

A DETERMINATION OF THE MUSCULAR STRENGTH OF GROWING GIRLS AND ITS RELATION TO THE ETIOLOGY, TREATMENT AND PROGNOSIS OF CASES OF LATERAL CURVATURE OF THE SPINE.¹

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In order that the surgeon may treat each case of lateral spinal curvature intelligently, and that scientific data may be accumulated by which a study of the etiology of this disease may be furthered, greater precision and a more extended observation is demanded in the recording of such cases. Hitherto careless methods or no method at all have been used. A rough sketch, a photograph, a general impression have served as records; or after Mr. Roth of London, a tracing has been made of the rotation present. In all the past the object has been, in making these records, simply to have a rough guide as to the progress of the disease. Instruments of more or less precision are now being used by a few in the study of these cases. It is in this direction, rather than in any other, that we must look for progress, in our knowledge of lateral curvature.

The value of most statements, hitherto, upon the muscular element in the etiology has been greatly lessened by an entire absence of carefully recorded facts. The muscular theories have been numerous. The following are the views held by a few:

Guerin attributed lateral curvature to active muscular contraction. The muscles on the concave side of a curvature are actively contracted, and become permanently fixed in this position.

Malgaigne taught that lax ligaments and weakened muscles form the predisposing causes to spinal curvature.

Bernard Roth² thinks that lateral curvature is predisposed to by weakness of the spinal muscles, combined with long-continued sitting or standing in stooping or relaxed positions. He has observed an inherited weakness of muscles and ligaments, associated probably with excessive softness of bones. He writes, "anything which weakens the muscular system tends to produce lateral curvature."

Adams³ believes that in the early stage of lateral curvature the spinal muscles on both sides are, as a general rule, decidedly passive; but that as the curvature advances, the muscles on the convexity are called into increased action and serve the purpose of limiting the extent and preventing the increase of the spinal curvature.

Dr. L. A. Sayre⁴ believes that rotary lateral curvature depends entirely upon abnormal muscular contraction. The spinal column is held in its normal position by the contractions of muscles situated upon either side of it, which should exactly balance each other. If, for any reason, one set of muscles overcomes the set upon the opposite side, the spine yields and a curve is produced with its concavity toward the side upon which the stronger set of muscles is situated. Dr. Sayre differs from Adams in placing the strong muscles upon the opposite side of the body.

Schreiber⁵ believes that in the early stages of the scoliosis there are no changes in the muscles. The muscular changes, he thinks, are due to long-continued stretchings and disuse.

¹ Read at the Fourth Annual Meeting of the American Orthopaedic Association, Philadelphia, Pa., September 17, 1890.

² The Treatment of Lateral Curvature of the Spine with Appendix. Bernard Roth, F.R.C.S. London: H. K. Lewis, 1889.

³ Curvature of the Spine. ⁴ Orthopaedic Surgery.

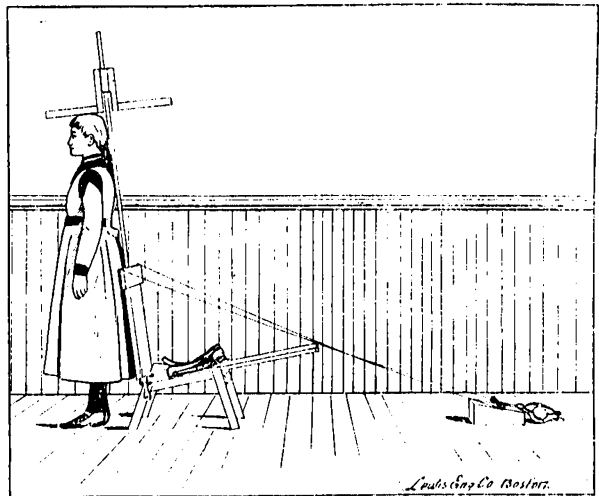
Eulenburg⁶ holds that slight continuous muscular action is necessary for the maintainance of the upright position of the body. This action must be equal on either side of the spine. The most frequent cause of deviations of the spine is a disturbance of the power of the spinal muscles. By the frequently repeated passive torsion, necessary in assuming faulty positions, gradually the trunk muscles are weakened.

Lorenz⁷ is correct in his criticism of the Eulenburg theory, when he says that muscular insufficiency is quite a voluntary and unproven assumption.

Lorenz sums up his criticism by the statement that anatomically, pathologically and clinically there is no foundation for the theory of a disturbed muscular antagonism.

That there is an element of muscular weakness present in cases of lateral curvature, pure and simple, has hitherto been assumed.

Believing, as I do, that it has been pretty satisfactorily demonstrated that two important factors in the production of the deformity are (*first*) the superincumbent weight of the head, neck, upper extremities and trunk falling upon (*second*) a spinal column which is out of plumb, the question arises, What position should the muscular factor occupy in the etiology? Is the assumption of muscular weakness in cases of lateral spinal curvature justifiable?



Chair for measuring the strength of the spinal muscles.

Before being able to determine the presence or absence of muscular weakness, it is necessary to establish a standard of strength for the back muscles for each age of the growing child. In order to establish this standard I have made an examination of the backs of one thousand one hundred and forty-one of the school girls of Boston. There was constructed for these examinations a chair with hinged and movable back, at right angles to a seat slightly inclined from the floor and long enough for the child to comfortably rest the legs upon. The back, at the level of the shoulders, is connected by stiff iron rods to the handle of a dynamometer, graduated in kilogrammes and fractions. Attached to the back of the chair is an upright with a cross-piece, movable up and down, by means of which the height both standing and sitting was taken. (See photograph.)

