonly preceded by convulsions and by acute febrile symptoms, markedly in contrast to the advent of adult hemiplegia. The deformities are of very rapid growth. The arm and leg are powerless and the reflexes are exaggerated. The foot is arched and adducted, the knee is bent, the hip is rotated inwards, and the femur is flexed. The arm clings to the body, the elbow is flexed to a right angle, the wrist is dropped, the hand being pronated and deviating to the ulnar side, while the fingers tightly grasp an adducted thumb. Rigidity comes on nearly always and is increased on passive movement or when the child attempts to move. The aphasia is motor and accompanies either right or left hemiplegia. Inequality of growth is the rule, but while the leg hardly ever shortens more than an inch it is not uncommon to note three inches of difference in the arms. From the point of view of treatment the following facts may prove useful if remembered: (1) The arm is more permanently and severely affected than the leg; (2) movements are performed spasmodically, slowly, and without precision; and (3) the power of dorsiflexion of the hand with simultaneous extension of the fingers is lost and usually the hand has no adduction power. In the lower limb general rigidity is accompanied by extension of the foot, contraction of the knee, and flexion and adduction of the hip.

The cerebral diplegic group is far and away the most serious condition to treat. We have here, of course, to deal with both arms and feet. Unless the hands can be used the surgeon is deprived of his chief allies in the treatment of the limbs. Where the spasm is confined to the limbs alone we give the name of "spastic paraplegia," or "Little's disease." The vast majority even of these cases present mental deficiencies of varying extent and in a considerable minority athetotic movements are also noted.

A severe case of spastic paraplegia brought to the surgeon at the age, say, of 12 months is characteristic. Usually contractions have occurred at the hip or knee; the child's legs are rigid, the toes point down, there is usually no internal rotation, and adduction is not sufficiently severe to cause a crossing of the limbs. The reflexes are exaggerated, the patellar reflex not usually causing a knee-jerk but a leg-jerk. If the little patient is held by his arms there is no endeavour to separate the limbs, and should the toes be brought to the ground and an effort made by the child to walk both limbs move synchronously and in parallel lines. When passive separation of the limbs is made, although it is easily effected, one can see and feel the antagonistic efforts of the powerful adductors. If at a later stage the patient is able to walk several changes will be noted. The adduction will be more marked, the scissors-walk will have developed, and a characteristic dragging of one knee round the other will be noted, which becomes more pronounced when any attempt at running is made. The body pressure is mainly transmitted to the ball of the toe. These contractures, however, at this stage are generally spasmodic and there is no appreciable shortening in muscle length. This shortening occurs at a still later stage and is known as contracture. In quite a number of cases the patients are in a hopeless position as far as walking is concerned. Any effort they make to move only serves to throw the muscles into violent contractions and the legs into extreme adduction. The most severe type of contractions in the legs may be associated with but very slight mental defects and unaccompanied by diplegia.

Before discussing treatment I will briefly touch upon the pathology of spasmodic paralysis, if only to suggest how futile are operative procedures directed to the primary

lesion. The pathological conditions in hemiplegia, paraplegia, and diplegia are the same in kind. The symptoms are due to the retardation of growth resulting generally from embolism or thrombosis, together with changes in the spinal cord. In later cases one finds wasting and sclerosis of the motor tracts with often a loss of substance in the form of cavities or cysts known as porencephalus. These cysts occur on the surface of the brain and sometimes dip fairly deep into it. They seem to be a late result in a growing brain and to have produced an extensive scar substitute for cerebral tissue. Should the porencephalus or sclerosis be unilateral hemiplegia results. If the scar is bilateral diplegia or spastic paralysis results. The lesions therefore are a late product of a hæmorrhage, an embolism, or localised encephalitis. In the cord degenerations of the pyramidal tract or of the lateral columns are to be found.

The treatment of spastic paralysis has been too solely in the hands of the physician for much real progress to have been made. Indeed, from medicine in this affection we have but little to expect apart from very indirect results, and we have only to scan the text-books on neurology to realise the note of pessimism which is sounded. I would argue that a large proportion of children suffering from severe spastic paralysis may be transformed into useful members of the community, improved both in body and mind by surgical efforts, enabled to walk with comparatively little deformity, and generally only requiring the aid to be derived from one or two sticks.

