The treatment of lateral curvature of the spine / Robert W. Lovett and James Warren Sever.

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Lovett, Robert W. 1859-1924.
Sever, James Warren, 1878-1964.
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Publication/Creation

Chicago : American Medical Association, 1911.

Persistent URL

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THE TREATMENT OF LATERAL CURVATURE OF THE SPINE

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For many years the treatment of lateral curvature has been considered a muscular problem to be met by muscular therapeutics, that is, by gymnastics. Although this treatment has been on the whole successful when properly carried out in the functional and milder structural types of the affection, it has been on the whole distinctly unsuccessful in the treatment of the moderate and severe types of scoliosis. The reason for this is that the treatment of the severer types of the affection is a bone and not a muscle problem, and must be carried out by means of sound surgical principles addressed to the reshaping of distorted bone. The treatment to be advocated in the present paper is based on these principles, and the results of the treatment are shown as carried out for three years in the lateral curvature clinic of the Children's Hospital, Boston.

There are two varieties of lateral curvature, (1) the postural or functional, and (2) the organic or structural. The first variety can be quickly discussed and laid aside, for it is the second variety which constitutes our real problem.

FUNCTIONAL OR POSTURAL LATERAL CURVATURE

The former is really nothing but a faulty attitude, and the latter would be a better name for it. The child, who is generally from 5 to 15 years old, stands with a slight or very moderate lateral curve of the whole spine, in most instances to the left. The left shoulder is higher than the other, and the trunk is displaced to the left, uncovering the right iliac crest and making it more prominent than the left. There is no marked rotation or twisting of the curved region, but when the child

bends forward from the hips and the trunk becomes horizontal, the right side of the back of the thorax can be seen to be very slightly higher than the left. The curve disappears when the patient lies down.

The condition is often associated with round shoulders and round back, and where statistics have been taken regarding it, it has been found to occur in from 20 to 25 per cent. of children of school age. The curve is always single, and compensatory curves do not exist. It is sometimes described as total scoliosis, which should be interpreted as being synonymous with functional or postural scoliosis.

Two mistakes are frequently made in dealing with this condition. In the first place, the curve is so slight that it is frequently overlooked, and second, if it is recognized, the parents are frequently told that the child will outgrow it. There is no reason for overlooking the existence of any postural curve, because it is perfectly simple to hang a plumb-line in the cleft of the buttocks and see if the spinous processes form a straight line and come under that plumb-line. If they deviate in a gradual curve, total scoliosis exists.

With regard to the second point, so far as observations go, there is no tendency to the spontaneous outgrowth of the condition. It is extremely common in adults, and the tendency of growth is entirely toward an increase of the deformity rather than toward a straightening of the spine. Such cases frequently change to the structural type in the process of growth, double curves forming out of single ones; but such cases do not as a rule change to the severe type of structural curve, so that having recognized the existence of a postural lateral curve, the parents should be told that it will probably increase somewhat, will undoubtedly persist into adult life unless efficiently treated, but will probably not cause serious or disabling deformity.

TREATMENT

The treatment is simple. The general hygiene should be looked into, overwork at school and at home prevented, and if the resistance of the child is below normal the day should be shortened slightly by a period of recumbency during the day.

The question of clothes is an important one and should be investigated. Most children of this age wear a waist with shoulder straps which rest near the tips of

the shoulders. To this waist are attached the clothes, and also side elastic garters running to the stockings, which are kept very tight. The tension of these elastics is transmitted by the waist to the straps over the shoulders, and the shoulders are continually pulled downward and forward. Round garters should be substituted for side elastics in these cases, the clothes suspended from the waist should be as light as possible, and in many instances they may be supported from a belt.

If there is any reason to suspect a visual error leading to an improper position in reading, the eyes should be examined and such error corrected. It is advisable in all instances to go into the question of a short leg, not by a measurement from anterior superior spine to the internal malleolus, which is of little practical value and often misleading, but by placing under the foot on the side to which the spine curves enough pamphlets to raise the pelvis on that side and see if an improved position of the spine results. If it does, a higher sole should be worn on that side with a view to inducing a constant improvement in the spinal position.

With these preliminaries taken care of, the treatment should consist of a special set of gymnastics which are within the range of any good teacher of gymnastics, consisting practically of a setting-up drill similar to that given to army recruits. Such patients should exercise daily for half an hour or an hour under the supervision of the teacher until they can maintain a symmetrical position for a few minutes, when they can be allowed to do the exercises at home under the supervision of a parent, and report for observation. The gymnastic work should be individual and class work discouraged.

