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A. B. JUDSON, M. D.,

Orthopædic Surgeon to the Out-patient Department of the New York Hospital.

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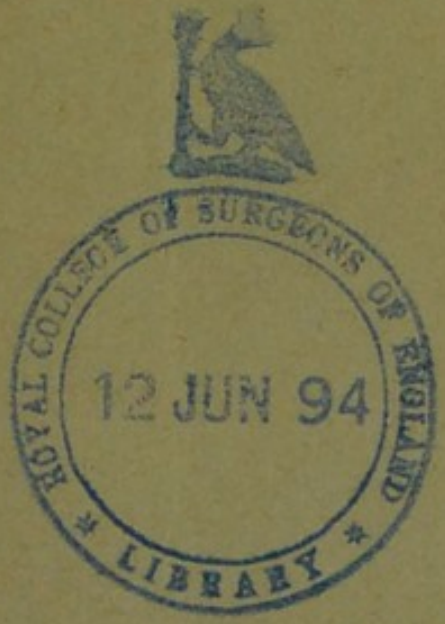

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HISTORICAL NOTES ON THE QUESTION OF THE VALUE OF TRACTION IN THE TREATMENT OF HIP DISEASE.*

By A. B. JUDSON, M. D.,

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

The treatment of hip disease has greatly changed in the last forty years. It can be still further improved, beyond a doubt, and to prepare for further advance we should keep well in mind the history of the past. As a slight contribution to such history the following summary or outline has been thought worthy of presentation.

The compilation from which the following extracts are taken was made previous to 1883. The reader will therefore not expect to find references to the many and valuable contributions to the literature of the subject which have been made since that date. I regret my inability, for various reasons, to bring these notes up to the present time. Neither can I claim that they are complete for the period which they cover. They are complete only so far as books and papers were readily accessible.

* Read before the American Orthopædic Association at its seventh annual meeting.

The manuscript compilation above referred to was made in the course of an inquiry as to which of the various opinions concerning traction expressed the correct explanation of its generally recognized good effects. The result of this inquiry—that is, the opinion which seemed to me correct—is noted in its appropriate place (pp. 20–22).

Incidentally several points of interest came into view. For instance, the word *extension*, used to signify a drawing down or away, has given place to the less ambiguous word traction.* Again, we hear but little of late years of spontaneous dislocation as a feature of hip disease. It was formerly considered an extremely important incident of the late stage, an opinion challenged by Dr. Alden March, who declared that "spontaneous dislocation of the hip (as purely the result of morbid action unaided by superadded violence) seldom or never takes place," adding that his convictions were "based upon actual observation and personal examination of about forty pathological museums in this country and in Europe."† Dr. George Hayward took the opposite side, saying: "It would require more specimens than would fill forty, or forty thousand, pathological museums to convince me that this [case related] was not a spontaneous dislocation of the femur."‡

The merits of this rather nice question were presently lost in the interesting practical questions which arose when efficient and continuous traction became possible with the introduction of adhesive plaster as a means of grasping the limb. Traction then became useful, not to reduce dislocation, but to relieve pain and promote recovery. And, with the beginning of what may be called the adhesive-plaster era, the effects of muscular contraction and measures for

* See quotation below from Dr. Yale, p. 39,

† *Trans. of the Am. Med. Assoc*, 1853, pp. 479, 480.

‡ *Surgical Reports*, Boston, 1855, p. 77.

moderating or preventing them became the ruling subjects of observation, experiment, and discussion. In 1860 Dr. Davis published the first description* of the application of adhesive plaster for prehension and traction of the limb in hip disease, and thus excited interest in the subject to such a degree that in the following year the treatment of this affection was discussed in three successive stated meetings of the New York Academy of Medicine by Dr. Batchelder, Dr. Bauer, Dr. Bronson, Dr. Gurdon Buck, Dr. H. G. Davis, Dr. Finnell, Dr. Holcombe, Dr. Krackowizer, Dr. Minor, Dr. Willard Parker, Dr. Post, Dr. Raphael, Dr. Sayre, Dr. A. H. Stevens, Dr. John Watson, and Dr. James R. Wood.† And four years later a not less important discussion on hip disease, in which the new treatment found its advocates and opponents, was carried through many sessions of the Surgical Society of Paris by MM. Blot, Boinet, Bouvier, Broca, Depaul, Dolbeau, Follin, Giraldes, Guersant, Hervez de Chégoin, Le Fort, Marjolin, Trelat, Velpeau, and Verneuil.‡

In these discussions and in contemporaneous and subsequent writings on the subject it is evident that muscular contraction was receiving unwonted attention. On the one hand the muscles appeared to threaten the joint, and on the other hand traction appeared to be the stout opponent of the muscles, and the result of the contest was the relief of pain. From these clinical premises, and too hastily in all probability, the conclusion was drawn that muscular action was the chief pathological factor and that traction was the most important therapeutic agent.

Reflex muscular contraction in joint disease had long been recognized. John Hunter, in his lectures delivered in

* *Am. Med. Monthly*, April, 1860, pp. 262, 263.

† *Am. Med. Times*, April 17, May 4, 11, 25, June 15, 1861.

‡ *Bull. de la Soc. de chir. de Paris*, 1865.

1786 and 1787, said: "This stiffness of the joint depends on the involuntary contraction of the muscles, and is in consequence of the muscles sympathizing with the joint."

"*Of Muscles losing their Action from Injuries done to Joints, Tendons, and Ligaments.*—It is remarkable that an injury done to tendons, ligaments, fasciæ, etc., especially of the strain kind, impair [*sic*] the muscles more than when the muscles themselves are injured, so that these muscles appear to sympathize with those parts of little motion and become wasted and weakened in consequence. I think this arises from sympathy, or a consciousness of the parts being nnable to answer to the action of the muscles, and it comes nearest to human reason of anything in the body. If the affection be temporary, as in common inflammation, the muscles do not waste, being conscious that the parts will recover." *

Reflex contractions were observed in hip disease by Guersant and Maisonneuve, and were considered by them as important guides to diagnosis.† Traction and counter-traction were applied to prevent their evil effects in the practice of Le Sauvage,‡ Brodie,# Alden March,‖ and Gustav Ross.△

* *Lectures on the Principles of Surgery*, Philadelphia edition, 1839, pp. 284, 290.

† *De la coxalgie.* Thèse de Paris, 1844, Maisonneuve, p. 106.

‡ See quotation, p. 23. # See quotation, pp. 11, 12.

‖ See quotation, p. 24.

△ See quotation, p. 28. Other surgeons applied traction and counter-traction in hip disease, but without intending especially to combat muscular action: Ducros, *Gaz. des hôpitaux*, June 3, 1835, p. 311; Harris, *Med. Examiner*, Philadelphia, January 19, 1839, pp. 37–40; Bonnet, *Traité des maladies des articulations*, Lyons, 1845; Zannetti, *Bull. gén. de thérapeutique*, 1853 (from *Gaz. med. Toscana*), pp. 136, 137. They used the apparatus in vogue at the time for the treatment of fracture of the femur.

But these observations and experiments attracted no particular attention until Dr. Davis made traction by adhesive plaster in the treatment of hip disease. This material had been used in the last century to control muscular action after rupture or division of the tendo Achillis and fracture of the patella,* and Dr. S. D. Gross made traction by adhesive plaster in fractures of the leg in 1830.† But this method of treating fractures was not generally appreciated till Dr. Josiah Crosby advocated it in 1850.‡ One of his patients described the sensation of traction thus applied in these words: "It feels as if my leg was in the mud, and I was trying to pull it out."# The words were homely, but they heralded in common phrase a happy emancipation from the pain and disappointment which had ever been the lot of patient and surgeon when traction was applied by bandage, fillet, or laced gaiter.

