good reputation of a pure milk diet is justified, it is in the treatment of uric-acid calculus. So often have I been successful in obstinate cases of frequently-recurring uric-acid gravel with the pure skim-milk treatment, that it is the first thing that I offer the patient. I have noticed that if the skim-milk diet is kept up for a month or six weeks, and then stopped, the attacks of colic do not recur. In carrying out this plan of treatment, I recommend that during the first day, a glass of milk be taken every two hours. After this, the quantity is gradually increased until sufficient to satisfy the patient is taken. The quantity required to sustain life varies between three and seven quarts per day. It depends partly upon the size of the patient, and the amount of exercise taken. The milk acts both as a diluent and as an alkaline fluid. One set of vegetables should be avoided in the diet of persons having an oxalic diathesis, and that is those containing oxalic acid, such as tomatoes, sorrel, and especially the pie plant.

The importance of the diagnosis is shown in the fact that if the stone is composed of phosphates, the milk diet is much less valuable as a cure. The indication is here to increase the acidity of the urine, but while it is true that the phosphates are soluble in acids, it is, practically speaking, impossible to give acids in amounts sufficient to affect the calculus without injuring the system. By the use of benzoic acid, in ten-grain doses, the reaction of the urine may be rendered acid, and the further deposition of phosphates may be thus prevented, but nothing can be done towards dissolving the stone. Fortunately, most calculi are of the uric-acid variety. In phosphatic calculi, you can simply hope to prevent increase in size by rendering the urine acid, and in the course of time, if not too large, it may descend into the bladder. If too large for this, there only remains the operation of nephro-lithotomy, the growing frequency of which seems to be justified by its results.

Original Articles.

OPERATIONS ON NERVES.

BY MAURICE H. RICHARDSON, M.D.,
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- I. RESECTION AND SUTURE. (a) Musculo-spiral, (b) Median, (c) Ulnar.
- II. PRIMARY SUTURE. (a) Ulnar, two cases.
- III. EXCISION FOR PAIN. (a) Middle cutaneous of thigh, (b) Long-saphenous, (c) Inferior dental, (d) Infra-orbital.
- IV. STRETCHING. (a) Spinal accessory for spasmodic wry-neck.

THE cases recorded below were treated at the Massachusetts General Hospital during the past fifteen months, with the exception of the last, which was at the Carney Hospital. As will be seen, some of the cases are complete, while others are still under observation.

NERVE SUTURE.

Case I. Injury to median nerve from bursting of bottle. Healing. * Painful neuralgia in fingers and thumb, with loss of power in thumb. Removal of injured portion, suture, relief of pain, and restoration of motor function.¹

Patient, J. C., a young man, bar-tender, was injured

¹ Mass. Gen. Hos. Records, p. 73, vol. 220.

by the bursting of a ginger-tonic bottle July 20th, 1885, in the left wrist in front. The cut healed readily, but there was loss of sensation in the middle and fore-fingers and the palmar surface of the thumb. Accompanying the loss of sensation there was severe pain in the thumb and palm of the hand. This symptom of severe pain led him to come to the Nervous Department of the hospital where Dr. Putnam examined him and recommended an attempt to relieve the symptoms by surgical means.

July 18th, 1885, operation with ether.

The median nerve was quickly exposed at the point where it was supposed to have received injury, about one and one-half inches above the palm. The nerve was found involved in the cicatrix and almost entirely severed, being united by only a few fibres. The whole nerve was isolated from the surrounding parts and the injured portion entirely excised by a transverse section above and below. The ends, which were sharply cut and clearly defined, were then brought into apposition and sewed together. Considerable traction was first used so that there would be as little tension as possible. A cat-gut suture was then passed into the proximal trunk half an inch above the cut, and brought out in the centre of the divided end. It was next introduced into the centre of the end of the distal part of the nerve and brought out half an inch farther along.

The divided sheath of the nerve was then brought into close approximation by fine cat-gut sutures, care being taken to include only the sheath itself. The wound was closed with silk, drainage provided for, and the arm and forearm placed upon an internal angular splint with the carpus well flexed. The wound healed rapidly, though not by first intention, and the patient was discharged August 11th, to the convalescent ward. There had been no change in his symptoms except almost complete relief of pain. There was still slight pain in the top of the thumb, ulnar side.

