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OF

TRACTION AND COUNTER-TRACTION

IN THE TREATMENT OF

HIP DISEASE?

BY

A. B. JUDSON, M.D.,

ORTHOPEDIC SURGEON TO THE OUT-PATIENT DEPARTMENT OF THE NEW YORK HOSPITAL.

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Ripley & Judson

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WHAT IS THE RATIONALE OF TRACTION AND COUNTER-TRACTION IN THE TREATMENT OF HIP DISEASE?

As suggested by Dr. L. M. Yale,[1] the word traction should be used instead of extension, when reference is made to the common method of applying mechanical treatment in hip disease. Whatever form of apparatus is used, the object sought is traction. This cannot be secured, however, in any case except by the simultaneous development of counter-traction. If the extension and counter-extension (tractive and counter-tractive) apparatus is used, counter-traction is made against the inferior surfaces of the os innominatum. If the weight and pulley are used, it is found in the friction which the body makes with the surface on which it lies, and partly in the weight of the body if the limb is elevated. If the patient is standing, the affected limb being pendent, and its weight tractive, then counter-traction is found in the pressure made by the head of the sound femur on the floor of its acetabulum. Manually, traction may be made on the condyles of the femur and counter-traction on the prominences of the pelvis, and it is conceivable that in certain cases favorable to the experiment, the contracted muscles may be thus opposed or "counteracted" while passive motions of the joint are made.

The reasons which lead to a substitution of the word traction for extension also lead to the use of the expression traction and counter-traction. This term will

[1] Dr. Yale writes: "The word extension is objectionable because of its obscurity, since it is used as the opposite of flexion." (MEDICAL RECORD, January 12, 1878, p. 27.) The point thus made had been aptly illustrated in the discussion which took place in the New York Academy of Medicine (Am. Med. Times, April 27, 1861, p. 279), when Dr. Bauer was credited with the very early use of extension (traction) in hip disease, although his method really consisted in the reduction of flexion followed by fixation (N. Y. Journal of Medicine, September, 1853, p. 173), the method of Bonnet and of Hilton.

therefore be employed in the present paper, which is to be a brief inquiry into the validity of some of the accepted theories offered in explanation of the efficacy of this form of treatment.

When we view the application of traction to a case of hip disease, an obvious incident is the apparent drawing away of the thigh from the trunk. The inference has been made that the usefulness of the application depends on the separation of the head of the femur from the floor of the acetabulum. It is an interesting question whether this separation can be affected in the cadaver. The experiments of Barwell [1] and Morosoff [2] sustain the negative, and those of Kœnig and Armand [3] the affirmative. It is probable that both sides are partly right, and that the facts have been indicated by Dr. Edward H. Bradford,[4] whose experiments show that in some conditions of development, and perhaps of disease, this separation is possible with ordinary effort, while in other conditions it cannot be effected by extraordinary force.

The question of the therapeutic value of attempting to separate these surfaces has also given rise to varying opinions, some writers believing that it is an important part of mechanical treatment. Dr. L. A. Sayre is reported as holding this opinion,[5] but I do not find it expressed in any of his valuable writings on this subject, and the weight of contemporary authority is decidedly opposed to such a view, if we may judge from the following quotations: "It is not possible for the two articular surfaces to be directly separated by an extension so insignificant" (Bauer).[6] "I do not believe it (the drawing out of the head of the bone) occurs, or ought to occur, nor do I believe it would be anything but harmful if it did occur" (C. Fayette Taylor).[7] "This separation is scarcely

[1] Diseases of the Joints, pp. 336-342, London, 1861. American Edition, 1881, pp. 16-18.
[2] Quoted by Charles Monod, Arch. Gén. de Médicine, p. 718, June, 1878.
[3] Jules Armand: Thèse de Paris, pp. 30, 31, 33, 34, 1878.
[4] Boston Medical and Surgical Journal, p. 465, November 11, 1880.
[5] Discussion in Surgical Section, New York Academy of Medicine (Medical Record, p. 541, December 6, 1879).
[6] American Medical Times, p. 345, May 25, 1861.
[7] Medical Record, p. 290, September 1, 1867.

possible under any amount of force likely to be employed by a surgeon" (Yale).[1] "I do not believe it possible, by any amount of extension that can be applied, to separate the inflamed and swollen interior surfaces of the joint" (Hutchison).[2] The united opinion of these authorities is an assurance that separation of the articular surfaces is not an adequate explanation of the efficacy of traction and counter-traction.