The daily active treatment should generally not cover a period of more than from one to three weeks under favorable conditions, but the observation period should last for at least a year. Under these conditions the prognosis for a complete cure is excellent, but exercises must be done with precision and vigor, and the general condition of the child must be regarded.

These cases may then be dismissed from our consideration and we can pass to our real problem—the treatment of structural lateral curvature.

ORGANIC OR STRUCTURAL LATERAL CURVATURE

This is accompanied by changes in the spinal structure, with deformity in the vertebræ. The phenomena cannot be reproduced experimentally, and the condition is outside of the normal behavior of the spine and implies structural change. Severe cases in childhood are due to one of five causes.

1. A congenital anomaly of the spine, such as split vertebræ, defective ribs, etc., a class of cases only recently recognized as so important, and until the general use of the *x*-ray not generally understood.

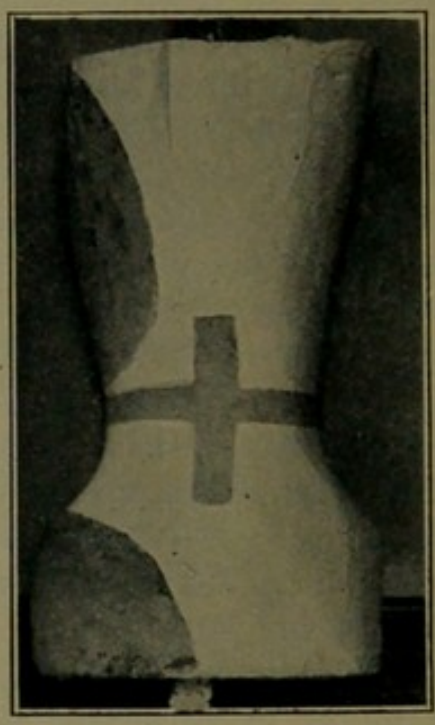

Figure 1.

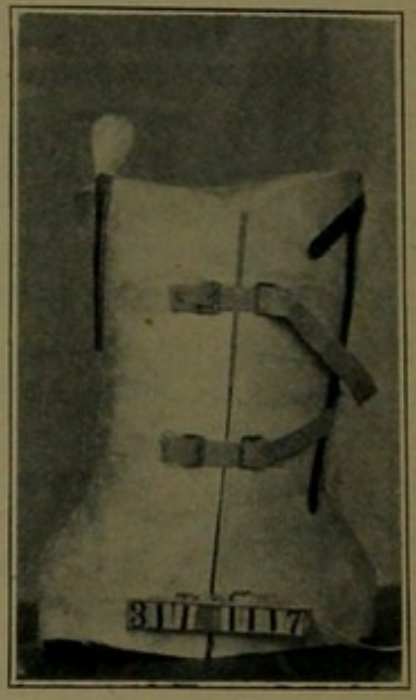

Figure 2.

Fig. 1.—Remodeled torso ready for application of jacket, in a case of right dorsal left lumbar scoliosis which has been cut in two at the waist and set apart 1 inch, so as to increase the upward pressure on the ribs. The dark areas on left of the torso show where plaster has been added on the concave side to allow for correction of displacement and deviation.

Fig. 2.—Front of jacket made over torso shown in Figure 1. Note shoulder pad.

2. Infantile paralysis.

3. Empyema.

4. Rickets.

5. A softness of the bones which we must assume without direct evidence of rickets, but in which bony deformity is so great that it is evident that the bony resistance is below the normal.

The characteristics of organic lateral curvature are definite curves, either single or double—more often the latter—and much more marked than in the postural class, in some cases running to extreme deformity. There is always a rotation of the vertebræ or horizontal twist