This simple and successful mode of prehension of the limb was first used in the treatment of diseases of the joints by Dr. Henry G. Davis,‖ an honorary member of our association, who named his treatment the American method△—a name which has sufficient warrant in the fact that the distinguishing feature of the method is the application of traction by the use of adhesive plaster, a device which had its origin in this country.

The immediate and earnest advocacy by Dr. Davis, Dr. Sayre, and Dr. Fayette Taylor of this method of treating

* *Medical and Chirurgical Observations.* By Benjamin Gooch, London, 1773, pp. 108–110.

† *The Anatomy, Physiology, and Diseases of the Bones and Joints*, Philadelphia, 1830, p. 50.

‡ *Trans. of the Am. Med. Assoc.*, 1850, pp. 382, 383.

New Hampshire Journal of Medicine, October, 1850, p. 65.

‖ *Conservative Surgery*, New York, 1867, pp. 213, 214.

△ The American Method of treating Joint Diseases and Deformities. *Trans. Am. Med. Assoc.*, 1863, pp. 139–170.

hip disease at once opened a new field of clinical observation and experiment, which has been under industrious and ingenious cultivation ever since. A short and very incomplete list of the questions concerning traction, which have been raised and answered in different ways, includes the following: The question of fixation, the question of separating the articular surfaces, the question of moderating the pressure between the articular surfaces by counteracting the muscles, the question of stretching the muscles till they are paralyzed, and the question of keeping them stretched while motion is made in the joint.

The following alphabetical arrangement of references is presented with the desire to facilitate an agreement among us as to the *modus operandi* of the method with which we have been credited:

Adams, William. On the Treatment of Hip-joint Disease by Extension with Motion, as practiced by the American Surgeons, instead of Long-continued Rest and Immobility. *British Medical Journal*, January 5, 1878, p. 10: "The object of this paper is to direct attention to the recent advances which have been made in the treatment of hip disease by American surgeons. . . . The first principle is that of extension as a means of relieving the most acute pain in joint diseases. . . . The second principle is that of extension combined with motion. . . . 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 surfaces. . . . The English idea has always been rest and immobility to the joint. The American idea, during the last ten years, has been extension with motion—*i. e.*, preserving motion in the joint while the pain is relieved by extension."

Agnew, Dr. Hayes. *The Principles and Practice of*

Surgery, 1881, vol. ii, p. 183: "They [walking splints described] are all constructed on very much the same principle and with a view to permit motion in the joint without articular pressure or friction—an impossible task."

Andrews, Edmund. New Instruments for the Treatment of Hip Disease. *Chicago Medical Examiner*, December, 1860. Describes his splint applied to the inner side of the limb, with a sliding rod carrying a crutch head and screw for extension. Adhesive straps are attached to either side of the leg. Page 274: "The screw is then turned up until the padded crutch top rests firmly against the perinæum and the desired extension is accomplished. In this way the weight of the patient rests upon the instrument and the instrument upon the ground without impairing the extension." Notes of Surgical Cases. *Chicago Medical Examiner*, June 1861, p. 294: "These [splints to keep up extension] are used in all stages of the disease. In the early months of the attack the extension takes away the pressure of the inflamed head of the femur in the joint and allows it to recover. After an operation it is used to prevent too great shortening while the end of the femur is contracting a ligamentous adhesion to the sides of the pelvis."

The New Splint for Hip Disease. *Chicago Medical Examiner*, August, 1861, p. 445: "Slight motion of the joint when it is firmly extended is of but little consequence."

Improved Methods of Treatment in Joint and Spinal Diseases. *Chicago Medical Examiner*, September, 1863, p. 428: "The local treatment of hip disease in the first or inflammatory stage consists in the application of some suitable instrument by which the weight of the body and the tension of the muscles can be entirely taken off from the joint, so that the inflamed surfaces no longer press and rub against each other." Page 430: "In the use of this instrument [an extension splint applied on the inner side of the

limb] the patient is soon conscious of great relief. Even little children discover in a few days that it greatly relieves their pain, and insist on keeping it on."

Report on Surgery to the Illinois State Medical Society. *Chicago Medical Examiner*, October, 1864, p. 558: "A vast proportion of the spinal, hip, and knee diseases are readily cured by any good extending apparatus which draws sufficiently to take off all the pressure and friction of the inflamed parts."

Armand, Jules. De l'extension continue comme traitement de la coxalgie chez enfants. *Thèse de Paris*, 1878, No. 38, p. 29: "Continued extension [by the American splints] separates the articular surfaces, or at least lessens the pressure." Page 69: "We believe that continued extension is an immobilizing agent. The thigh is drawn down in its axis, the muscles are fatigued and overcome and rendered incapable of movement, and the pelvis is restrained from wide motion by the counter-extension."

Barwell, Richard. *A Treatise on Diseases of the Joints*, London, 1861, p. 261: "Under these circumstances [pain and tonic contraction of the muscles increasing] the proper plan of treatment is to fight against the irritation and to counteract the muscular contraction." Page 266: "To counteract such force [muscular contraction pressing one bone on another], I have invented a form of splint." Page 267: "Besides the mere power of straightening a bent joint (only a secondary use of the splint, and not that for which it was invented), the India-rubber spring counteracts that force which presses the bones too violently together, thereby producing the spasm, keeping up the irritation and the caries. I have seen the most violent pains yield gradually to this contractile force; it appears by its unvarying, constant, and unyielding power to tire out the muscles, to

overcome their spasm, and to keep the joint surfaces, if not asunder, still not pressing together."

Lectures on the Natural History and Treatment of Hip-joint Disease. *Lancet*, 1862, 1863; October 17, 1863, p. 441: "Perhaps you will tell me that I am arguing in a circle—that having asserted the muscular spasm to be due to inflammation, it is not logical to prove inflammation due to the spasm. True, this is a circle; but it is Nature's own, and not mine."

Diseases of Joints, 2d edition, 1881, p. 464: "To prevent this pressure [produced by muscular contraction], or at least to mitigate its effects, is the object of extension."

Bauer, Louis. Some Observations on Hip-joint Disease and its Rational Treatment. *New York Journal of Medicine*, September, 1853, p. 173: "We possess in permanent extension [traction?] a sovereign remedy for overpowering muscular reflex action, and ultimately restoring the greatly distorted form."

Discussion in the New York Academy of Medicine. *American Medical Times*, May 4, 1861, p. 297: "The new instrument [combining motion with extension] was admirably adapted to control and alleviate progressive hip disease." May 25, 1861, p. 345: "It was not possible for the articular surfaces to be directly separated by an extension so insignificant as that exercised by the splints."

Lectures on Orthopædic Surgery, New York, 1868, 2d edition, p. 282: "I have derived little or no benefit from extension *per se* in the treatment of progressive joint diseases. Whatever benefit I have derived from it at all is unquestionably due to its collateral effect upon fixing the affected articulation."

Blandin. M. Maisonneuve (*Annales de la chirurgie française et étrangère*, 1844, pp. 191, 192) says that M. Blandin advocates and practices a combination of extension

of the limb with continued traction, saying that it is "a wonderful thing to see how the pain, often extremely severe, of hip disease disappears as if by enchantment."