We must place in a group outside remedial art the idiot, the microcephalic, and that violent irritable type of diplegic, so often seen, subject to fits and active athetotic moments who has generally lost all control over his secretions. The treatment of any condition short of this may be undertaken with varying success subject to conditions which obtain in any surgical case requiring prolonged attention. For instance, active treatment may be required for two years. It would therefore be unwise to admit a case into hospital for two months and then to send it to a miserable home where neglect would be sure to follow. Such a case, however, after hospital treatment, happy in the care of anxious, intelligent parents, no matter how poor, would prove a credit to all concerned. Another class which gives the greatest anxiety and trouble is that where the affection of the hands is of such a kind as to promise but slight hope of their assistance to the limbs during walking. Before despairing, however, I think it is well to give such hands the opportunity of a careful trial, both as a mental discipline and because success sometimes exceeds expectation. I would divide the treatment of all cases of spastic paralysis into operative and post-operative, for although mechanism is involved in nearly every case there is only an insignificant minority which we are called upon to treat without invoking operative aid.

The treatment of the hand and arm in infantile hemiplegia is distinctly less promising than in the diplegic case, but there are clinical signs to which I would draw your attention which help us to predict either success or failure. If the paralysis is complete, or in other words, if the little patient is never known to relax his spasm, treatment is futile. If he only moves the fingers of his affected hand in conjunction with the fingers of the opposite side the results will in all probability be discouraging. In all cases where the parents are able to say in the spirit of true observers that the patient is able to do more with the hand now than a little while ago the success of treatment is assured. Similarly, where any degree of voluntary relaxation of spasm exists apart from an associated movement on the opposite side treatment is emphatically indicated.

Noting that the dominant deformities in both hand and elbow are pronation and carpal flexion, treatment should consist in fixing the elbow supine and hyper-extending the wrist. The hyper-extension of the wrist should be combined with that of the fingers and a special arrangement should be adapted to keep the thumb at right angles to the palm. The spasm in these cases is often so pronounced that the extension of the wrist and fingers must be brought about very gradually. If the elbow is affected by contraction of the biceps and brachialis anticus, supination may be combined with extension. If this be not the case the flexed position of the elbow will suffice. If, instead of being firmly pronated, the elbow lies semi-prone it is not necessary to treat it and all one's energies should be directed to the hands. If the hemiplegic hand spasm is mild this treatment may be discarded in about 12 months, provided that during the whole of this period the extension has been

kept up without intermission. The test for relaxation must be the power of voluntary movement, however slow it may be. It will be noted that generally at this stage the patient in endeavouring to extend his wrist will first of all close his fingers and will only open them on completion of extension. The process is reversed when the wrist is flexed. In order to meet this difficulty the splint employed to extend both wrist and fingers is modified so as to extend the wrist alone and to allow freedom to the fingers.

It is difficult to give a reason as to how improvement comes about, but it may be taken as an axiom that prolonged fixation of spastic muscles in a position opposed to their contraction lessens the severity of their spasm. This is true wherever spasm may be found and its influence may be tested even in spasmodic torticollis, intractable as we know that affection to be. It would appear as if the group of muscles at last got tired of trying to pull. At this stage or earlier the surgeon may decide whether in a given case success may be predicated, and, if he is in doubt, operation should unhesitatingly be performed. Operation will consist of tenotomy or tendon transplantation. An incision is made over the tendon of the flexor carpi ulnaris just above the annular ligament, another is made over the flexor carpi radialis, and both tendons are divided low down and are taken—(1) the flexor ulnaris to be inserted into the extensor ulnaris and (2) the radial flexor into the radial extensor. I performed this operation some time ago upon two spastic children, whom I showed to the members of the Society for the Study of Disease in Children, and in both instances voluntary movements were steadily performed, and one, a girl, seven years of age, was able to write quite a respectable hand. My friend Mr. A. H. Tubby, in order to overcome the spasmodic pronation of the forearm, has changed the point of insertion from the front to the back of the radius of the pronator radii teres and has succeeded in transforming the muscle into a supinator.