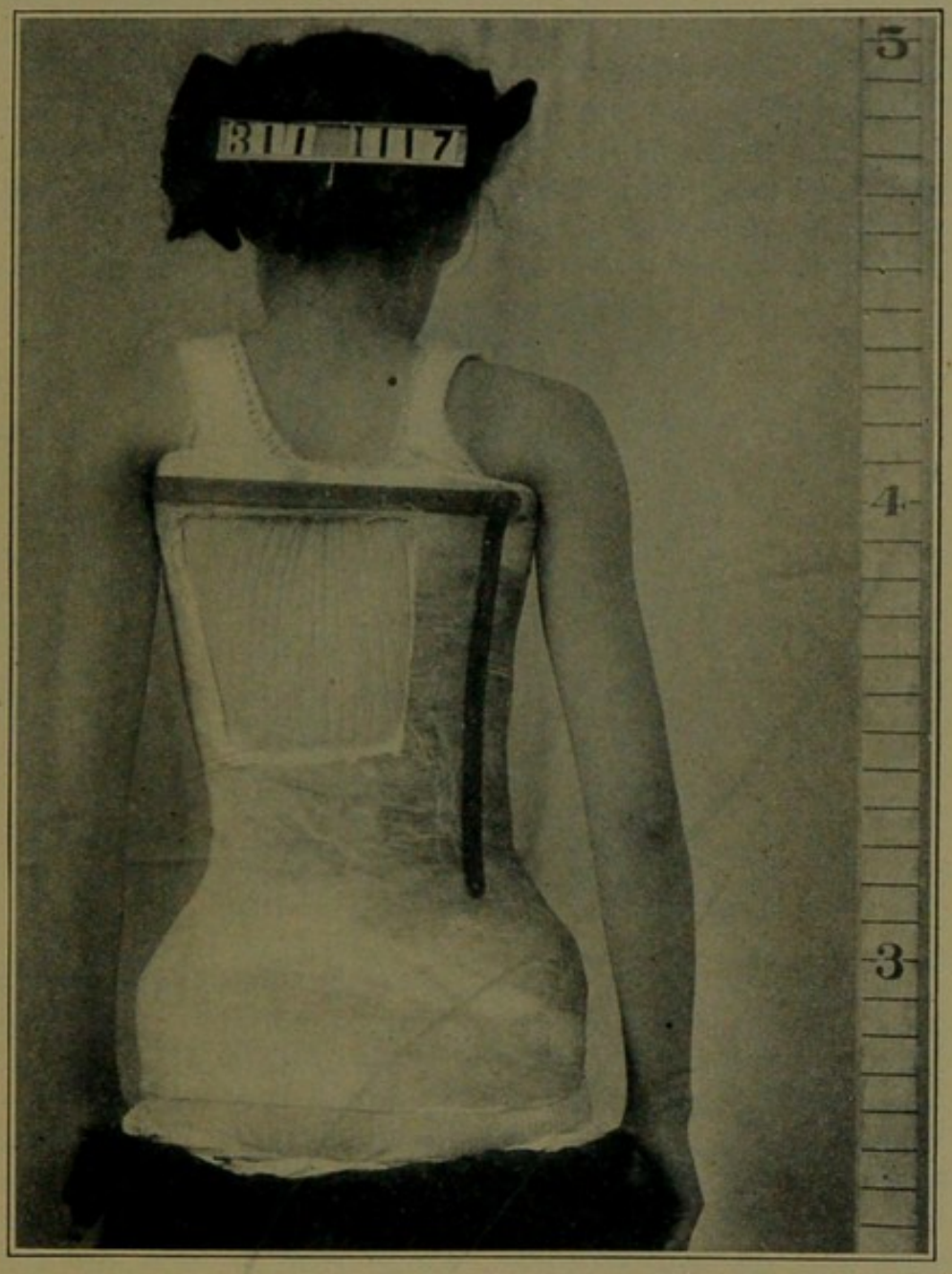

Fig. 3.—Patient in jacket shown in Figure 2. Note window on concave side. Jacket reinforced by steel strips.

at the site of the curve, and in bending forward, with the trunk horizontal and the arms hanging, there is always to be seen a more or less marked upward bunch or prominence in the affected region on the side to which the spine curves, that is, on the convex side of the lateral

curve. If the curve is double, there are two rotations corresponding to the two curves. This is a constant characteristic, and is diagnostic of this type of curvature. A right curve has always a right prominence and *vice versa* on the other side. The curve does not disappear on lying down, and the *x*-ray shows a deformity of the vertebræ, with compression of the intervertebral disks on the concave side, and in the more advanced cases, with a wedge-shaped deformity of the vertebræ. Distortion of the figure, the elevation of one shoulder, the prominence of one ilium, a general displacement of the body to the side, etc., are the results and expression of this bony spinal deformity.

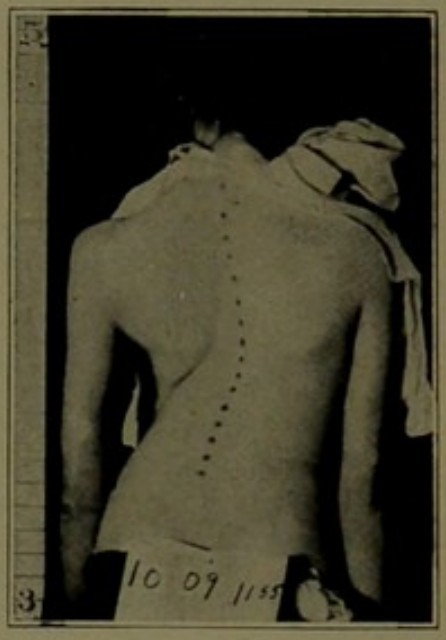

Fig. 4.—Girl aged 16, before treatment.