August 29th, 1886, a little more than a year later, I examined him. There was a prominence in the anterior carpal region at point of suture. Sensation was good in all parts supplied by the median. There was no pain and had been none for months. Finally, the muscles supplied by the median alone, *adductor* and *opponens pollicis*, were well developed and responded to the man's will. In this case, therefore, the functions of the nerve were completely restored.

Case II. Stab in back of arm. Division of musculo-spiral nerve. Wrist-drop. Suture of nerve stump, suppuration, erysipelas, no improvement at end of three months. Second operation. Resection and suture. Complete and permanent recovery after four months.²

George Donahue, laborer, forty-three years of age. Came to the Massachusetts General Hospital, May 19th, 1885, having been stabbed by an Italian with the blade of a pair of shears. The external wound was small. The triceps was cut and the musculo-spiral nerve severed. Two small pieces of bone were clipped from the humerus. Had wrist-drop and inability to extend fingers.

Dr. Warren enlarged the cut. The ends of the nerve were found and united with six small cat-gut sutures through the sheath. The triceps was sewed up with cat-gut. Drainage-tubes were left in wound

² Mass. Gen. Hosp. Records, Vol. 220, p. 108.

and sterilized cotton dressings applied. Arm put on internal angular splint.

After the operation some sensation along course of radial nerve was noticed. One month after, bad erysipelas and prolonged and extensive suppuration of whole upper arm. July 6th, Dr. Putnam found no reaction to galvanic current. Sensation was found over dorsum of hand. Strong wire brush current caused painful sensations everywhere supplied by musculo-spiral. Muscles were soggy and skin dry and hard. Voluntary motion of ulnar and median preserved, but feeble.

Reëntered hospital August 10th, for resection of the nerve, not being able to use arm, his condition being same as when discharged. At this time the case was examined by Dr. Putnam with me, and it seemed best not to wait any longer before making another attempt, on the ground that there had not been the slightest improvement or sign of any, and that the failure of immediate union, with prolonged and extensive suppuration of the neighboring parts, rendered it extremely improbable that any improvement in his condition would ever result.

It having been decided to make a second attempt, the patient was etherized and the musculo-spiral nerve exposed by a cut about six inches in length made over the normal course of the nerve at an angle with the scar of the stab. It was found running into the dense mass of cicatricial tissue by which the former wound was healed, and from which the distal portion of the nerve was with some difficulty found emerging. The nerve was divided above and below the old wound by a clean, sharp incision, and the cicatricial tissue with the excised nerve-end was dissected out. This specimen measured an inch and a half.

After thorough stretching of the proximal end, by which the nerve was quite materially elongated, the sheath was united with seven fine silk sutures threaded upon a fine cambric needle. The joint made in this manner was quite perfect. No suture was put into the nerve itself. The external wound was closed with silk, drainage established, and the whole arm extended upon a straight splint. The most careful antiseptic precautions were taken and the wound healed immediately by first intention under Dr. Warren's sterilized cotton dressings.

No improvement of any importance was observed up to the time of his discharge except that he could use his *extensor secundi internodii pollicis*. He was discharged to report to Dr. Putnam, whose patience in his treatment was rewarded about four months later by a complete restoration of the powers of the nerve.

Ten months after the operation I saw the patient holding a piece of iron pipe weighing more than a hundred pounds, which he was putting into a deep hole he had just dug in the streets.

Case III. Ulnar nerve completely divided by glass. Healing of wound. Motor and sensory paralysis. Resection and suture of nerve stumps. Union by first intention. Case still under observation.³

Mary Quinn, twenty-two years, single, domestic. August 10, 1886, patient came to hospital having previously cut wrist in putting her hand through a pane of glass. The wound had entirely healed. There was loss of sensation in little and half of ring fingers, white abduction and adduction of fingers was very slight. Patient was etherized and a cut made over

the ulnar nerve on the radial border of the *flexor carpi ulnaris*. This cut was at right angles to the original wound. The ends of the divided nerve were only found after a long dissection as their relations were considerably altered and the distal portion of the nerve retracted some distance. The upper portion of the nerve was stretched as much as possible before refreshing the end, but it was found extremely difficult to elongate the trunk sufficiently to make it join the peripheral portion without considerable tension.