Bœckel, Eugène. Des effets de la coxalgie infantile sur la croissance ultérieure du membre. *Archives de physiologie*, vol. iii, 1870, p. 558: "Continued extension is also a method of immobilization, and many surgeons still object to the latter on the ground that it produces ankylosis. But it is arthritis, not immobilization, that produces ankylosis."

Des applications de la traction continue au moyen de l'appareil à sparadrap. *Bulletin général de thérapeutique*, vol. lxxxix, 1875, p. 449: "Continued traction by the American method consists in traction of the joint by a suspended weight through the intervention of adhesive plaster applied to the limb." Page 456: "The effect of continued traction in hip disease is first to relieve the pain, then to remove or lessen the pressure of the head of the femur in the acetabulum, and finally to reduce the deformity."

Bradford, Edward H. The Treatment of Hip Disease. *Boston Medical and Surgical Journal*, November 11, 1880, pp. 465, 466: "It would seem, therefore, reasonable to infer [from experiments described in detail] that the relief given by extension in some cases of hip disease is due to the actual separation of the bones involved in the joint, and that this more frequently is not the fact in the early stages of the disease is probable, considering the anatomy of the joint. In these cases, however, the muscular force which in disease draws the femur upward, crowding the head against the acetabulum or forcing it above the normal position of the latter, is counteracted by thorough extension. It is to this, probably, that the relief obtained by extension in the majority of cases is due. This relief is so marked that there can be no doubt of its efficacy as a means of treat-

ment. It is also true that extension, provided the pelvis is steadied, can be made to give efficient fixation, but it is manifest, from cases which are frequently met with, that simple extension without any attempt to secure the pelvis gives great and immediate relief." Refers to experiments of Morosoff, König, Paschen, Schultze, Reyher, and Ranke, made to determine the effect of extension on separation of the head from the acetabulum and on the degree of hydraulic intra-articular pressure.

Brodie, Benjamin. *Pathological and Surgical Observations on the Diseases of the Joints* (third London edition, 1834), Washington, 1834, p. 55 : "At a later period when, in consequence of the extensive destruction of the articulation, the muscles begin to cause a shortening or retraction of the limb, I have found great advantage to arise from the constant application of a moderate extending force, operating in such a manner as to counteract the action of the muscles. For this purpose an upright piece of wood may be fixed to the foot of the bedstead opposite the diseased limb, having a pulley at the upper part. A bandage may be placed round the thigh above the condyles with a cord attached to it, passing over a pulley, and supporting a small weight at its other extremity."

Clinical Lectures on Surgery—Philadelphia edition, 1846, p. 297—describes the same apparatus: "In this upright piece of wood there is a pulley, which pulley is just in line with the thigh bone. . . . A few ounces of lead or some copper penny pieces put into a basket are sufficient in the case of a child. . . . The patient suffers because the head or neck of the femur is leaving its own place and getting into new parts which are not intended to have the rough bone in contact with them. . . . It is astonishing what comfort I have known this to give the patient in some instances."

Diseases of the Joints—fifth edition, London, 1850, p. 139—describes the same apparatus, a leather strap being substituted for the bandage above the condyles of the femur and "the pelvis being at the same time fixed by a strap to the middle or upper end of the bedstead." Page 140: "This in some instances seemed to relieve the pain, and I am inclined to think it was useful otherwise by counteracting the muscles, which tended to draw the limb upward. However, it almost always happened that something occurred to prevent the experiment being fully and fairly tried; and all that I can venture to say respecting it is that it may be worth while, in certain cases, to give this mode of treatment a further trial." *

Busch. Armand, on pages 74 and 75 of his thesis, states that Busch affirms the good effect of continued extension on the course of the disease, but believes it to be the result of an increase of hydraulic pressure in the capsule, in opposition to which Armand cites the experiments of König and his own.

Cooper, E. S. Editorial, *San Francisco Medical Press*, July, 1861, p. 145: "Often have patients slept better the first night after its application [referring to his tin splint for extension] than they had done for months previously."

Davis, Henry G. Deformities and their Remedy. *American Medical Monthly*, March, 1856, p. 212: "These artificial muscles answer another important part in wearying out the contracted muscles by their constant action night and day, thus tending to elongate them." May, 1856, p. 329: "This same principle of treatment—viz., the

* Sir Benjamin was very familiar with Scott's dressing of those days, which consisted of adhesive plaster applied so abundantly as to obstruct the motion of the hip. It would have been a happy thought to use the same material with his weight and pulley instead of the bandages and leather strap.

separating of the diseased surfaces and removing from them all irritation from pressure—is equally applicable to disease of the hip joint." Page 330: "This [rubber used as an extending power] will act steadily and gradually without any violence and with very little suffering in comparison with permanent fixtures. When contracted muscle is to be overcome, it stealthily wearies it until it silently comes off conqueror."

A Case of Pott's Disease, with Remarks. *American Medical Monthly*, November, 1859, p. 361: "In morbus coxarius we separate the diseased head of the femur from the acetabulum, thus leaving the parts in a condition to recover so far as pressure might have interfered. By this means we also get in both instances [Pott's disease and hip disease] passive motion without friction."

On the Effect of Pressure upon Ulcerated Vertebræ and in Morbus Coxarius. *New York Journal of Medicine*, November, 1859, p. 418: "Extension was made upon the limb, and after the muscles had become wearied so as to allow the head of the bone to come down upon the inferior portion of the acetabulum, the pain was relieved." Page 420: "I can but consider it highly beneficial to keep up motion of the joint, yet not allow friction upon the diseased surfaces."

On the Mechanical Means adopted in the Treatment of Morbus Coxarius. *American Medical Monthly*, April, 1860, pp. 263, 264: "The extension is first made at that angle with the body that I find the limb; as the tenderness of the joint subsides, the body should be gradually lowered until it is brought in a line with the limb; when this is effected, the splint can be applied and the patient put upon crutches and permitted to exercise." Page 267: "It puts the diseased parts in the best position for their restoration with a perfect joint, as it relieves the pressure upon

the head of the bone, while at the same time it admits of motion, which increases the recuperative energy of the parts, inasmuch as it increases vitality."

On the Advantages of Elastic Extension in Morbus Coxarius. *American Medical Times*, Sept. 1, 1860, p. 149: "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 continuously upon the stretch, whether by means of a weight and pulley or some elastic material, the result of which process upon the muscular fiber is to weary it and put it at rest."

On the Pathological Basis of the Treatment of Joint Diseases. *American Medical Monthly*, November, 1862, p. 323: "If handled a little roughly all the muscles will be upon their guard." Page 336: "When extension is made by an elastic material the muscular fiber becomes wearied, the nervous influence is expended, and the bones come down until the extending power is exerted entirely upon the unyielding tissues. . . . An unremitting draft is kept up upon the muscles, and yet the limb is not fixed but that the muscles may contract and thereby exhaust their nervous influence and ultimately rest like any muscle wearied from exercise."