It must be clearly recognized that these are the cases that present the difficulty in treatment, the vertebral column in these cases being deformed to some extent, with the changes mentioned, namely, shortened ligaments and muscles, compressed disks, and, in the severe cases, wedge-shaped vertebræ. In addition to these deformities to the side, the vertebræ twist on a vertical axis and are thus distorted along with the ribs and the bony structures of the thorax, which share in the deformity in severer cases. These changes in the lateral and in the horizontal direction result in distortion of the viscera, compression of the lungs, displacement of the heart and disturbance of the abdominal viscera, which in severe cases predispose to impaired digestion, deficient chest capacity, and in general to impaired

resistance, so that it is safe to say that as a rule patients with severe scoliosis in adult life are badly nourished and have an impaired resistance. Extreme deformity may result in the severest cases.

TREATMENT

Having thus defined very briefly the essentials of the condition, we come to the very difficult question of how such cases should be treated. As the keynote of the treatment to be advocated, we must recognize that bone is an adaptive structure, and in its growth follows the line of least resistance, and we must remember also that we are dealing with a lateral bony deformity of the spine. Putting these two considerations together, it

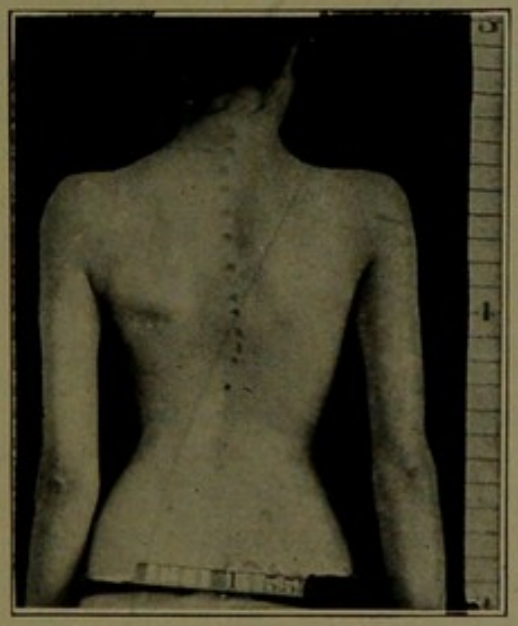

Fig. 5.—Girl aged 17, after fourteen months' treatment by removable jackets without exercises.

would seem as if our best chance of remedying the bony deformity was to force the spine into as normal a position as can be obtained, and to hold it in that position during part of the period of growth. This is, in brief the treatment that will be advocated.

The majority of such cases in this country, as a matter of fact, are at present treated by gymnastics, and one rarely sees a bad case in which this treatment has not already been pursued and has failed. There are, apparently, two reasons for this. First, the treatment by pure gymnastics is inadequate for any but slight and moderate cases, and therefore unsuited to the treatment of severe cases, and second, in general it is ineffectually

given, because the average medical gymnast thinks if he gives a treatment which he has reason to believe is proper, his responsibility ends; he does not measure the efficiency of his treatment by the results. If gymnastic treatment is to be given for cases of more than slight grade, let it be given as it is in Europe, where a patient goes to an institute and lives, abandoning school and family, works for several hours a day in specially constructed apparatus, spends perhaps hours in a recumbent position, and pursues this treatment for month after month under the supervision of skilled assistants. Under these conditions one may expect results from gymnastic treatment in properly selected cases; but contrast that treatment with what is generally given here as the gymnastic treatment, an exercise period perhaps three times a week with the patient under no supervision in the meanwhile and wearing no apparatus, the treatment interrupted by home demands, illness and other conditions, followed out in a half-hearted way for some months and finally abandoned. It is not reasonable, under these conditions, to expect much from the gymnastic treatment.

If we look at the facts from a general surgical point of view, the condition seems to be as follows: A deformity analogous to knock-knee exists between each two vertebræ. We would not in a child of 8, for example, expect to cure knock-knee by an hour's muscular exercise given three times a week or oftener, while the rest of the time, except during sleeping, gravity is at work to exaggerate the condition. Our knowledge of the principles of general surgery would not allow us to sanction such a treatment, but it is allowed and sanctioned in an analogous deformity affecting the spine.

Moreover, not only does gymnastic treatment in the severe grade of cases as a rule do no good, but if effectually carried out, it does harm up to a certain point by loosening up a stiff spine and allowing the spine to sag farther into the bad position. A spine with severe lateral curvature soon becomes stiff and gets slowly worse, but if it is loosened by effective gymnastics, the side thrust of the superincumbent weight is so great that it becomes rapidly worse and the patient's average standing position is worse than before treatment was begun.