The stumps were united by eight fine silk sutures, passed upon cambric needles through the nerve sheath. The arm was placed upon a splint and carpus kept in flexed position. Two weeks later she was sent to the Convalescent Home, the incision having healed perfectly by first intention, with no constitutional disturbances, under antiseptic dressings. She was sent to the neurologist upon her discharge from the home and is now under observation, with as yet no apparent restoration of motor-power in the nerve, and without any disturbance from neuritis or other cause.

PRIMARY SUTURE.

Case IV. Laceration of arm just above internal condyle. Ulnar and internal cutaneous nerves torn. Suture of ulnar. Union by first intention. Case under observation, symptoms as yet negative.⁴

Bartholomew Lynch, entered hospital July 8th, with left arm lacerated half an hour before admission by being caught in a flying belt. There was a ragged wound of left arm two inches above internal condyle. The wound extended from near the middle line in front around to the back of the arm, dividing the ulnar nerve, basilic vein and part of the *triceps* muscle and tendon. The wound was filled with dirt and blackened grease. After prolonged searching the stumps of the torn nerve were found. The ragged ends were carefully cut off above and below, three-fourths of an inch of nerve being thus sacrificed. Both portions of nerve were stretched with as much force as it was possible to apply, and the sheaths were united with fine silk sutures.

The *triceps* muscle and tendons were united with cat-gut sutures and the external wound closed with silk. The forearm was extended upon a straight splint, the wound having been covered with iodoform and carbolic gauze. Discharged on the 19th to report to the neurologist. No improvement noticed when last seen, and no pain or discomfort from the operation.

Case V. Cut of wrist. Ulnar nerve, *flexor carpi ulnaris*, and ulnar artery divided. Ligature of artery, suture of tendon and nerve. Immediate union, absence of local and constitutional symptoms. Case still under observation.⁵

This patient came to the hospital August 10, 1886, with a fresh cut of the wrist, ulnar side, a short distance above the joint, caused by a piece of glass. The ends of the nerve were found and united by their sheaths, fine silk sutures being used. He was sent back to the out-patient room and made a rapid recovery, the wound healing by first intention. There was absence of all constitutional and local symptoms. He was then referred to Dr. Walton who reports to-day, eight weeks after operation, as follows: There

⁴ Mass. Gen. Hosp. Records, Vol. 226, p. 53.

⁵ Mass. Gen. Hosp., Out-patient Department.

³ Mass. Gen. Hosp. Records, Vol. 224, p. 135.

has been no improvement as yet, although the area of anæsthesia has retracted a little.

NEURECTOMY.

Case VI. Cut over middle of right thigh. Pain in scar and along course of middle cutaneous branch of anterior crural nerve. Painful cramps in calf. Dissection. Branch of nerve found to enter scar. Excision of scar eight months later, and an inch of nerve trunk. Cure.

James Preto, thirty-three years. In August, 1885, cut his right thigh with an ice hook. There was, on entrance to the hospital, April 3, 1886, a small scar on the right thigh, six inches above the knee-joint, at its middle and outer part. There was pain at this point and he was tormented by frequent and persistent cramps of the muscles of the calf. He was seen by Dr. Walton, who considered the pain and cramps probably due to the scar in which it was thought some branch of the middle or external cutaneous nerve was entangled. An operation was therefore advised for the removal of the scar and a portion of the nerve, if any should be found.

A cut was made above the scar parallel to the usual course of the nerve. A small branch of the middle cutaneous nerve was found an inch or more above the scar and followed down into it. The scar itself was then dissected out and with it an inch of the central end of the nerve.

April 26th, patient discharged, wound being healed and the pain and cramps having entirely disappeared.

Dr. Walton, to whom the case was referred after discharge from the hospital, reports as follows: The pain which existed to a greater or less extent before the operation went away. The cramps ceased. A patch of anæsthesia was found below the scar in the parts supplied by the excised branch.

Case VII. Cut on inner aspect of foot, of four years' standing. Pain in scar referred along course of internal saphenous nerve; dissection. Branch of nerve found involved in scar. Renewal of scar and portion of nerve; cure.⁶

John Sullivan, aged forty-eight, had a painful scar on the inner aspect of the left foot, from a cut four months before. Suffered a good deal of pain in the region of the scar, of a lancinating character. Referred to me by Dr. Walton. I found, on cutting down upon the probable course of a branch of the long saphenous nerve, a small filament, which, when followed, was found to enter the cicatrix. An inch of the nerve was excised, and the scar itself. A complete cessation of the pain followed immediately.