The American Method of treating Joint Diseases and Deformities. *Transactions of the American Medical Association*, 1863, p. 150: "Pressure, mostly owing to muscular contraction, is the most active agent of destruction in the morbid process. . . . The essential parts of the apparatus are simply means of exerting an elastic, continually extending force on one side and a resisting counter-extending one on the other." Pages 154–156: "The joint becomes in a manner fixed . . . as a remedial measure. . . . It undoubtedly is to protect the surfaces of the joint (that come in contact in the natural movements of the limbs) when

diseased from friction. . . . So far as this object can be accomplished by the muscles holding the joint motionless they so act. Now, in effecting this immobility, are the muscles of the diseased joint relaxed, and therefore at rest? Or are they in a semi-contracted state, and thus fix the joints by acting equally upon every side of it? . . . If it is true that the diseased joint is held in a fixed position by a certain rigidity of the muscles passing to or beyond it, an amount of pressure corresponding to the contractile force of the muscles as then exerted must be produced upon the articulating surfaces of the joint, . . . producing absorption, when not sufficient entirely to arrest the nutrition of the parts, and when going beyond this point death, with exfoliation of the parts pressed upon."

Conservative Surgery, New York, 1867, pp. 85, 86: "After the lapse of an indefinite period from the receipt of severe injury to a joint the muscles acting upon it sometimes pass into a state of fixed contraction, or may start into spasmodic action upon any effort being made to move the joint either voluntarily or by the attendant. . . . This action of the muscles is not dependent upon any disease of their fibers or their nerves, but is simply a contraction for the purpose of preventing, instinctively as it were, motion in parts where motion is productive of pain. This constant contraction of muscles passing over a joint, thereby guarding with increased vigilance against motion, when all movements of the joint give pain, is the efficient cause of the destruction of the parts pressed upon or against each other, and should always be counteracted." Page 206: "When disease about a joint renders the movements of that joint painful, . . . the joint is always liable to be destroyed by uninterrupted pressure effected through the contraction of the muscles passing over it. They do this by preventing the parts pressed upon from receiving nourishment, in the same

way as a bedsore is produced." Pages 209, 210: "The treatment of simple synovitis in its earlier stages by extension is as imperatively demanded as at any later period, and relieves the pain as effectually. . . . Continued elastic extension is applicable not only to synovitis, but to all other diseases within the capsule; and not only these, but when parts about or in the vicinity of a joint are so painful as to compel the individual to hold the joint motionless, extension should be applied, for the reason that the pressure exerted by the muscles in holding the joint motionless will strangulate the nutrient vessels of the parts held in contact." Pages 212, 213: "In diseases of the joints we were the first to point out, as an always-present factor in the destruction, the existence of unremitting pressure as effected by contraction of muscles passing over the joints causing constant forcible opposition of the surfaces within the joint. . . . When this fact was fully established in our mind we were led to seek the best way of counteracting the contraction of the muscles, and soon came to the conclusion that a constantly acting force, however moderate, must eventually weary muscles by giving them no respite." Page 214: "The first splint, as well as all my modifications, admits of free motion at the diseased joint, but rigidly excludes all friction of the diseased surfaces within the joint upon each other. This we consider the essential element in the treatment of the disease under consideration—viz., motion without friction."

Gibney, V. P. *The Hip and its Diseases*, New York, 1884, p. 324: "By far the surest method [of relieving pain] is fixation and traction. The weight and pulley sometimes act like a charm. The spasm is overcome, the limb is supported, and the child falls asleep without fear." Page 358: "The one practical idea, however, to which all these splints tend is immobilization or fixation, with the

associated idea of motion if desirable." Pages 359, 360: Points that seem to be settled: "(1) Traction does not produce any appreciable separation of the head of the bone from the acetabulum. (2) It does induce fixation and prevents concussion. (3) It relaxes muscles by overcoming reflex spasm. (4) Fixation is considered of far more value than pure extension. (5) Traction to be efficacious must be in the line of the deformity."

Hennequin. Quelques considérations sur l'extension continue et les douleurs dans la coxalgie. *Archives générales de médecine*, December, 1868, p. 79: "Continued extension, having overcome muscular power, separates the articular surfaces and does away with pressure and pain." Page 80: Recognizes the vicious circle in which pain increases muscular action, which in turn produces more pain. Suggests the theory that the contracting muscles keep the femoral head turned in such a way that the less sensitive portions of its surface receive the pressure. Page 176: "The object of continued extension is to paralyze the action of the muscles." Pages 186, 187: A case of eighteen months' duration in a girl of eighteen years with apparent shortening of ten centimetres treated by continued extension. "Twenty-four hours had not passed before the pain disappeared, the pelvis descended laterally around the lumbar column, the swelling subsided, and a cheerful confidence succeeded depression."

Hildreth. Discussion in the Boston Society for Medical Observation. *Boston Medical and Surgical Journal*, April 26, 1877, p. 506: "Dr. Hildreth thought that not so much extension was required as rest; extension sufficient only to overcome the muscular contraction."

Holmes, Timothy. *Surgical Treatment of the Diseases of Infancy and Childhood*, London, second edition, 1869, p. 444: "The early symptoms of hip disease are in a great

measure muscular, and can only be treated successfully by measures directed to the relief of muscular contraction—*i. e.*, by mechanical extension." Page 447: "The first indication of treatment is to place the parts at perfect rest under the influence of sufficient extension to avoid exacerbations induced by muscular spasm." Page 448: "I have found nothing answer so well as the old plan of suspending a weight to the foot sufficient to overbalance the tension of the muscles. . . . The spasmodic pains will subside and the child, freed from the irritation and the loss of sleep which they occasion, will rapidly recover the aspect and appetite of health. . . . The most convincing experiment and one which I have frequently repeated is, after the starting pains have subsided (which they do usually on the second or third day from the application of the weight), to leave it off, when they will almost infallibly recur on the second succeeding night, again to disappear on renewal of the treatment."

Hugman, William C. *On Hip-joint Disease*, London, second edition, 1866. Pages 35–39 contain reference to the Fifth Report of the Hamburg Hospital, where treatment was "in the latter stages by keeping up a gradual extension, so as to overcome the spasmodic action of the extensor muscles, which, according to the opinion of Dr. Fricke and Dr. Taudtmann, when dislocation had taken place, not only tends to increase the deformity by further shortening the limb, but also adds to the inflammatory condition of the part by friction of the head of the thigh bone upon the dorsum of the ilium."

Hutchison, Joseph C. *Contributions to Orthopædic Surgery*, New York, 1880, pp. 8, 9: "The object of extension is: (1) To correct the malposition of the limb. . . . By means of extension we also (2) overcome the spasm and contraction of the muscles which, by reflex contraction,

press together the inflamed articular surfaces, and constitute the chief cause of pain in joint inflammation; but I do not think it possible by any amount of extension that can be applied to separate the inflamed and swollen interior surfaces of the joint so as to relieve them from pressure and the consequent pain. What we do accomplish by extension is the relief of spasm and of muscular shortening; and to quiet the muscles is an important therapeutic axiom . . . motion without friction, a condition which . . . seems to me to be a mechanical absurdity. We might with equal propriety speak of sound without vibration of the air." Pages 18, 19: "To obtain extension of the limb no apparatus is required. Extension is made by the weight of the suspended limb [the patient being provided with crutches and a high sole on the well foot], which is equal to a fifth of the whole weight of the body and is greater than the weight usually employed for extension. This is quite sufficient to subdue the spasm of the muscles which crowd the head of the bone into the inflamed acetabulum and is the chief cause of the pain which the patient experiences. . . . The extension not only relieves pain, but it corrects the malposition." Page 40: "The spasmodic contraction of the peri-articular muscles is overcome by the gentle, persuasive, and painless (physiological) extension made by the weight of the limb." Pages 19, 20: "This plan of treatment should be adopted . . . except in the comparatively rare form . . . attended with great constitutional disturbance and excruciating pain. . . . Until after the acute symptoms have subsided such cases should be treated in bed with the long splint and the weight and pulley."