Fixing our attention still further on traction as applied to a case of hip disease, there is, in addition to an apparent drawing away of the limb from the trunk, an apparent antagonism between two forces, that of reflex muscular action and that of traction. There is thus produced an apparent counteraction of the muscles surrounding the joint, and the inference has been made that upon this depends the efficacy of traction and counter-traction. I believe, however, that their usefulness is entirely independent of the alleged counteraction of the muscles.[3] While taking this ground I retain the highest possible appreciation of this mode of treatment, and find a satisfactory explanation on other grounds. Leaving to another occasion the consideration of the question whether "a fractional degree of fixation,"[4] such as is secured by traction and counter-traction is not the true explanation, it will be sufficient in this paper to critically

[1] Loc. cit.

[2] J. C. Hutchison: Contributions to Orthopedic Surgery, p. 9, New York, 1880. Mr. Howard Marsh believes that separation is impracticable (British Medical Journal, p. 99, July 28, 1877).

[3] Because reflex muscular action—("vigilance musculaire"—*Verneuil*. "If handled a little roughly, all the muscles will be upon their guard"—*Davis*, American Medical Monthly, p. 323, November, 1862)—is an important clinical feature and of great assistance in diagnosis, it does not follow that it is the chief element in the pathology and the point against which our local therapeutics are to be directed. There are occasions in practice when direct counteraction of muscular fibre is feasible and important, as in the cramps of the extremities in cholera and the nocturnal cramps of the sural muscles. In the treatment of stumps immediately after amputation, painful twitchings may be prevented by traction (R. F. Weir, MEDICAL RECORD, p. 51, April 1, 1867). In Buck's extension for the treatment of fractures traction is believed to be useful by directly controlling the spasmodic twitchings of the muscles (ibid., p. 50). After exsection of the hip the muscles may doubtless be counteracted by a tractive force. But all these cases are so radically different from acute hip disease that an argument cannot be drawn from them. After exsection or fracture the muscles are in a position peculiarly suggestive of the propriety of traction, because their points of origin and insertion are abnormally approximated to each other.

[4] H. O. Thomas: Diseases of the Hip, Knee, and Ankle Joints, p. 10, Liverpool, 1875.

consider the statement that traction and counter-traction owe their usefulness to the counteraction of the muscles.

That this opinion is widely entertained is evident from the following quotations from writers of note, American and foreign, who have considered this method from a practical point of view. "It is obviously of importance in treatment (1) to keep the surfaces at all times from contact, and (2) to control the muscles." "This constant contraction of muscles passing over a joint should always be counteracted." "The India-rubber spring counteracts that force which presses the bones too violently together." "To overcome the injurious pressure from irritated muscles is imperative." "The object of extension is to overcome reflex muscular action." "The object of such appliances is merely to relieve the joint from pressure, by permanently extending the morbidly contracted muscles."

A proposition drawn from the above expressions, no two of which are from the same authority, may be worded as follows: Traction and counter-traction are useful in hip disease because of their power to counteract the muscles which are injuriously contracting around the joint. If it can be proved that they have not this power, or if undue importance has been ascribed to the action of the muscles in question, then the reason of the efficacy of this form of treatment must be sought elsewhere. Although I believe that the muscles cannot be thus counteracted to any practical degree, it is impossible to give a demonstration from the nature of the case. All that can be done will be to present certain reasons for disbelief, leaving the question to the judgment of the reader.