The rule should be, therefore, either (1) not to use gymnastics alone in any but slight cases, (2) to keep

the patient recumbent until the gymnastics have developed muscles as well as restored flexibility, or (3) to use a support in connection with gymnastics to hold the improved position.

The use of gymnastics alone in lateral curvature of the spine should be limited to the slighter grades of structural curves. Such gymnastics should obviously have two aims, (1) to restore flexibility, and (2) to cultivate the holding power. The exercises should be done with vigor and precision for at least an hour daily, and they are to be regarded as effective only so long as they produce manifest improvement. Gymnastic treatment should be stopped temporarily if the patient loses weight, becomes irritable or languid, or if the menstruation in girls becomes profuse. The gymnastics to be used are to be found in the text-books on orthopedic surgery and in certain French and German books devoted to the subject.[1] Until the medical profession insists on the adequate and careful performance of gymnastic treatment and limits it to suitable cases it will fall into even greater disrepute than now.

Recognizing then the need of attacking moderate and severe lateral curvature as a bone problem, we advocate a treatment analogous to that universally recognized as effective in the cure of congenital club-foot, namely, securing a proper position of the deformed structures and maintaining this position until the bones are reshaped by growth. In the treatment to be advocated for this grade of lateral curvature, no more attention in the beginning is paid to the muscles than is the case in the treatment for club-foot, which is a radical departure from accepted views.

A curious experience directed our attention to the possibility of this method. A girl with severe lateral curvature applied at the Children's Hospital for treatment. A forcible plaster jacket was applied and an *x*-ray of the spine in the corrected position taken through windows cut in the jacket. The girl was instructed to return in two weeks to have the jacket changed. Instead of returning in fourteen days, she stayed away fourteen months and came back wearing the same jacket. The improvement in her position at the end of this time was

1. Wilbouchewitch: Gymnastique. orthopédique, Paris, 1903 Mikulicz and Tomas Cwzewski: Orthopädische Gymnastik., Jena, 1904. Lovett, R. W.: Lateral Curvature of the Spine, Phila., 1907. Klapp: Funktionäle Behandlung der skoliose, Jena, 1910.

extraordinary, and an *x*-ray of the spine taken at the second visit showed an improvement in the bony curve. This suggested a treatment which has been followed out in modified form during the last three years.

For moderate and severe structural lateral curvature the treatment is of two kinds, either (1) by the use of a permanent corrective jacket worn for long periods, or (2) in its modified form by the use at first of a corrective jacket followed by a removable jacket and exercises.

Permanent Jackets.—The first form, the permanent forcible jacket, is better suited to hospital practice than

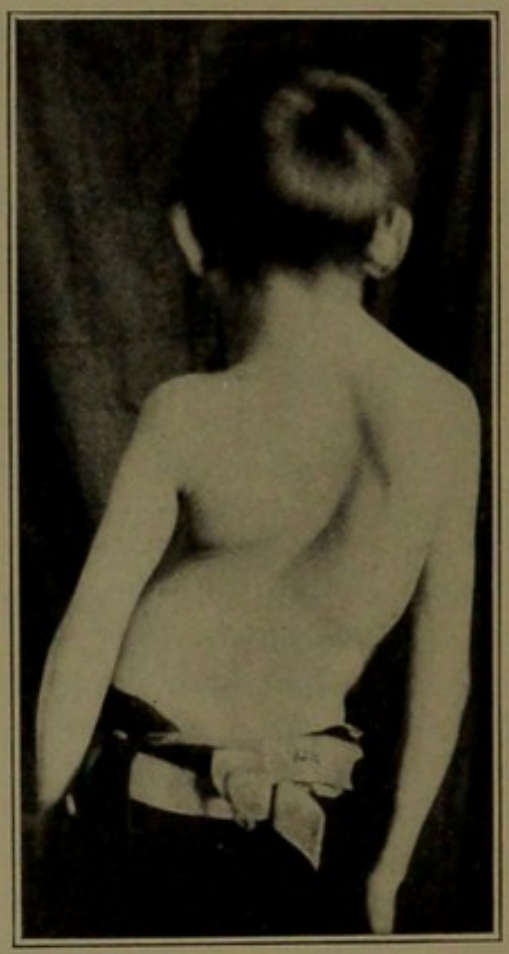

Fig. 6.—Boy aged 12, before treatment.

the other. We have for two years been taking cases of similar grades in the clinic and treating some by one method and some by the other, as a result of which we have come to the conclusion that the treatment by permanent jackets produces better results. The treatment by permanent jackets is as follows: Either in recumbency or in suspension a jacket is applied to the patient, securing the best obtainable position without the use of high degrees of force. At first we used the recumbent position with considerable amounts of force, but in hos-

pital practice sloughs occurred, and if much force was used, occasionally trouble with respiration followed, and experience has shown us that we can obtain the same efficiency without the risk by the use of smaller degrees of corrective force in the initial jacket put on in suspension.