⁵ Real-Encyclopädie: Bd. 11, p. 560, under Rückgratsverkrümmungen.

⁶ Pathologie und Therapie der Sittlichen Rückgratsverkrümmungen, Wien., 1886.

Each child was in turn weighed, and her height taken both standing and sitting. Then, upon sitting in the chair, a strap was passed over the hips (to prevent slipping forward), the arms were folded, and the child forcibly extended her back upon the thighs. The back of the chair was then raised to above the level of the occiput, and again the muscular strength was taken — this time testing principally the trapezius and deep muscles of the neck and upper back. The muscles used in the first test are chiefly those of the lower back. The action of the thigh and leg muscles is as nearly as possible eliminated by raising the legs on the inclined seat. The amount of the pull or the strength of the back muscles is recorded upon the self-registering dynamometer.

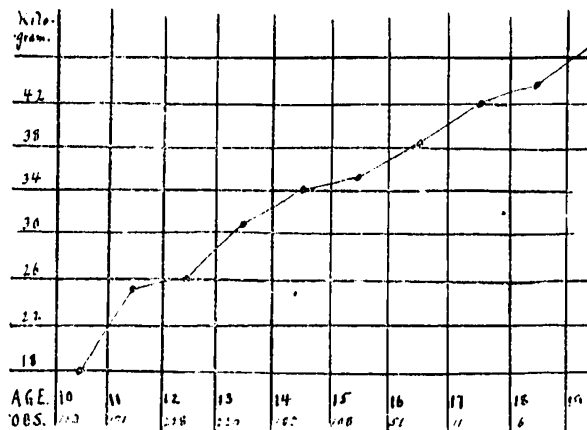


Chart showing the strength of the back muscles for each age of healthy girls.

The results of these observations are seen, in part, upon the chart. There is found to be a gradual increase in the strength of the back muscles of growing girls with each year's increase in age from ten to nineteen. There were no marked cases of deformity amongst these children; and the results are taken to represent the average strength of the backs of growing girls, irrespective of nationality.

We possess then an index of muscular strength for each age in healthy girls from ten to nineteen.

It is now necessary to measure the strength of the backs of lateral-curvature patients during all stages of the disease from its inception — when it has been assumed by some that there is and by others that there is not muscular weakness present — to the period of osseous change, when it has been proven by autopsy that the spinal muscles are so altered or replaced as to have no contractible power.

These two groups of observations — *first*, of normal backs; *second*, of backs with lateral curves — when completed and compared, will demonstrate the presence or absence of muscular weakness in the different stages of lateral spinal curvature. It will thus be possible to determine the history of the muscular strength through the various stages of the disease. And the muscular element in its etiological importance may then be discussed intelligently in one of its aspects.

Muscular exercise indiscriminately prescribed in cases of lateral curvature is irrational. The presence of habitual faulty attitudes does not necessitate the assumption of muscular weakness. The importance of determining the presence of muscular weakness and of measuring it, is greatest when the deformity is slight and the child is apparently strong. Treatment by

posture and exercise is successful in the great majority of cases in the non-osseous stage. But I am convinced that the application of this treatment will be more rational if each case shall be compared with, what may be designated, the physical index of development. This physical index, for any child, is the height and weight and strength which that child ought to have at its age as determined by the tables of Bowditch and the table given above.

From the researches of Dr. H. P. Bowditch, of Boston, it is known what the height and weight of growing girls should be at each age. It is known approximately, from the results of the investigation presented to you to-day, how strong the back muscles should be for each age. With these data at hand it is possible to determine whether a given patient is up to the standard of development or not. Special muscular exercise can *then* be prescribed when it has been demonstrated that it is needed. Mr. B. Roth's method of determining the need for muscular exercise is an excellent one, but with this additional test treatment is placed upon a firmer and more accurate basis.

The ordinary method of marking improvement or not is by comparing the rotation tracing taken at intervals. In some cases, however, the rotation may remain constant, and yet the attitude of the child improve with the increase of muscular strength. The tracing, in such cases, will not be of great value. But a measure of the muscular strength at intervals will serve a valuable index of progress. Then, again, in those cases in which there is no rotation present, by making measurements of the muscular strength at intervals the value of the muscular treatment will be demonstrated. And, again, in those cases in which the rotation diminishes by treatment, the tracing may be supplemented by a test of muscular strength.

A committee on lateral curvature of the spine appointed by the Clinical Society of London, reported that "the amount of improvement which may be hoped for in any given case may not unsafely be gauged by the improvement which the patient can voluntary effect (directed or helped by the surgeon) in her position when first seen." In addition to this, the relation existing between the age, the height, the weight and the muscular strength of any given individual will assist in forming a prognosis.

There is, of course, a normal relationship between the several factors of the physical index. If, upon examining any given child, she is found to vary in any one or more points from the standard, it may then be considered whether this variation is to be taken as one of the etiological factors or not.

In conclusion:

(1) To-day has been established a scientific basis for the study of the muscular element in the etiology of lateral spinal curvature.

(2) Suggestions have been offered as to the bearing of these observations upon (a) the treatment, (b) the records, (c) and the prognosis, in cases of this disease.

— According to an official return of deaths due to wild beasts and snakes in India during the last year, it appears that 1,972 persons were killed in the Madras Presidency, of which number 1,587 were due to snake bites. The number of cattle destroyed in this way was 12,555.

⁷ See Clin. Soc. Trans., vol. xxi, 1888, p. 301.