There should be no obscurity in regard to the meaning of the term "to counteract the muscles." If the joint were fixed the muscles would in a certain sense be counteracted, because they would be prevented from action. But this is evidently not the meaning of the term. Nor does it apply to the effect of extension (the opposite of flexion), which would indeed counteract the flexor muscles, or to the effect of flexion, which would counteract the extensors. The term is evidently used with reference

to all the muscles surrounding the joint, and it signifies to make traction on them in such a way as to prevent their contraction (or at least to obviate its pressure effects) by the direct application of a force acting in an opposite direction.

It is evident that a contracting muscle can be counteracted only when traction is made on the bone in which it is inserted. In the case of the hip-joint it is necessary to obtain a secure hold of the femur, and a little consideration will show that the ordinary method of grasping the femur by adhesive plasters applied to the skin is very imperfect. If our adhesive plasters could be applied directly to the bone, or if it were admissible to use a device like Malgaigne's hooks for the treatment of fracture of the patella, we might perhaps hope to make such traction on the bone as to counteract the muscles. The shaft of the femur may be said to occupy the middle of a cylinder of elastic integument, the space around it being filled with a jelly-like mass, composed mainly of relaxed muscular fibre and loose connective tissue. It is not denied that a slight amount of traction is thus exerted on the femur, but it is unreasonable to suppose that in circumstances so extremely unfavorable it is strong enough or steady enough to counteract the muscles which directly move the joint.[1] If the great muscular masses of the thigh and hip were in a state of rigid contraction the case would perhaps be different, but these muscles are, with few exceptions, in a relaxed condition in acute disease. In the thigh the adductors are probably the only muscles which are found in sustained contraction. The sartorius, gracilis, quadriceps extensor, the three hamstring muscles, and the tensor vaginæ

[1] Mr. Howard Marsh says: "I suppose the greatest amount to which the surface of the head of the femur can be separated from that of the acetabulum cannot be more than about the tenth of an inch. And it is very difficult to preserve efficient extension and counter-extension within this range: for the parts cannot be acted upon as if they were parallel metal plates to be adjusted by a screw; they must be controlled through the agency of perineal bands and strapping fixed upon the skin, and all these are apt to give when they are subjected to constant traction; and if they yield, though it be but slightly, they soon, in the aggregate, lose this tenth of an inch of extension which they should maintain, and then the articular surfaces come again into firm contact" (British Medical Journal, p. 99, July 28, 1877).

femoris are found (in acute disease) relaxed and atrophied. The reason for this exceptional condition of the adductors is perhaps to be found in the fact that they alone of all the muscles thus far enumerated have their origin in one osseous member of the joint and their insertion in the other, an arrangement which may make them more liable to reflex action, the result of ostitis near the joint. The psoas magnus has its origin above the os innominatum. The only muscles, then, which move the joint and have their origin and insertion immediately above and below it, besides the adductors, are the iliacus, pectineus, glutei, gemelli, obturators, and quadratus femoris. The glutei are, as a rule, relaxed and atrophied. The gemelli, obturators, and quadratus femoris are simple rotators, acting only in horizontal directions. By this process of exclusion we have left as muscles liable to sustained contraction and proper subjects for counteraction the iliacus, the pectineus, and the adductors. Considering the secondary position of these muscles, when compared with the immense muscular masses of this region, it does not appear that counteraction is imperatively demanded for the protection of the joint, even if the mechanical difficulties above pointed out did not exist.[1]

It is difficult to explain the efficacy of traction in hip disease on these grounds, while reasonable explanation may be reached without difficulty by an adoption of the opinion of M. Verneuil,[2] that fixation is of prime importance, and a recognition of the fact that traction and counter-traction furnish the best solution of the difficult problem of the fixation of the hip-joint.

Before concluding, however, it is necessary to review two theories which have been advanced for the purpose of explaining more fully how the alleged counteraction of the muscles promotes recovery.