Tenotomy alone has proved somewhat disappointing though one has had an occasional successful case. The operation should be confined to the division of the flexor carpi radialis and ulnaris. It is, in my opinion, better to elongate the other flexors of the hand by a long median incision such as one would employ in lengthening the tendo Achillis. Tendon transplantation, however, is a better operation, less complicated and more reliable. The surgeon's art does not end with the operation and hyper-extension of the wrist, leaving the fingers free, should be practised for a further few weeks. In order to prevent adhesions after the operation the wrist should be freely but very gently withal moved in about a fortnight's time. Whether an operation has been performed or not the final stages of treatment are identical. They should consist in getting both guardian and patient to strive every nerve to urge and to practise movements from simple to complex. The nature of the movements to be practised must be left to the ingenuity of the surgeon. The principle which should govern him may, however, be here indicated. (1) The movements should be practised slowly and without excitement; (2) they should be made interesting to the child; (3) those opposed to the direction of the deformity should predominate; and (4) those presenting the greatest difficulty should be chiefly practised.

Just a word, before we deal with paraplegia, regarding tenotomy of the spastic muscle. Empiricism has taught us that for some reason or other tenotomy lessens both in frequency and intensity the spasmodic element in paraplegia. I do not merely mean to say that division of the tendo Achillis controls spasm in the calf muscles, although of course it does, but rather that spasm in which those muscles are not directly concerned is also influenced. This is beyond all question and must have been noted by everybody who has had the opportunity of observing, and the fact has now reached the robust stage when physiological explanations are vouchsafed. Whitman urges that by elongation of the tendon the response to the exaggerated motor impulses is lessened and an opportunity for more effective control is afforded. Discussing the question with Mr. Tubby he propounded the theory that once the immediate pathological effect of the central nervous lesion had subsided the spinal cord remains in a state of undue reflex excitability. A tightly contracted muscle and tendon tend to augment this condition and so induce in themselves further contractions. In other words there is a vicious circle of reflex action which can be interrupted by section of the tendon and diminution of the tension of the affected muscle and tendon. Lorenz attributes the

effect to the shortening of the muscular portion of the tenotomised muscles so that their range of action is diminished. Both these theories, of course, refer to spasm in which the divided muscle is concerned and do not explain the diminution in spasm experienced elsewhere. We must, further, remember that the opponents of contracted muscles are always elongated and weak and that the rest afforded them by tenotomies by relieving them of strain helps to restore muscular equilibrium.

The practical deduction from these observations is that no opportunity should be lost of performing a tenotomy. Even in mild cases where a spastic tendon is to be felt we need have no hesitation in dividing it. If the surgeon has decided that a case of spastic paralysis is suitable for treatment a splint should be prepared so designed as to keep the limbs in pronounced abduction. The area over the hamstrings, the adductors at the groin, and the tendo Achillis should be suitably prepared for operation. The adductors should be first attacked. An incision an inch or two long should be made to the inside of the adductor longus. This muscle should be seized by a forceps and about three-quarters of an inch of it removed. The limb is then abducted and portions of the adductor brevis and gracilis are excised in similar fashion. The horizontal portion of the adductor magnus, and if necessary the pectineus, is divided and also any tissue, muscular or fibrous, obstructive to an absolutely free abduction of the femur. Experience has shown me that although the chief offenders are the adductors longus and brevis nevertheless the deeper muscles often require division. To anyone who has practised the operation the futility of attempts to divide the muscles effectively subcutaneously will be apparent. Division is followed with but little hæmorrhage and the wounds are closed without drainage. Having excised the pieces of the adductors each tendo Achillis is divided, or, better still, elongated, for we often note that after division of the tendon outright there is a tendency to walk too much on the heel. Rectangular splints are then applied to the foot. The limbs are then well abducted and the surgeon notes whether there is any obstacle to easy extension of the knees. If there should be (it is not often the case) an open incision must be made on each side of the popliteal space and the tense hamstrings are in turn divided. If these incisions are long enough the fascial contraction can be attacked on either side, for it is here that opposition is found. I would discourage the use of a transverse incision, as when adopted it often seriously hampers the surgeon's efforts to extend fully the knee by reason of the strain cast upon the sutures. Simple division, however, with fasciotomy usually suffices to allow of easy extension and excision of tendons could do no more. In 1885 when I was at the Liverpool Stanley Hospital there used to be an adult diplegic man always at the gates in a perambulator and on two or three occasions I took him in to try to straighten his contracted limbs. On one occasion I removed about an inch from each of the hamstrings, but he was mentally so deranged that we did not do each other any credit. I mention the fact, however, because Lorenz of Vienna has quite recently written on the advantage of excising portions of the hamstrings.