Discussion in the New York Academy of Medicine. *Medical Record*, May 1, 1880, p. 492: "He believed it to be impossible to separate the head of the bone from the acetabulum by any mechanical appliance, and all an appara-

tus could do was to prevent the head of the bone from jamming up into the acetabulum, and thus prevent pain."

Hyde, J. N. An Adaptation of the Plaster Jacket to the Splints for the Hip. *American Journal of the Medical Sciences*, July, 1877, p. 124: "It will be seen from the preceding description that the hip splint, as thus modified [combination of plaster-of-Paris jacket and short traction splint], provides for extension and counter-extension, with free mobility and without perineal pressure."

Judson, A. B. Considerations respecting the Mechanical Treatment of Hip Disease, with Especial Reference to the Value of Traction. *St. Louis Courier of Medicine*, May, 1881, p. 370: "The advantages derived from the traction exerted by the hip splint are due solely to the fact that it secures fixation." Page 371: "It is not believed that the hip splint secures absolute immobility, but fixation or a reasonable degree of immobility."

Some Practical Inferences from the Pathology of Hip Disease. *New York Medical Journal*, July, 1882, pp. 9, 10: "In these cases [early stage] the articular surfaces directly exposed to pressure are free from erosion or ulceration, while the underlying spongy tissue of the bone is deeply implicated, and yet reflex muscular contraction is one of the earliest recognizable symptoms. So far as the incipiency of the disease is concerned, the recorded facts of pathology fail to sustain the importance of muscular action." Pages 10–15: In the middle stage ulcerations first appear on the neck and not on the articular surface, and when the articular surface is marred its lesions are less severe than those of the underlying tissue—facts which show that the morbid action proceeds from within outward, from the interior of the bone toward its surface; whereas, if the muscular contraction were an important factor the reverse would be true. When the evidences of pressure are found

they are seen in the altered shape of the head and neck of the femur, and are as readily referable to the pressure and concussion incident to standing and walking as to the pressure resulting from muscular contraction. Page 15: "In this [the late] stage the signs of disease are never limited to the parts directly exposed to pressure, for all the surfaces of the upper extremity of the femur and sometimes a portion of the shaft are thoroughly diseased. If the action of the muscles is productive of mischief in this stage, the unremitting and firm pressure which is thought to accompany reflex muscular action ought to produce effects much graver than those which are found." Page 16: "If the femur were in fact propelled by such a force, instead of the recession of the upper edge of the acetabulum and the occasional perforation of its floor we should have in every case, and soon after the accession of the disease, an abrupt invasion of the pelvic cavity by the decapitated femur."

What is the Rationale of Traction and Counter-traction in the Treatment of Hip Disease? *Medical Record*, May 12, 1883, p. 511: "There are great mechanical difficulties in the way of the practical application of this idea [traction with motion]. If traction and counter-traction are applied in the line of the thigh and trunk, it is difficult to conceive that the same amount of force can be maintained through all the variations of flexion, extension, adduction, abduction. . . . The idea is that traction and counter traction are curative because they deprive the muscles of their contractility. Muscular fiber may lose its contractility from rupture or degeneration, but that it surrenders this high endowment to the application of traction is, to say the 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."

The Fixative Power of Traction in the Treatment of Hip Disease. *Medical Record*, July 7, 1883, p. 2: "Take two rods of iron and form an eye in the end of each by bending its extremity into a small circle. When the rods are joined by these eyes they will together resemble two links detached from a surveyor's chain, and there will be wide and free mobility at the joint. Then tie the free end of one link to a staple and apply traction, by means of a weight and pulley, to the free end of the other. It is seen at once that the mobility which existed at the joint between the links is absent so long as the traction continues. . . . Or subject the two links to traction in a hip splint, tying the free end of one to the perineal straps and that of the other to the leather straps which lead to the foot piece. The result of applying traction by the rack and pinion is fixation of a remarkably stable and indestructible kind." Page 4: "The fixation which this apparatus secures is of a peculiar quality. It may be compared to the condition found in some forms of paralysis, when a joint is said to resemble a leaden pipe, which may be bent with suitable force, but retains with sufficient firmness whatever position it may be placed in. This fractional degree of fixation is attended with sufficient arrest of motion to allay inflammation, encourage the reparative process, and afford relief from pain; and yet it is not so inflexible as to prevent the gradual correction of deformity in obedience to the unconscious efforts of the patient to place the limb in its most useful position, which is that of slight flexion with neither adduction nor abduction."

Knight, James. *Orthopædia*, New York, 1874, p. 263: "Nothing is more fallacious than to expect a cure to be made by a continued extension of the limb, as that of the weight and pulley, which continues to extend . . . to the impairment of the tone of the muscles. In our experience

it is only palliative to pain, and not curative, but actually injurious as a treatment."

Le Fort. Discussion in the Surgical Society of Paris. *Bulletin Société de chirurgie*, March 8, 1865, p. 77: An indication urged by American surgeons is continued extension, "not to prevent spontaneous dislocation, but to promote cure of the disease and especially to relieve the pain often so severe in the early stages." Le Fort's extension apparatus described by Philipeaux (*Traité de th rapeutique de la coxalgie*, Paris, 1867, pp. 418, 419) is designed to gradually reduce flexion, to diminish pressure of the head in the acetabulum, and to permit locomotion and motion in the joint.

Le Sauvage. Mémoire théorique et pratique sur les luxations dites spontanées ou consécutives, et en particulier sur celle du fémur. *Archives générales*, November, 1835, p. 280: "I believe that the use of the bandage for continued extension is not only to lengthen the limb, which is not necessary in every case, but also to prevent motion and pressure caused by muscular contraction."

Liston, Robert. Lectures on Diseases of the Bones and the Joints. *Lancet*, November 25, 1843, pp. 237, 238: "All this [the use of a weight and pulley] may amuse the patient's mind, perhaps, but I do not think any good can come of it further than preventing motion."

Macnamara, C. *Lectures on Diseases of Bones and Joints*, London, second edition, 1881, p. 425: "There can be no question that spasm of the muscles in cases of this kind may be overcome by extension effected through a weight and pulley, a means of treatment which can not be too highly recommended."

March, Alden. On Coxalgia, or Hip Disease. *Trans. of the Am. Med. Assoc.*, 1853, p. 499: "It is proposed now to show how extension and counter-extension . . . can be ex-

plained on pathological principles. . . . By the pressure of the muscles that act on the head of the bone and acetabulum, in addition to ulcerative absorption, we get progressive absorption, and hence the great destruction of the osseous parts of the joint. . . . Extension and counter-extension are used with a view to prevent undue pressure on the delicate and tender surfaces of the diseased bones."

Markoe, Thomas M. *A Treatise on Diseases of the Bones*, New York, 1872, p. 114: "There is a mode [weight and pulley] of securing rest to the limb . . . which is attended with the very great advantage of relieving the pressure of the joint surfaces against one another, produced by the tonic contraction of the muscles surrounding the joint."