The first was proposed by Dr. Henry G. Davis, who

[1] That the pathological facts do not call for the counteraction of the muscles in hip disease has been shown in a preceding article. See N. Y. Medical Journal, pp. 1–17, July, 1882.

[2] Verneuil teaches : 1, that prolonged fixation is powerless alone to produce anchylosis ; 2, that the best way to prevent anchylosis is to combat inflammation ; and 3, that fixation of a diseased joint is an antiphlogistic of the first importance (Bull. et Mém. de la Soc. de Chir. de Paris, pp. 510, 511, 1870).

believed that the muscles could be counteracted by an apparatus which should at the same time allow the joint to perform its normal motions. He wrote: "I can but consider it highly beneficial to keep up motion of the joint, yet not allow of friction upon the diseased surfaces."[1] This idea has been adopted by a number of eminent writers. One of them who declares that "motion is just as essential to a joint as light is to the eye,"[2] advocates a "plan by which extension could be maintained that would remove pressure from the acetabulum and the head of the femur, and at the same time permit motion of the joint." Another has devised a combination of a plaster-of-Paris jacket with a hip splint, by which he claims that "extension and counter-extension and mobility of the affected limb are made feasible." Another has devised a splint in which "the movements of every joint of the limb is most perfectly secured; that at the hip especially not being in the least interfered with by the counter-extending force." Still another form of apparatus secures "mobility of the joint with extension," and a recent most instructive writer frankly admits that "up to the present day (1882) no effectual appliance to secure these results (motion and avoidance of articular pressure) had been afforded." The device which he advocates, although very ingenious, has not as yet perhaps been sufficiently tested by time to prove its superiority.

The idea entertained by these authorities is that the muscles can be counteracted by an apparatus which shall permit the ordinary motions of the joint. There are great mechanical difficulties in the way of the practical application of this idea. If traction and counter-traction are applied in the line of the thigh and the trunk, it is difficult to conceive that the same amount of force can be maintained through all the variations of flexion, extension, adduction, and abduction.[3] The difficulty depends partly

[1] New York Journal of Medicine, p. 420, November, 1859.

[2] This proposition was questioned by a distinguished opponent, who said: "Light is for the eye in a healthy state, but in disease light should be excluded" (American Medical Times, p. 311, May 11, 1861).

[3] Mr. Marsh says: "If the perineal band be adjusted when the limb is extended, it will become loose when the limb is flexed" (loc. cit.).

on the irregular shape of the inferior surface of the bony prominence made up by the body of the ischium and the rami of the ischium and pubes. As motion of the limb is made in different directions, different facets of this prominence, more or less removed from the lower end of the femur, are successively presented to the pressure of the counter-tractive part of the apparatus. If the facet presented is prominent, traction will be more severe, if depressed, less severe. And even if we imagine the bony surface reduced to a mathematical point, presenting the same resistance to counter-traction from whatever direction it comes, there is a further difficulty in the fact that the point of counter-traction (ischiatic tuberosity) is on a lower level than the point of motion (acetabulum), the effect of which arrangement is that motion will make a change in the distance between the point of counter-traction and the point of traction (lower end of femur) with, of course, a change in the degree of traction. To prevent these variations it is necessary to make the point of counter-traction identical with that of motion, and on reflection it will be found that in this way alone, which is of course impracticable, can mobility be maintained with equable traction.

It has been supposed that the use of India rubber would facilitate the practical development of this idea. Dr. Davis himself, in 1860, described an ingenious apparatus partly constructed of this material, but this device failed to secure general adoption, and none of its successors has as yet proven its value.[1]

It is, indeed, desirable to adopt some theory in accordance with which traction and counter-traction may be transferred from empirical to rational medicine, but it

[1] Dr. Davis, who employed an elastic perineal strap, described his invention as follows: "Quite at the top and inside of the splint is an eye, through which runs the catgut attached to the two ends of a perineal or extending band, and forms part of it when the whole is applied to the patient; the catgut, passing through this eye unconfined, allows the upper portion of the splint to traverse back and forth without disturbing the perineal band. All that portion of the splint that passes above the hip-joint has a motion of which the joint is the centre. By this management, allowing the catgut to traverse in the eye of the splint, the perineal band is not disturbed by any motions of the limb, and all irritation from motion is avoided" (American Medical Monthly, p. 264, April, 1860).

surely is not necessary to adopt an explanation which is burdened with so many mechanical impossibilities.