We have now presumably got our patient stretched comfortably upon an abduction frame and we must keep him there for three months. The wounds heal very rapidly and suppuration has occurred in the adductor cavity on three occasions only, despite the position of the wounds and the number of operations performed; for instance, in 1890 I operated on 27 patients and this may be taken as a fair index of my yearly return. At the end of three months the splint is taken off during the day and movements are sedulously practised. For some weeks stiffness exists and often the movements are at first painful, but after a time (always shortened by vigorous exercise) the pain disappears and the effort must be made to walk. The splints are of a simple kind designed to keep the knee from bending. The boots should be made of felt with substantial soles. The nurse should be instructed to keep both boots and splints upon the patient day and night, and for the first two weeks, frequently during the day, abduction, adduction, flexion, and extension of the hips should be practised. This should be done with and without resistance. At night-time the feet should be attached to the side of the bed in order to maintain abduction. After the first few days of this later stage of treatment the splints should be removed twice a day and the muscles well massaged and both active

and passive movements of ankles, toes, knees, and hips encouraged. Any movement executed in a jerky style should be practised until perfected.

The little patient may now try to walk. It will be noted that one of the difficulties of an untreated spastic child when he tries to walk is the narrowing of the pedestal upon which the trunk rests by reason of adducted limbs. Operation has now overcome this and with abducted limbs the body is poised upon a pedestal that is widened. During early training the nurse must see that while walking the limbs are not approximate and that from the first swinging aided by crutches must be prevented. Crutches should not be allowed until the patient has been taught to stand unsupported. I need not enter into any more detail regarding this most important stage of treatment, but would add that it affords an inexhaustible field for ingenuity and that upon the intelligence and industry of the nurse very much depends.

I cannot now deal with individual cases, but I may say that I have operated upon patients from 12 months to 20 years of age. A large number of these were so bad that they had never attempted to place one foot before the other. Some were structurally flexed (contractured) at ankle, knee, and hip. A most helpless youth, aged 20 years, with one limb across the other, was able in six months to stand erect and to walk with sticks, and 12 months later he was able to move his limbs north, south, east, and west with hardly an appreciable jerk. Success in an ancient case where so much has to be unlearned, and where the mechanical stage offers so much difficulty, proves the soundness of the principles I have endeavoured to expound. It is logical to infer that if old neglected cases are amenable to surgical education our prognosis should be very hopeful in the young.

With regard to the degree of benefit to be derived from treatment, the parents should be given to understand that under favourable conditions of nursing and tuition the child, aided by the hand or sticks, will be able to walk distances in from 12 months to two years, and that with perfectly straight limbs and heels on *terra firma*. A large proportion of cases will later manage aided by one stick. Even in the least successful cases parents, mostly having despaired, are full of gratitude. The mental condition of the children obviously improves when their physical defects are remedied and they are enabled to mix with their little friends. Complete recovery in spastic paraplegia is, of course, impossible.

It will be gathered from my remarks that the treatment of spastic paralysis should resolve itself into a system. That system involves operative, mechanical, and educational stages. The treatment cannot be separated into parts. If the surgeon is not satisfied that the case is to be under his control for 12 months he will consult his reputation best by leaving it alone. Operations not followed up by careful and prolonged after-care give rise to disappointment and discredit. Merely dividing tendons and trusting to massage and electricity is futile and dispiriting.

In conclusion, gentlemen, I would say that infantile paralysis offers an immense field for surgical enterprise and if I have succeeded in even suggesting to you some of the possibilities your time will not have been altogether wasted.

LUNACY AND LAW: THE CARE AND TREATMENT OF PERSONS OF UN- SOUND MIND IN PRIVATE HOUSES AND NURSING HOMES.¹

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My paper to-day is the natural outcome of the address by Sir William Gowers upon Lunacy and the Law,² the views of a London hospital physician, particularly in regard to private patients, given at our last general meeting in London. The discussion which followed was

¹ A paper read at the general meeting of the Medico-Psychological Association held at the County Asylum, Mickleton, near Derby, on Feb. 12th, 1903.

² THE LANCET, Nov. 22nd, 1902, p. 1369.