When the jacket is hardened, it is left solid over the parts that are made prominent by the rotation behind and in front, that is, in a right dorsal curve the right back and left front are not touched, but large windows

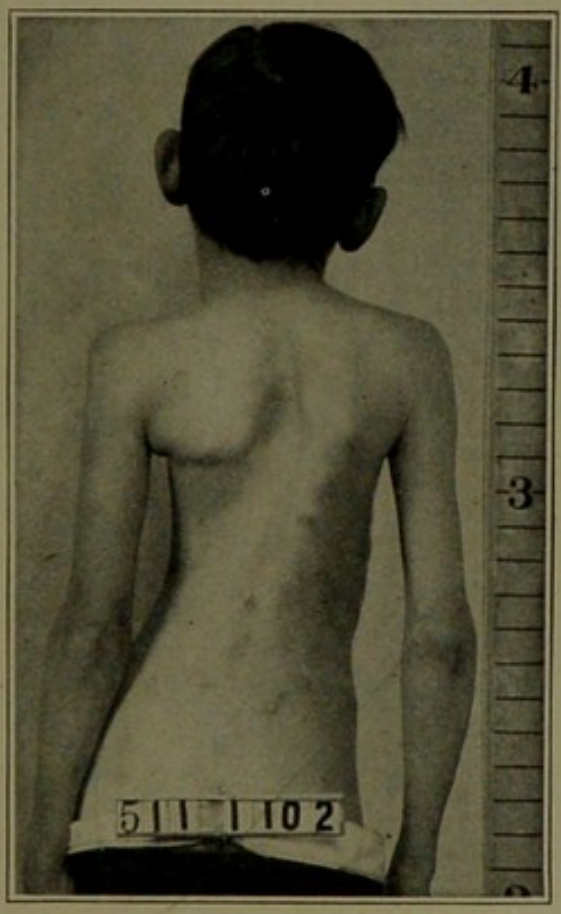

Fig. 7.—Boy aged 14, after two years' treatment by means of permanent jackets.

are cut over the depressed side of the chest behind and the corresponding portion diagonally opposite in front, so that in a right dorsal curve the left side would be cut out behind and the right side in front. This makes it possible for the depressed parts of the chest to be expanded by respiration, while the prominent parts are compressed. Pads of felt are now inserted between the prominent part of the chest behind and the jacket, and sometimes in the corresponding region in the front, thus making the jacket more corrective, and thicker pads are

substituted each week without changing the jacket, these being drawn through without difficulty by means of a bandage. In this way, a continual diagonal side-pressure is kept up on the curved portion of the spine and is steadily increased. At the end of two or three months, it will be found that it is advisable to apply a new jacket, to cut it out in the same way and to begin on the progressive padding. The use of such a permanent jacket is continued for a period of from one to two years, being