Marsh, Howard. On the Prejudicial Effect of Interarticular Pressure in Joint Disease; and the Application of Continuous Extension, by Means of a Weight and Pulley, as a Remedy for this Condition. *St. Bartholomew's Hospital Report*, 1866, p. 149: "When the child had become free from pain, which was usually the case in from three to eight days, I went during the night, while he was asleep, and raised the weight and lodged it in the bottom of the bed, thus setting the muscles free from restraint and giving them liberty to contract. In a very few hours many of the children so treated became restless in their sleep, and presently awoke with the old pain, and screaming. . . . The influence of such pressure as that which muscular action produces on the surfaces of a diseased joint is in the highest degree prejudicial." Page 150: "Seeing how grave an influence is excited on the course of joint disease by the pressure and bruising which the articular surfaces inflict upon each other, both during any movement of the limb and during muscular action, it is obviously of importance in treatment (1) to keep the surfaces at

all times from contact, and (2) to control the muscles." Page 151: "The necessity of providing artificially for the relief from pressure in disease is obvious when it is remembered that in the spontaneous course of events not only is the pressure constant, but also that it is greatly increased in its amount by abnormal muscular action. Extension by means of a weight is well adapted for supplying this need. The second indication in the management of joint disease to which I have referred is to control irregular muscular action. As this abnormal action is due, as we learn from Mr. Hilton, to the inflamed condition of the joint, it may be expected to subside when the inflammation passes off. Until this is the case, however, it will be found that it is perfectly controlled by continuous extension. By this force the muscles are tired out, and are soon made to capitulate."

Lectures on the Diagnosis and Treatment of Hip Disease in Children. *British Med. Jour.*, July 28, 1877, p. 98: "As the muscles and other rigid structures yield, the limb will subside into its natural position until it is in full extension and parallel with its fellow. As this change goes on, you must gradually shift the pulley so that it is kept still in the line of the long axis of the femur." Page 99: "The greatest amount to which the surface of the head of the femur can be separated from that of the acetabulum can not 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 can not 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 exten-

sion which they should maintain, and then the articular surfaces come again into firm contact. Besides, I may refer to what has seemed another difficulty. Both Dr. Sayre and Dr. Taylor allow their patients to move the thigh upon the trunk by bringing it toward flexion, and it has always appeared to me that if the perineal band be adjusted, according to their direction, when the limb is extended, it will become loose when the limb is flexed."

Maylard, A. Ernest. The Double Splint in Affections of the Hip. *Glasgow Med. Journal*, March, 1882, p. 162: "To obtain what is absolutely necessary for joint repair—perfect rest—movement must be checked, muscular action counteracted, and, still further, any pressure of the inflamed surfaces upon each other prevented."

Monod, Charles. De l'extension continue dans le traitement des arthrites. *Arch. gén.*, June, 1878, pp. 723–725: "Recall the painful contraction, the muscular rigidity of arthritis, the *vigilance musculaire*, protecting the joint from inadvertent disturbance, but entailing deformity and destruction. Evidently continued extension, especially if applied in the early stages, acts by combating the excited muscles. Challenging them to the contest, it deprives them of their power, and in this lies the great advantage of this method. . . . Traction, really continuous, must triumph over muscular resistance. If the traction is permanent and strong enough the muscle will, after resisting for a time, finally yield and fall into relaxation. . . . We recall these facts because those who are using this method do not seem to view them aright. Overlooking the real object and seeking to separate the articular surfaces, they are absorbed in increasing the amount of traction, instead of making it really continuous."

Parker, Willard. Discussion in the New York Academy of Medicine. *Am. Med. Times*, May 11, 1861, p. 311: "The

treatment of inflammation in the early stage is rest. We get our extension and counter-extension by the application of this splint, and thereby we accomplish everything in the joint. Our patient gets the air, but that joint is still at rest."

Philipeaux, R. *Traité de thérapeutique de la coxalgie*, Paris, 1867, p. 261: "The so-called American method is the application of continued extension to arrest the progress of acute disease and to dissipate the severe pain so common in the early stage." Page 262: "They apply continued extension to remove all pressure on the articular surface by the weight and pulley at night and special apparatus in the daytime. This practice leads to the neglect of the great principle of immobilization without which nothing can be done." Page 284: "Starting with the mistaken idea that the pain is due to pressure on the articular surfaces and that the shortening is due to absorption of cartilage and deepening of the acetabulum, they apply continued extension to prevent pressure and avert deformity." Page 285: "After deformity is reduced immobility may be assured by continued extension in the absence of proper immobilizing apparatus."

Roberts, M. J. Elastic Extension and Articular Motion as Therapeutic Agents in Chronic Joint Disease. *The Medical Gazette* (New York), Feb. 18, 1882, p. 74: "He believed that it was necessary, in order to preserve the integrity of the joint and the part below it, to keep up a certain amount of motion. . . . If motion without friction was to be obtained, the splint must keep up extension with no articular pressure, and allow for the lateral deviation. What was wanted was an instrument that would automatically lengthen as the limb shortened in flexion. Such an instrument he had devised."

The Hip and its Diseases. By V. P. Gibney, New

York, 1884, p. 377: Dr. Roberts describes portions of his splint as "constructed with special reference to exerting continuous elastic linear traction [by India rubber] upon the thigh." Page 379: "By continuously exerting elastic traction, it is further claimed, articular motion becomes possible without interarticular pressure or friction."

The Fundamental Principles of Mechanico-therapy in Hip Disease. *New York Medical Journal*, March 15, 1884, p. 294: "The combined use of efficient resilient support, firm tensile circumferential compression, and elastic linear traction, renders the patient more comfortable and more quickly subdues reflex spasm than the independent use of any one or two of these measures; and during the continuance of their conjoint use, articular motion can be made without the slightest discomfort to the patient." May 3, 1884, p. 490: Maintains "the feasibility of permitting articular motion at the hip, under the restrictions of efficient resilient support, firm tensile circumferential compression, and elastic linear traction."

Ross, Gustav. Ueber ein neues Behandlungsprincip der Gelenkkrankheiten. *Deutsche Klinik*, March 4, 1854, pp. 96–99: Deformity is caused by reflex muscular action. Refers to his statement made in Blandin's clinic, Paris, 1845, that myotomy of biceps in the case of a diseased knee would have lessened caries because the pressure from muscles would have been lessened. In hip disease muscular action prolongs inflammation, and treatment should consist in preventing the contraction of the whole muscular mass around the joint. Treats all cases of joint disease by extension by weights and pulleys. The pain lessens astonishingly.

Sayre, L. A. *American Medical Monthly*, April 1860, p. 298: "When left to itself, the rest which is so essential to the joint is procured by the firm muscular contraction which prevents the motion in the joint, and is so perfect

as in many instances to assume the appearance of genuine bony ankylosis. But this constant muscular contraction exhausts the nervous system and induces hectic fever; gives the child nocturnal spasms of intense agony; prevents nutrition of the limb, which results in atrophy. We therefore resort to artificial means to produce this rest. . . . The great difficulty to be overcome in securing entire rest of the joint is the danger of producing bony ankylosis, resulting from the general inflammation of the surrounding structures, and sometimes great stiffness and partial ankylosis of the well joints. On the other hand, if we remove the instrument and commence passive motion, without keeping up extension, there is danger of reproducing the inflammation. I have therefore come to the conclusion that perfect rest, however essential it may be to an inflamed synovial membrane, is not only unnecessary to the ligaments (which in the earlier stages were not involved in the inflammation), but was positively physiologically wrong. As the eye needs the healthy stimulus of light, so does the ligament need the stimulus of motion. If, then, we can give motion to the ligaments of a joint, while at the same time we prevent muscular contraction, so as to remove pressure from the synovial membrane, we shall accomplish our object." Page 300: "The India rubber, by the permanency of its contraction, will overcome the muscular rigidity."