The other theory also owes its origin to the fertile and ingenious mind of Dr. Davis.[1] He formulated it in 1860, as follows: "When I speak of extension I do not apply the term to confining the limb in a given position, but to the process by which the soft parts are kept continually upon the stretch, whether by means of a weight or some elastic material, the result of which process upon the muscular fibre is to weary it and thus put it at rest."[2] This idea has been entertained by a number of writers, American and foreign, from whom the following quotations are made: "It (India rubber) appears, by its unvarying, constant, and yet not unyielding power, to tire out the muscles." "By this force (continuous extension) the muscles are tired out and soon made to capitulate." "We must carry extension until the muscles relax, and then we must maintain the extension until they lose their irritability and the inflammation in the joint has been given time to become retrogressive." "The object of continued extension is to paralyze the muscles." "When the muscular contractions are completely overcome, and the muscles are thoroughly tired out, but little extension is needed." "The object of extension is not, as generally supposed, to separate articular surfaces, but to overcome reflex muscular contraction, and by relaxing the muscular rigidity to prevent undue pressure of inflamed articular surfaces." "Forcible traction being applied in the axis of the thigh, the muscles are fatigued and overcome and rendered incapable of contraction." "If prolonged and powerful traction be applied to a muscle, it will, after resisting for a time, at length yield and fall into relaxation." "We must overcome the contractility of the muscles governing the joint."

[1] Referring to "artificial muscles," Dr. Davis in 1856 wrote that "when contracted muscle is to be overcome, it (India rubber) stealthily wearies it until it silently comes off conqueror" (Am. Med. Monthly, p. 330, May, 1856). In 1859 he related a case of hip disease in which, on the application of continued traction, the muscles became "wearied, so as to allow the head of the bone to come down upon the inferior portion of the acetabulum" (N. Y. Journal of Med., p. 418, November 1859).

[2] Am. Med. Times, p. 149, September 1, 1860.

The idea contained in these quotations, no two of which are from the same writer, is that traction and counter-traction are curative because they deprive the muscles of their contractility. Muscular fibre may lose its contractility from rupture or from degeneration, but that it surrenders this high endowment to the application of traction is, to say the very least, extremely questionable. If an elastic force be used the muscles to which it is applied would probably increase in size and vigor from the exercise. If an unyielding force be used we have already seen how great are the mechanical difficulties to be overcome. But if it were possible to grasp the femur and maintain unyielding traction, the amount of stretching is necessarily limited by the ligaments of the joint, and furthermore is extremely minute when compared with the elongation to which the muscles are accustomed in the ordinary motions of the joint. When, for instance, the thigh is extended on the trunk the flexors are of course relaxed and lengthened, and this normal lengthening is so great that it is unreasonable to suppose that the minute degree of stretching which traction and counter-traction produce can determine any important change in the qualities of the muscular fibre.[1]

It thus appears that this theory also contains points of fatal weakness.

Which of these essentially different theories shall we adopt? Shall we say that the hip splint secures mobility with traction or deprives the muscles of their contractility? Authorities are clearly divided. The fact that there are two current explanations calls for caution before the adoption of either and suggests the possibility that neither is the true one. And if this possibility were to become a certainty, and if fixation were recognized as the key to the efficacy of traction and counter-traction, these conditions would not lessen the value of the hip-splint or materially diminish the credit of those who have illustrated American surgery by its invention and use.

[1] Traction applied to the flexors by extension, as opposed to flexion, is not of course relied on to deprive the muscles of their contractility, because in this case there would be the obviously absurd application of traction to one set of muscles the flexors, and relaxation to their opposites, the extensors.