

THE MANAGEMENT OF SCOLIOSIS*

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John Cobb of America, recently stated in a lecture in London, that in order to treat scoliosis, 'You don't have to be crazy but it sure helps'! In recent years, however, the management, although still controversial, has gradually progressed along certain sane and definite lines. This has been due, in particular, to the development of accurate measurement of the curves by the method of Ferguson,¹ later modified by Cobb;² spinal fusion as a method of treating scoliosis by Hibbs;^{3,4} the use of a correcting turnbuckle jacket by Risser⁵ and, finally, the establishment of an accurate prognosis in idiopathic scoliosis by Ponseti and Friedman.⁶

Scoliosis is a lateral curvature of the spine and consists of 2-4 curves. The commonest pattern is the triple curve

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with a primary or major curve in the middle, and two secondary or compensatory curves, one above and one below which develop later in order to keep the head directly above the pelvis. The major curve undergoes secondary changes, consisting of fixed rotation of the bodies of the vertebrae so that the spinous processes are rotated to the concavity of the curve, and of wedging of the vertebrae on the concave side. In the secondary curves rotation is much less marked and does not develop until much later. (See Figs. 1 and 3.) Other less common patterns may consist of 2 or 4 curves (see below).

Clinical Examination

Cases of scoliosis are best dealt with in a special clinic so that adequate time can be given to a detailed history and examination of each case. It is useful to record the findings on a special form. The history should include the age of onset of the scoliosis, past illnesses (particularly

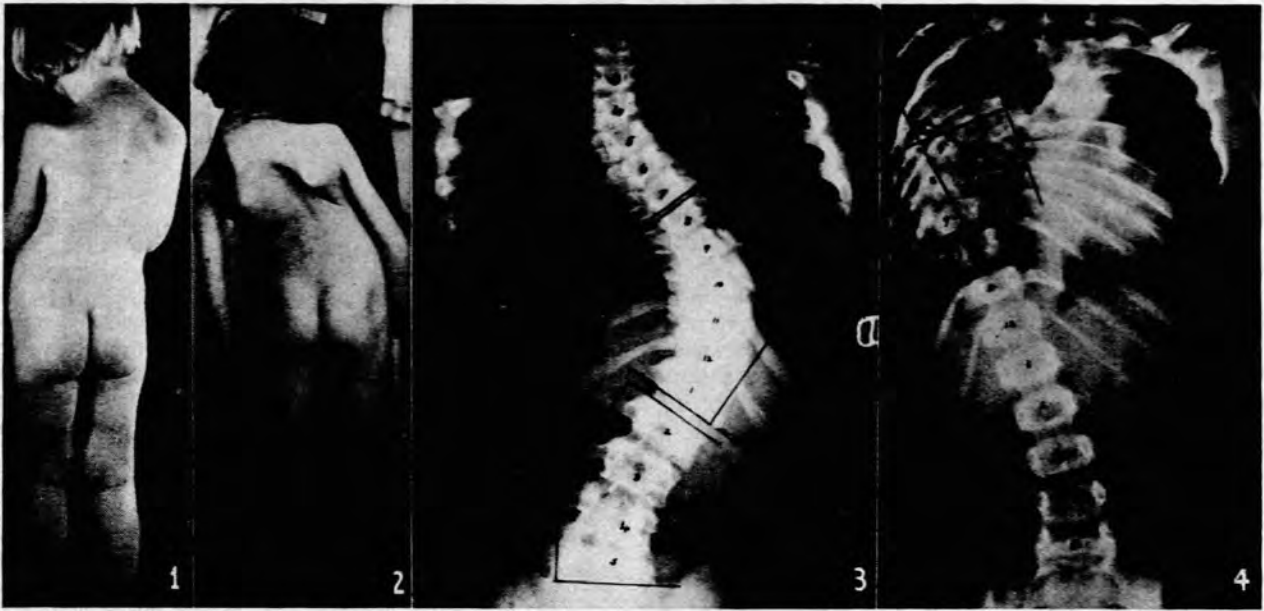


Fig. 1. A typical thoracic scoliosis T2-T11, measuring 79°. Fig. 2. A case of neurofibromatosis showing café au lait skin pigmentation, and a severe thoracic scoliosis. Fig. 3. A thoraco-lumbar idiopathic curve, T8-L1 = 71° (major curve), with upper secondary curve, T2-T7 = 39°, and lower secondary curve, L2-S1 = 35°. Fig. 4. X-ray of a case of neurofibromatosis, showing a typical short acute curve T5-T9, measuring 95°.