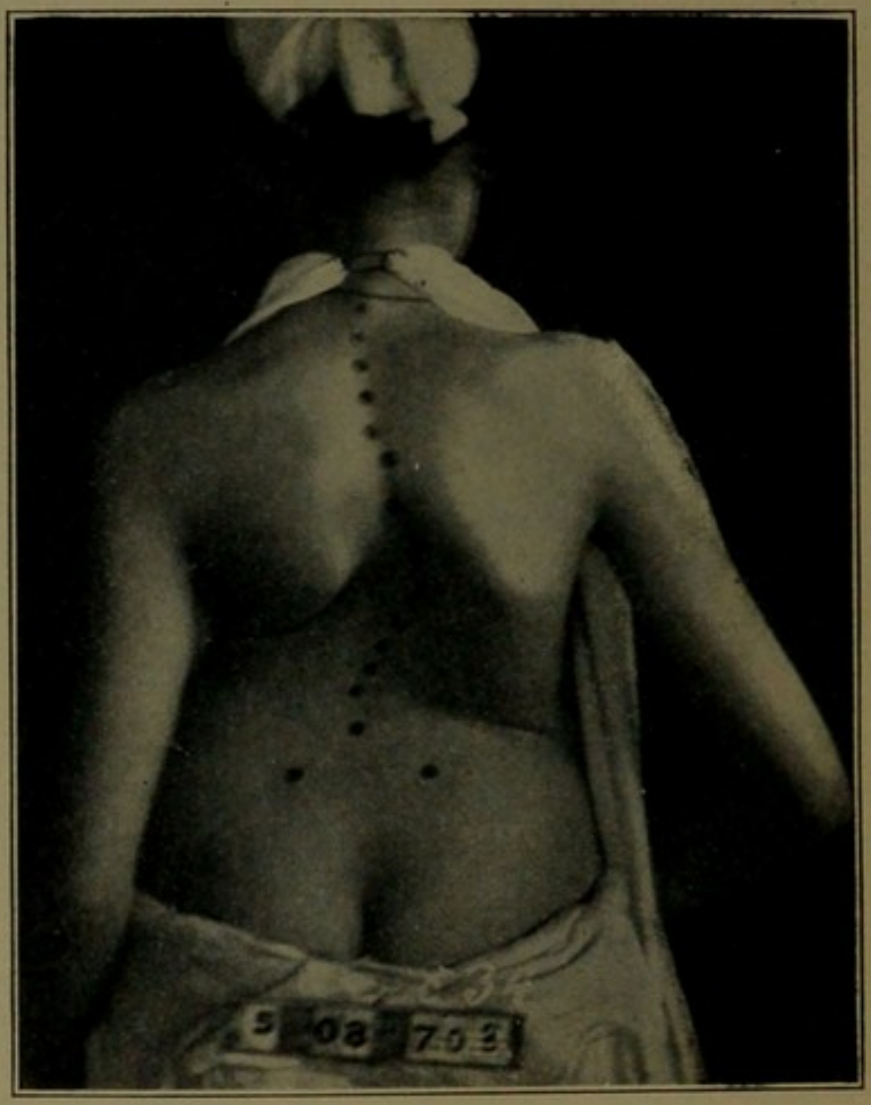

Fig. 8.—Girl aged 16, before treatment.

changed at long intervals, and at the end of this time a removable jacket is substituted for the permanent one and gymnastic treatment is begun. The removable jacket is then gradually discontinued while the patient's muscular condition is being improved by gymnastic exercises.

Removable Jackets.—As in the former method, the second treatment, that by removable jackets, is started by the application of a forcible jacket either in recum-

bency or suspension. This is followed by a second jacket at an interval of a week. After the application of the second jacket, the patient is suspended and a plaster jacket is applied which is immediately cut off to serve as a mold, and a third forcible jacket is applied to be worn while the removable apparatus is being made. The jacket which is to serve as a mold is then bound together and filled with plaster of Paris and water, a torso thus being obtained. This torso is then remodeled by cutting