Report on Morbus Coxarius, or Hip Disease. *Trans. Am. Med. Assoc.*, 1860, p. 475: "If the effusion be excessive, or the inflammation acute, you will have an apparent ankylosis, caused by muscular contraction, which is an involuntary act, produced by reflex action of the inflamed or irritated nerves, and is done for the purpose of keeping the joint perfectly still. It affords the natural indication for the surgeon, by imitating this action, to accomplish the same result of perfect rest to the inflamed synovial mem-

brane. This we may do in a much more effectual manner, for at the same time we succeed in relieving the other parts from a pressure which, if long continued, must cause, in the absorption of the cartilage and bone, the destruction of the joint. Motion, when not accompanied by extension, is much more painful than rest, even if accompanied by the pressure caused by the muscular contraction. Hence the patient, naturally choosing the least of two evils, obtains rest of the part by muscular rigidity, even at the expense of the absorption arising from the pressure."

Objections to the Treatment of Morbus Coxarius in its Advanced Stages by Extension, unless preceded by Tenotomy. *American Medical Times*, May 9, 1863, p. 219: "The object of extension in the inflammation of all joints is to relieve pressure from the inflamed synovial membrane and cartilage."

On the Mechanical Treatment of Chronic Inflammation of the Joints of the Lower Extremities. *Transactions of the American Medical Association*, 1865, p. 379: "Chronic inflammation of any joint produces reflex contractions, causing deformity and severer pain by increasing pressure at the diseased surfaces, thus making extension and counter-extension a necessary part of the treatment."

Introductory Lecture, New York, 1868, p. 11: "I have been enabled to test the correctness of the now established principle of extending a contracted muscle by the constant application of an elastic force, moderately but persistently applied."

Clinical Lecture on Fibrous Ankylosis. *Medical Record*, Sept. 1, 1874, p. 449: "Extraordinary results can be obtained in the way of overcoming muscular rigidity by the application of a constant unremitting force. Under circumstances favoring the application of constant unremitting elastic force equally as favorable results can be ob-

tained by paralyzing muscular power, thus overcoming deformities produced by it."

On Ankylosis. *Transactions of the New York Academy of Medicine*, 1874, p. 27: "This contraction [produced by reflex irritation] not only aggravates the disease by causing undue pressure on the parts inflamed, but also distorts the limb in accordance with the action of the most powerful muscles involved, and the distortion can only be prevented by the proper application of an extending and counter-extending force during the treatment of the disease."

Lectures on Orthopædic Surgery, New York, 1876, p. 244: "This pain, moreover, is self-perpetuating, for the irritation of the diseased joints causes the muscular contractions, and these in turn aggravate the inflammation." Pages 273, 274: "The most important of all the means to be employed [first stage], and the one upon which all prospect of success depends, is rest of the joint and perfect freedom from pressure of the inflamed articular surfaces." Page 275: "Extension is employed [second stage] for the purpose of counteracting the morbid contraction of the muscles, and to relieve the pressure upon the articular surfaces of the joint, and is persisted in until the more prominent inflammatory symptoms have subsided." Page 278: "The object of such appliances is merely to [third stage] relieve the joint from pressure by permanently extending the morbidly contracted muscles and at the same time securing its perfect mobility."

Discussion in the Surgical Section of the British Medical Association. *British Medical Journal*, Aug. 30, 1879, p. 317: "The first point to be attended to is the employment of extension and counter-extension carefully regulated so as to readily relieve the parts from pressure, as indicated by the comfort of the patient. The next great element is

rest, as complete and perfect as can be given to the parts." Page 319: "The first principle was rest, as absolute and complete as it could be made, for the individual joint involved in the disease; and the next thing was to prevent the muscular contraction that would always take place whenever there was inflammation. There should be extension of the joint, just such as would prevent pressure and no more; otherwise destructive changes would go on."

Discussion in the Surgical Section of the New York Academy of Medicine. *Medical Record*, Dec. 6, 1879, p. 544: "Constant muscular contraction kept up constant pressure of the diseased surfaces one upon the other, absorption occurred, and where it had extended sufficiently far, the acetabulum was perforated and the head, or rather the upper extremity of the femur, rode through it. It was to overcome the constant and persistent action on the part of the muscles that some mechanical apparatus was employed which relieved them, and at the same time simply kept the diseased surfaces from coming in contact with each other. . . . By fulfilling these conditions [by extension and counter-extension] the exciting cause of the muscular contractions was removed, and with its removal went the tendency to reflex muscular movements, and at the same time more or less motion in the joint was obtained."

A Clinical Lecture. *Medical Bulletin* (Philadelphia), January, 1882, p. 4: "Where slight extension is made, the movements of the joint can also be made and thus permit of recovery without ankylosis."

Discussion in the New York Academy of Medicine. *Medical Record*, May 1, 1880, p. 492: "Give the parts involved in the disease absolute rest and freedom from pressure without materially interfering with the mobility of the joint. Extension in such a manner as to permit motion should be the object sought for in any mechanical appli-

ance, except in cases in which the inflammation is so violent that absolute rest is required for a time."

Schede. Armand, on page 42 of his thesis gives a case from Schede of a girl of fourteen years who had suffered the acute pain of hip disease for four weeks. For the six days before treatment the temperature was between 101·1° and 100·8° in the morning and between 102·6° and 103·1° in the evening. Traction was applied, and after a night of sleep, the first in a long time, the thermometer recorded—

The first morning, 99·5° ; evening, 102·9°.
The second " 100·4° ; " 101·1°.
The third " 99° ; " 100°.

From that time the temperature was normal.

Shaffer, Newton M. On Reflex Muscular Contraction and Atrophy in Joint Disease, with Remarks on Mechanical Extension. *Archives of Clinical Surgery*, June 15, 1877, p. 82 : "The primary contraction that occurs in joint disease is reflex. Clinical experience proves that whatever relieves joint pressure and arrests motion will modify the contraction, and that whatever increases joint pressure aggravates the inflammation and intensifies the contraction. The primary indications are therefore to relieve joint pressure and to arrest motion. These can both be accomplished by a properly adjusted extension apparatus. . . . The extension is then exerted, so far as the conformation of the hip joint will permit, directly upon the joint, and the contracted muscles yield as the cause of the contraction is modified."

A Review. *Archives of Medicine*, October, 1880, pp. 198, 199 : " When traction exists, the patient has the advantage of that peculiar and perfect immobility which the extension of the long hip splint affords. . . . We made an experiment several years ago which demonstrated beyond a doubt that the Taylor-Sayre instrument produces almost

complete fixation in a healthy hip joint. The experiment, in brief, was the application of a hip splint to the right lower extremity of a child, whose left hip was ankylosed from former disease. After the application of the splint to the healthy limb the patient could not walk a step. All motion at the left hip being lost, the boy, with extension, was unable to bring the flexible vertebral column to his aid. When the knee-cap was loosened and flexion of the thigh was permitted, the patient walked very awkwardly for a step or two."

Stillman, Charles F. Extension and a New Method for its Production. *Med. Record*, Dec. 4, 1880, pp. 620, 621: "The contractile force of the muscles is involuntarily excited to press the opposing articular surfaces still closer together. As a result of the increased irritation, we have . . . injury to the articular surface, and, finally, implication of surrounding tissues. Therefore, in order to overcome this primary irritation of the joint, we must overcome the contractility of the muscles governing the joint."