SCOLIOSIS CHART

Name: John Jones

Surgeon F. J. Hedden

Diagnosis: Paralytic Scoliosis

Record No. 7364

Date	8.4.53	30.9.53	21.7.54	11.1.56	27.1.56	
Age	13-1/12	13-6/12	14-2/12	14-7/12	14-7/12	
Ht. Standing	60½"	61"	61½"	61½"	61½"	
Ht. Sitting	31½"	32"	32"	32¾"	32¾"	
X-ray Date	8.4.53	30.9.53	21.7.54	11.1.56	27.1.56	
(C3-T5) Curve	Standing	10	10	18	24	24
	Bending Rt.	12	14	27	31	33
	R. Bending Lt.	-5	-3	4	14	14
	Left Supine	2	5	11	16	17
Rotation (+, ++, etc.)				+	+	
Wedging (+, ++, etc.)				+	+	
(T6-L2) Curve	Standing	24°	20°	43°	57°	63°
	Bending Rt.	5	7	14	27	28
	Right Bending Lt.	26	25	47	73	73
	L. Supine	19	21	24	35	37
Rotation (+, ++, etc.)			++	++	++	
Wedging (+, ++, etc.)			+	+	+	
(L3-S1) Curve	Standing	8°	14°	19°	27°	27°
	Bending Rt.	10	16	22	28	29
	R. Bending Lt.	-6	-1	3	7	7
	Left Supine	5	9	15	22	24
Rotation (+, ++, etc.)			+	+	+	
Wedging (+, ++, etc.)				+	+	
Tilt of Lower Curve (L3-S1)					7	

poliomyelitis), the rapidity of progress of the curve, and whether there is any family history of scoliosis. The examination should be conducted with the child standing and the back should be examined in erect and bending positions. Details of the deformity should be recorded, such as elevation of the shoulder, prominent scapula, list of spine to one side, prominent flank crease and prominent hip. The apex of the major curve should be defined clinically with the child bending forward.

A complete muscle charting should be performed, and the height, weight and leg lengths recorded. The chest deformity should be noted and the vital capacity of the lungs estimated. Finally a careful search should be made for the *café-au-lait* marks on the skin found in neurofibromatosis, and clinical photographs are taken for record purposes (Fig. 2).

X-ray Examination

This consists of routine films taken on 17×14 inch plates. These are AP erect and supine of the whole spine, and also a lateral of the spine on the first visit of the patient. *Bending films* are taken with the patient bending first to the right and then to the left to determine the rigidity of the curves. In a paralytic curve after poliomyelitis, a tilt film is also taken (see below).

The angles of the curves are measured and recorded. The limit of each curve is distinguished by noting that, whereas in the primary curve the disc is widened on one side, in the curve above or below it is widened on the opposite side. At each junction there is a neutral disc equal in width on both sides. Lines are drawn parallel to the lower border of the lowest vertebra and the upper border of the highest vertebra of each curve. From these lines perpendiculars are erected, and the angles at which these meet are the angles of the curves. The degree of wedging and rotation of the vertebrae is also noted (see Fig. 3). The results should be recorded on the special Scoliosis Chart shown here.

Finally, the child should be seen every 3 months, or later 6 months, for clinical examination and X-ray, until spinal growth has ceased and there is no further increase of the curve.

CLASSIFICATION BY AETIOLOGY

The aetiology of the case must now be accurately determined. In this paper the subject is considered in accordance with the following aetiological classification:

A. Functional

1. Postural
2. Compensatory

B. Structural

1. Idiopathic Scoliosis, i.e. scoliosis in which the exact aetiology is not known, constitutes 80-90% of all cases
2. Post-poliomyelitis 5-10%
3. Neurofibromatosis 2%
4. Congenital cases less than 2%
5. Thoracogenic cases (post-empyema, post-thoracoplasty) less than 2%
6. Osteochondrodystrophy (Morquio's disease) less than 1%
7. Friedrich's Ataxia less than 1%
8. Spastic Paralysis and Rickets—very rare.

A. Functional

1. *Postural Scoliosis.* In postural scoliosis there is a mild single lateral curve, which disappears on suspension or on bending forward. Rotation of the vertebrae does

not occur, and the curve does not change into a structural one.

2. *Compensatory Scoliosis* is due to a short leg or to deformity of the hip joint. It shows two curves without rotation, commencing at the level of the lumbo-sacral joint. It does not progress and only rarely, if ever, becomes a fixed structural curve.

B. Structural

Structural Scoliosis is a lateral curvature of the spine with rotation of the vertebrae.

1. Idiopathic Scoliosis

The natural history and prognosis of the curve have been described by Ponseti and Friedman,⁶ of America, and James, of London,^{7,8} and are of the utmost importance in treatment. The higher the site of the primary curve and the earlier its onset, the worse is the prognosis. The onset may be at any age in childhood.

*Risser's sign*⁵ is useful in the prognosis. It is said to be positive when the iliac apophysis appears in the radiograph all the way round the crests, from the anterior to the posterior superior spines. This coincides with the fusion of the vertebral epiphyses, following which, as there is no further growth, no further deterioration in the curve will occur. In girls, the onset of menstruation usually precedes this sign by a few months.