Case VIII. Neuralgia of inferior dental nerve for five years. Division of nerve inside mouth; relief for two years. Return of pain in aggravated form, lasting one year. One inch of nerve destroyed by opening inferior dental canal from outside. Immediate recovery and cure.⁷

S. P. B., seventy-two years old, entered September 3, 1886. Eight years ago, developed severe neuralgia in the right side of the face, over the lower jaw. Three years ago, inferior dental nerve was divided just above the point where it enters the dental foramen. This operation gave relief for two years, when the same trouble returned.

August 4th. One inch of the inferior dental nerve

was cut out. An incision parallel to, and through the fibres of the *masseter* muscle, three inches in length, was made down to the jaw-bone. With a gouge and mallet a narrow opening, one inch long, was made through the ramus of the jaw over the dental canal. The nerve and artery thus exposed were cut at each extremity of the opening, and the whole curetted out. There was little hæmorrhage. The external wound was closed with silk, and iodoform dressings applied.

Two days later, stitches and drainage-tube were removed. For some days after the operation there was complaint of slight pain in the parts supplied by the mental branch of this nerve. This rapidly disappeared. He was discharged on the 10th.

August 25th. Came and reported that "it was a real pleasure to live; that he had had more real pleasure in life since leaving hospital than in any ten years before."

Case IX. "Epileptiform neuralgia" of side of nose and face. Neurectomy of infra-orbital nerve; complete cure.⁸

Tim O'Brien, sixty, married, laborer; entered hospital, August 8, 1885, with history of trouble in face for sixteen years. Some years ago had an operation done in an English hospital, without relief. Has pain in right side of face and nose, in parts supplied by the infra-orbital nerve. This is spasmodic, and extends from the inner canthus of eye down to the ala of the nose. During this paroxysm he leans his head upon his hands, with evidence of great pain, and the muscles of the nose contract spasmodically upon the right side, drawing up the ala and wrinkling the skin.

August 12th. Under ether, the infra-orbital nerve was found, a needle having been first inserted into the infra-orbital canal. The nerve was pulled out of the canal as far as possible, and cut. The peripheral end was then drawn up, and its branches dissected down an inch or more, and then divided.

The next day patient reported himself very comfortable, with pain much relieved. What pain still existed was referred to the ala of the nose.

August 18th. Five days after operation the pain had entirely left the face.

August 21st. No return of pain; face healed. Discharged.

NERVE-STRETCHING FOR SPASMODIC WRY NECK.

Case X. Spasmodic wry neck, probably of central origin; rapid and uncontrollable contraction of right sterno-mastoid. Constitutional treatment a failure. Head made immovable in plaster-of-Paris helmet; failure. Spinal accessory nerve exposed and stretched. Right sterno-mastoid becomes perfectly quiet, but left becomes affected; patient much improved. Spasm returned two months later to less degree.⁹

James Dutton, twenty-eight years old, weaver; April 10, 1886, entered Carney Hospital. Previous history good. Eight months before entrance noticed a slight twitching of the neck, which would appear at intervals of a week or two. Stimulants or lying down would stop the twitching. Never any trouble in swallowing; no venereal disease. The left side of the neck seemed enlarged and swollen. There was a distinct swelling behind the posterior pharyngeal wall, which looked red, and felt brawny. Two days after entrance the lump in pharynx was aspirated; no pus.

⁶ Out-patient Department, September 4, 1886.

⁷ Mass. Gen. Hosp. Records, Vol. 226, p. 163.

⁸ Mass. Gen. Hosp. Records, Vol. 220, p. 100.

⁹ Carney Hospital Records.

April 26th. Head put into stiff bandage, which kept him steady and comfortable.

June 19th. Head-gear was removed, and head found to shake as much as ever. Became despondent and suicidal.

From July 1st to August 3d, was put upon large doses of quinine, salicylate of soda, and iodide of potash without benefit.

After consultation with Dr. Bullard and the staff, and at the patient's earnest request, it was decided to try stretching of the right spinal accessory, as the twitching seemed to be mostly in the right sterno-mastoid. Operation under ether.