Tarbell, G. G. A Review. *Boston Med. and Surg. Jour.*, Aug. 31, 1876, p. 263: "The patient is not to be confined, as formerly, to bed, but is to be furnished with such mechanical aid [portative traction splint] as will prevent motion of the joint and slightly separate its inflamed surfaces. . . . Motion at the hip joint [is] the very thing which, in the acute inflammatory condition of the joint, is acknowledged to be harmful, and to prevent which is the whole object of the apparatus."

Taylor, C. Fayette. Improved Counter-extension Splint for Morbus Coxarius. *Am. Med. Times*, July 20, 1861, p. 38: "The movement 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-extension force."

Some Considerations in regard to Hip-joint Disease. *Med. Record*, Sept. 1, 1867, p. 290: "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. The sole object of counter-extension is to destroy the tonicity of the muscles about the hip joint. This destruction of tonicity gives relief and motion. . . . And this should be our aim, and until we have accomplished it we have not realized the benefit of counter-extension treatment at all. If a splint or weight be applied, it may assist in keeping the limb steady and quiet, and in that way the patient may improve; but the improvement is due to the confinement and protection from motion, rather than to extension and motion, which latter are the two sources of benefit when counter-extension is efficient. I repeat, the muscular tonicity must be temporarily destroyed. The counter-extension must be carried to that point. And we have a certain guide as to the amount of force to be used and the extent to which it is to be carried. When we have destroyed tonicity, our chief labor is done. . . . If contractions accompany or follow the disease, we may be sure that our counter-extension has been inefficient, and therefore worthless as such, and that the improvement, if any, is due to the quiet fixation of the joint, which the splint has been a convenient means of accomplishing. And I suspect this is very often the case in the use of both splint and pulley."

On the Mechanical Treatment of Disease of the Hip Joint, New York, 1873, p. 13: "On the very first intimation of a diminished ability to bear pressure, which is the great obstacle to a spontaneous arrest of any morbid process within the joint, the exigency of arresting motion to save the joint from immediate pain causes the muscles to take on a contraction of such a rigid and permanent char-

acter as to be a condition of perpetual wounding of the parts. Their own excessive action, as well as their inelasticity, constitutes a continued source of severest injury. Hence there is established a self-continuing traumatic condition calculated to increase and prolong any diseased action once commenced in this joint; the more the disease, the more the muscular contraction and rigidity to avoid motion, and the greater the pressure and injury to the affected tissues. . . . But add motion to a diseased and compressed joint, and can we wonder at the destructive course disease of the hip joint ordinarily runs? . . . It is pressure, or motion under pressure, which is the destructive agent." The first indication is "to relieve the pressure in the joint due to muscular contraction by temporarily destroying the muscular irritability and contractility. . . . The indication for arresting motion in the joint . . . pertains only to a condition of rigid muscular contraction and consequent pressure in the joint. But no such necessity exists after the muscular rigidity has been overcome to the degree of entirely removing all pressure within the joint. On the contrary, motion in the joint without pressure is not only not injudicious, but it is highly beneficial." Pages 25, 26: In regard to the first indication, "I mean not only the increased muscular action which is incidental to the disease, with the consequent increased pressure in the joint, but all muscular action, together with all pressure in the joint, ought to be removed, as the first step of any treatment which would carry out the principle of treatment of this disease by extension and counter-extension. A treatment which purports to be this, but which stops short of relieving all pressure in the joint by means of overcoming all muscular action, is not this treatment at all, but something else far different in principle. And here is where so many think they are adopting the treatment by extension, but, not car-

rying it far enough to destroy, temporarily at least, the irritability and contractility of the muscles, fail of success. Either through not conceiving that the legitimate object of antagonizing the muscles by counter-force is to entirely overcome them, or not having mechanical appliances capable of producing such a result, they must necessarily fail of realizing any of the advantages of this treatment. It is not enough to stretch the muscles; they must be stretched till they yield. And they must be kept stretched and relaxed till the disease in the joint subsides." Page 38: "I am speaking of a mechanical treatment of disease of the hip joint which is capable of actually, not seemingly, overcoming—that is, temporarily destroying—the action of all the muscles concerned in the movements of the thigh, for the purpose of relieving all the pressure, not a part of it, in the joint."

On Some Elements of Diagnosis in the Different Stages of Diseases of the Hip Joint. *Medical Record*, May 8, 1875, p. 318: "I follow one indication—viz., to overcome completely the muscular action. I use the counter-extending force, not till the pain, if any exists, is relieved, but till the muscles relax."

Observations on the Mechanical Treatment of Disease of the Hip Joint. *Boston Medical and Surgical Journal*, March 6, 1879, p. 318: "The pressure from irritated muscles at this time is a much greater evil than motion alone could be. To overcome the injurious pressure from irritated muscles is, then, imperative. Hence we must stretch them." Page 319: "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 limitation is reached at the point of time when the muscles have become soft and compressible and the interstitial

movements have become completely retrogressive. From this moment reflex irritation of the muscles ceases entirely, and with it the necessity for extension."

Thomas, H. O. *Diseases of the Hip, Knee, and Ankle Joints*, Liverpool, second edition, 1876, p. 10 : " Continuity of extension '*per se*' is not a remedy in hip-joint disease, as I shall subsequently show ; in its application it involves unavoidably a fractional degree of fixation which is sufficient to mask the evil of this ridiculous malpractice."

A Review of the Past and Present Treatment of Diseases of the Hip, Knee, and Ankle Joints, Liverpool, 1878, p. 19, footnote : " All forms of extension in joint disease involve inseparably in their application a certain amount of fixation."

Velpeau. Discussion in the Surgical Society of Paris. *Bulletin de la Soc. de chir.*, 1865, p. 126 : " For twenty years I have advised extension and counter-extension in my lectures and have used it in my practice. It is an excellent method of restraining the pressure of the articular surfaces."

Volkmann, R. " Distraction " was advocated by Volkmann in 1865 as a means of reducing pressure between the surfaces and relieving pain. Monod, *Arch. gén.*, 1878, pp. 706, 707.

Watson, John. Discussion in the New York Academy of Medicine. *American Medical Times*, May 11, 1861, p. 310 : " I placed her [patient in acute stage of hip disease] upon the straight apparatus as if she had a fracture of the thigh. I had hardly put on the counter-extension before the girl was entirely free from pain. It operated beautifully and instantly."

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Yale, L. M. Certain General Considerations respecting the Mechanical Treatment of Chronic Diseases of the Joints, with Especial Reference to the Use of Traction. *Medical Record*, January 12, 1878, p. 27: "When the muscular spasm is urgent, fixation can not be secured save by the use of a force as constantly acting as that which is to be overcome, and the agent best adapted to this purpose is traction, or, as it is generally called, extension. The word extension is objectionable because of its obscurity, since it is also used as the opposite of flexion." "The relief gained is not, as was formerly supposed by some, from separation of diseased surfaces. This separation is scarcely possible under any amount of force likely to be employed by a surgeon; and, again, it is very probable that whatever separation could be accomplished has already resulted from the effusion within the joint. The relief is gained simply from the prevention of muscular

contractions which violently grind together the inflamed and perhaps eroded surfaces. The aim of the surgeon should then be, not to use all the traction that can be tolerated, but to use the smallest amount that will insure rest of the articulation. . . . Then, when the relief of the pain allows the muscles to relax, the direction of the traction may be changed."


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