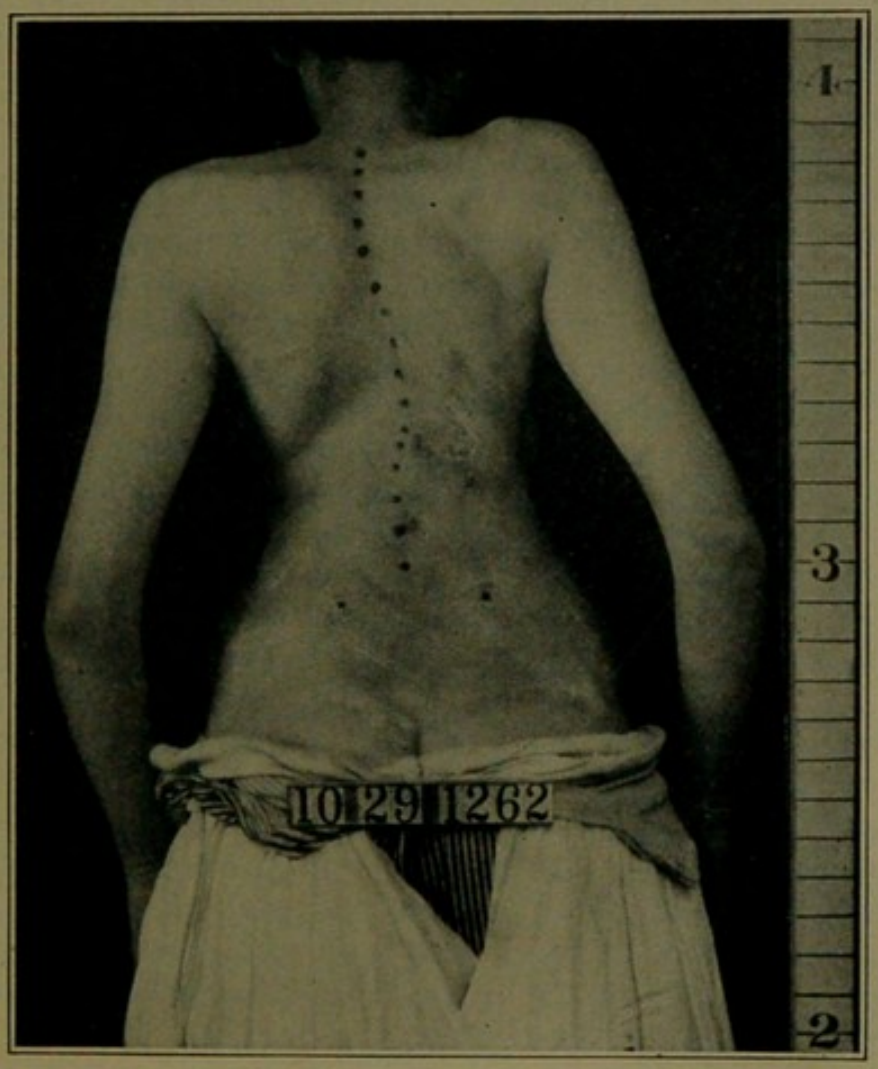

Fig. 9.—Girl aged 18, after two and one-half years' treatment by means of a series of permanent jackets.

off on the prominent side and building up on the other side, until it has become decidedly more symmetrical than the patient. It is also sawed in halves at the waist and set apart about an inch in order to secure continued extension.

On this corrected torso a plaster jacket is applied which is to be the removable jacket worn by the patient. This removable jacket should be supplied with shoulder

pads to hold the shoulders in position, and should open down the front, being supplied with buckles and straps or lacings. It may also be advisable to slash such jackets over the iliac crests. The addition of 5 per cent. Portland cement to the plaster with which the jacket is made gives greater strength and durability. This jacket is to be worn by the patient night and day and to be removed only for the exercise period, which should consist of one hour or more daily, the exercises being of the type mentioned above. When the jacket is applied, it is sprung open and slipped on the patient, who then lies on the back, and the arms and legs are pulled on to extend the spine. It is then buckled tightly in place before the patient stands up.

Jackets of either kind should be tested for efficiency by measuring the height of the patient with and without the jacket. Without the jacket the patient places the hands on the hips and pushes up, making himself as tall as possible, and his height is taken in this position. The jacket is then applied and the patient's height is again taken. If the jacket does not hold him in as good a position, as estimated by height, as the patient can possibly assume with the hands on the hips, it is discarded and a more corrective one is made. In these jackets it is often advisable to cut the windows as in the permanent form, and to use padding in addition to the correction of the torso.

If such a jacket is worn by a patient who is making good progress, in a few weeks from the beginning of treatment it will be found to be inefficient and not to be holding him on account of his improvement. Under these conditions the torso must be again remodeled, more cut away from the prominent side and greater pressure exerted. In the course of a year, probably two or three such remodelings would be required. These jackets may be made of leather or celluloid if preferred rather than plaster, but the plaster is perfectly efficient, although heavier.

This treatment is more acceptable than the former to private patients, and where the patient is under complete control, it is probably nearly as efficient as the other, although perhaps taking a little longer time. When such treatment as the latter has been continued over a period of a year or more in the severer cases, a trial may be made of removing the jacket for a short period each day and watching the patient during this period, the jacket

being gradually abandoned as the patient's corrective power increases. In neither form of treatment in severe scoliosis is the treatment likely to last less than two years, although in the moderate forms it may take less time to secure the desired results.

Finally, it may be well to meet two criticisms which are likely to be made. In the first place, the results are presented by photographs, patients unconsciously pose, shadows distort, and the method is not scientifically accurate. At the same time, in this clinic we have tried many other methods of measurement, including the Schultess machine for recording lateral curvature, and after a careful trial of each we have returned to photographs as, on the whole, the most reliable and practical method of presenting results.

In the second place, the criticism will be made that the results that we show are not necessarily permanent. This treatment has been used by us, for too short a time for us to be able to produce in this series, definite evidence that the results are permanent. In answer to this criticism, it can only be said that bone is an adaptive structure; that we have seen a change in the bony curve under this treatment as demonstrated by the *x*-ray; that the Chinese woman's foot is deformed permanently by pressure; that the shape of the bones in club-foot is permanently altered and restored to normal by pressure; that experimentally, bony lateral curvature was produced by Wullstein in dogs; that in the cases under observation longest the results have tended to be permanent, and finally, that Schanz of Dresden from a similar treatment has shown the persistence of good results for one or two years after the cessation of treatment. It is possible to state that if the treatment is stopped half way, immediate relapse follows and nothing is gained, but if the treatment is persisted in until the end and gradually discontinued, it seems likely that the results obtained will be permanent.

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Reprinted from The Journal of the American Medical Association
September 2, 1911, Vol. LVII, pp. 786-791