An incision, four inches in length, was made from the mastoid process downward and forward, along the anterior border of the sterno-mastoid muscle. The dissection was carried directly backwards toward the vertebræ, until the nerve was exposed. Continued and repeated tension was put upon it by means of hooks and the fingers. By measurement, ten pounds weight was applied. Dr. W. N. Bullard tested the nerve with the electric current after each stretching, but at no time did the sterno-mastoid and trapezius fail to respond. The wound was closed antiseptically, and the union was immediate.

The next day the twitching had entirely disappeared, and the muscle remained perfectly quiet for two months. The left sterno-mastoid, which had been perfectly quiet before, now took upon itself an action precisely similar to that which had existed in the right, but less in degree.

Examination, October 11th, shows that there is still rapid contraction of the right sterno-mastoid, though much less than before the operation. His general condition is much improved, and his discomfort is quite trifling.

The first suggestion that the ends of a divided nerve be sewn together in order that the interrupted functions of the nerve might become re-established, dates back many years. "The union of the ends of a divided nerve had already been proposed by Wilhelm von Saliceto and Guy Chauliac in the last century. Arneman mentions this subject, and as it appears was the first to study the operation experimentally. Unfortunately, according to this author's statements, his first attempts were failures, and it is highly probable that owing to this lack of success the nerve suture found for a long time after Arneman no surgical support. Up to the twentieth year of our own century but few authors had occupied themselves with this operation, and their researches were, moreover, so incomplete that they could do but little towards the further solution of the question. (Delpeich, Collisan, Lemmering and others.)

"Flourens, however, published in 1828 the results of his experiments, among which several made upon fowls were so successful that they enabled him to determine that a primary union took place between the ends of a divided nerve, and that the same occurred immediately following the application of the suture.

"Larrey at the same time found the central ends of two nerves in an amputation stump completely grown together. Surgically the operation remained for a still longer time without any application, and but a very small number of cases are to be found in the literature of the subject,¹⁰ and they are obscurely

reported and scantily described, the operators satisfying themselves with their mere mention."

The present stage of the operation began in 1864, with the work of Weir, Mitchell, Velatin, and Langier. This work has been carried on to the present time by numerous writers until the literature of the subject is very extensive. While most writers agree that the suture of divided nerves should be done, others reject entirely the operation.

The indications for nerve suture is generally considered to be when the wound is such that the divided ends do not fall naturally together. When the adjacent parts keep the distal and peripheral stumps in their normal position, and the ends are only separated by the natural retraction of the nerve itself, it is thought that the restoration follows as well as when suture is employed, and that there is less danger of neuritis and other complications.

I believe that suture should be employed in all cases where important nerves are divided, because in no recorded cases have serious local or constitutional symptoms been observed, and because it is only in this that we can hope for a primary intention. In all the cases recorded above, except Case IV, the cut has been a clean incision. Yet, in dissecting down to find the retracted ends or the cicatrix, it has been found either that the nerve ends were so placed as not to fall together or even near together, or when cicatrized that the normal nerve tissue was interrupted by a very considerable interval of dense cicatricial tissue, through which the regenerations must take place. Nevertheless, it is true that a nerve may regain its functions even when the stumps are separated a long distance and no sutures have been applied.

THE OPERATION.

In primary suture it is often difficult to find the ends of the nerve. In Cases IV and V this trouble was met with. The dissection then should be made well above and below, where the nerve preserves its normal relations. This very fact (difficulty of finding nerves) confirms my belief that the nerve ends do not readily fall together.

The ends having been found, if clean-cut they should be stretched sufficiently to make any longitudinal tension impossible,—so that when sutured the nerve will lie in the bottom of the wound, lax and tortuous. This is aided by flexion or extension of the nearest joint, as may be required.

In lacerated wounds where the ends of the nerve are torn and bruised, a clean-cut surface should be made with a sharp bistoury. The use of scissors for this purpose I do not think best because the nerve fibres are crushed between the blades instead of being cut. If it is necessary to remove a very long piece of contused nerve—an inch or more—it is better to leave the contused end rather than trust to great elongation, or to the efforts of nature to fill the gap. In Case IV so large a piece of nerve was excised for this reason that it was found extremely difficult to bring the ends into apposition, and if an unfavorable result follows it may be due to this fact.

In applying the suture the thread is either passed through the nerve itself or its sheath. Of the forty-eight cases collected by Rawa, twenty-one were of the direct variety, through the nerve itself, nine perineuritic, and the others not recorded. In eight

¹⁰ Rawa in Kiew. Wien. Med. Wochenschrift, Vol. 35, p. 221, March, 1885.

cases of the direct, rapidly disappearing neuroses came on, and once or twice neuritis. The indirect (perineuritic) was followed in but two cases by nerve symptoms.

In Case I, both the direct and indirect method was used. In all the others the perineuritic.

This method I believe to be the better, though most surgeons incline to the direct, believing that a better and more thorough union of the stump surfaces is thus obtained.

It is for this very reason that I believe the indirect method the better. Nothing could be more perfect than the union of the stumps in my cases in the manner to be described. Though the number of sutures employed varies much with different men, the only accurate joining of the ends can be made by six or eight threads.

The material should be silk or cat-gut. Silk makes the better knot and neater joint and holds longer. The technique is as follows:

The nerve having been elongated as much as possible without injury to the stump, the ends are let fall into the bottom of the wound in the position they will naturally assume. This will give the anterior surfaces. A fine cambric needle is passed through the sheath, about one-eighth of an inch from its cut edge, towards the end of the stump. It then is passed beneath the sheath of the other stump through its open end, and emerges one-eighth of an inch from its edge. The knot is tied and the long ends of the thread left. The assistant takes these long ends and pulls gently away from the operator. This rotates both stumps enough for the placing of the second stitch. This in turn is pulled and the next applied. In this way the nerve can be turned enough to place the stitches into the posterior surface. The operation is completed by starting in the centre in front again and rotating the nerve in the other direction. The line of suture made in this way is as perfect as can be imagined. Its strength exceeds that of the direct method, and it may be relied upon to hold the nerve ends together until union is completed.

The prognosis is favorable in nerve suture when union by first intention takes place, though months or years may elapse before the function of the nerve is restored.

The cases of neurectomy and nerve stretching are offered as contributions to the statistics of these operations. The method used of excising the inferior dental from outside the face proved more difficult than was expected, owing to the depth of the wound, but was very satisfactory, and will doubtless be followed by a long period of rest from pain.

In finding the spinal accessory the best incision is along the anterior border of the sterno-mastoid. This should be carried down two or three inches from the mastoid process and the tissue divided carefully until the nerve is found, running obliquely outwards. Ten pounds weight was applied, and this seems to me about as much as a spinal accessory nerve of average size will safely bear.

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REPORT OF PROGRESS IN ORTHOPEDIC SURGERY.

BY E. H. BRADFORD, M.D., AND R. W. LOVETT, M.D.

LATERAL CURVATURE.¹

THE occurrence of lateral curvature at different ages is very fully discussed by Dr. Samuel Ketch. He quotes passages from the leading orthopedists to show that the prevailing idea is that it is a disease occurring for the most part about the age of puberty, the only authors who dissent being Adams, Eulenberg, Hueter and Shaffer. He takes exception to this idea and quotes Eulenberg's cases. In 1,000 cases of lateral curvature collected by him, 87 per cent. are recorded as beginning before the tenth year, 56 per cent. of all cases occurring between the ages of seven and ten. Ketch collected the cases of lateral curvature treated at the New York Orthopedic Dispensary within the last eight years. Of 229 cases, 189 were in females. It occurred from birth to the twelfth year in 52 per cent.; from the twelfth to the eighteenth year in 41 per cent.; from the eighteenth year upward in 3½ per cent.; period of appearance not noted in 2½ per cent. The youngest case was two weeks old. He concludes first, that rotary lateral curvature is principally a disease of childhood and may be congenital or acquired; and second, that puberty, except as a concomitant occurrence has no direct causative influence.

A NEW METHOD OF APPLYING THE PLASTER JACKET IN SCOLIOSIS.

Fraenkel² announces a new method based upon the necessity of over-correction of the lateral curvature. He insists upon the importance of this over-correction in other deformities (club-foot, etc.), and describes how it can be applied to the spine. The child must undergo a preliminary course of treatment directed to restoring flexibility to the spine; this is done by the ordinary methods of bending the child over the knee, and com-

¹ New York Medical Record, April 24, 1886.

² Berl. Med. Wchsch., May 8, 1886.