The severity of the curves are: (1) mild, i.e. less than 70°, (2) severe 70-100°, (3) very severe—over 100°.

Idiopathic scoliosis is commoner in girls than boys and the curve is commoner to the right, with one exception only (see (a) (iii) below).

(a) *Lumbar Idiopathic Scoliosis* occurs in 26% of cases. The apex is at L. 1 usually, and the curve extends from T. 11 to L. 3. 91% are mild and the deformity is slight because no ribs are involved and the shoulders remain level. The prognosis is good, and none of the cases need correction or fusion. The only complication is low back pain in middle life from arthritis of the posterior intervertebral joints due to their extreme rotation.

(b) *Thoraco-lumbar Scoliosis* occurs in 8% of cases. The apex of the curve is at T. 11 or 12 and extends from T. 6 or 7 to L. 1 or 2. Two-thirds are mild and only one-third become severe, and deformity is not usually marked except in severe cases, where ribs are involved and the shoulders drop and the hip becomes prominent (Fig. 3).

(c) *Thoracic Scoliosis* occurs in 43%. This is the most important group, for in these cases the curves progress more rapidly than in other types, giving the largest curves and producing the worst deformities. The apex of the curve is between T. 6 and T. 10, and the vertebrae show marked wedging, rotation and osteoporosis. They are classified according to the age of onset, and occur mainly in the 3 periods of rapid growth:

- (i) The *adolescent* group, commencing after the age of 10 years (21%).
- (ii) The *juvenile* group, commencing between the ages of 5 and 8 years (5%). The cases in groups (i) and (ii) are commoner in girls and the curves are mainly to the right in both groups. The prognosis is bad; 60% of the adolescent cases and 85% of the juvenile develop severe curves.
- (iii) The *infantile* thoracic group commences before 3 years of age (17%). It is commoner in boys

and the curve is more often to the left, making this a distinct pattern from the previous thoracic curves. The deformity is severe, rotation occurs early, and over 90% of cases are severe by the age of 10 years. The prognosis is very bad in the majority of cases; although in a few the condition remains stationary or disappears, in the majority it progresses steadily.

(d) *Combined Thoracic and Lumbar Scoliosis* occurs in 23%. This combines the characteristics of both lumbar and thoracic scoliosis, and has 4 curves—2 primary in the middle with rotation, and 2 secondary. The upper primary curve is usually from T. 6 to T. 10, and the lower primary from T. 11 to L. 4. The two curves keep in step and balance each other, and the deformity is slight, for the shoulders remain level and the hips are covered. The prognosis is good.

2. *Paralytic Scoliosis*⁹

Scoliosis is common in a growing child after an attack of poliomyelitis with paralysis of the trunk muscles. There are two main groups (Fig. 5).

(a) Firstly severe symmetrical paralysis, which causes a collapsing spine, as the spine is unstable in the erect position, but does not give a severe curve. It is due to the force of gravity.

(b) Secondly, and more commonly, a curve develops from asymmetrical weakness of the trunk muscles plus the force of gravity, the convexity developing on the weaker side. The muscles which cause the scoliosis are the intercostals, the lateral abdominals and the quadratus lumborum. Even moderate inequality in these muscles on the two sides will produce a definite curve. A scoliosis may develop soon

after the attack of poliomyelitis, or it may be delayed 5-10 years; so a careful watch must always be kept on the spine. The erector spinae, shoulder muscles, anterior abdominals and leg muscles do not cause scoliosis, although a contracture of the tensor fascia lata may cause pelvic tilting.

The curve patterns have some similarity to idiopathic scoliosis, but their prognosis is different (Fig. 6):

The Lumbar (Apex at L. 1—L. 2) and *Thoraco-lumbar* (Apex T. 11 or T. 12) are due to weakness of the lateral abdominals and quadratus lumborum muscles, and the *Thoracic* are due to the additional weakness of the lower intercostals (Figs. 10, 7, 8, 9). These curves may progress and cause severe deformity, but they can be corrected surgically.

High Thoracic curves starting at C. 1 or C. 2 are due to paralysis of the intercostals. This can be demonstrated by a cine-film, by the decrease of movement of the ribs on the convex side, and by their more vertical position. The head is stepped to one side and the rotated ribs make the trapezius prominent, causing severe deformity. This curve is very difficult or impossible to correct and has the worst prognosis of all the types of paralytic scoliosis.

Quadruple curves may occur with double primary curves in opposite directions and compensatory curves above and below, and the primaries may not balance each other as in the idiopathic variety.

Pelvic Obliquity may be caused by contracture of the hip abductors and the tensor fasciae latae, paralysis of the lateral abdominals and quadratus lumborum, or a combination of them, and may be associated with a short marked lumbar curve (Fig. 11).

The paralytic curve differs in appearance from the idio-

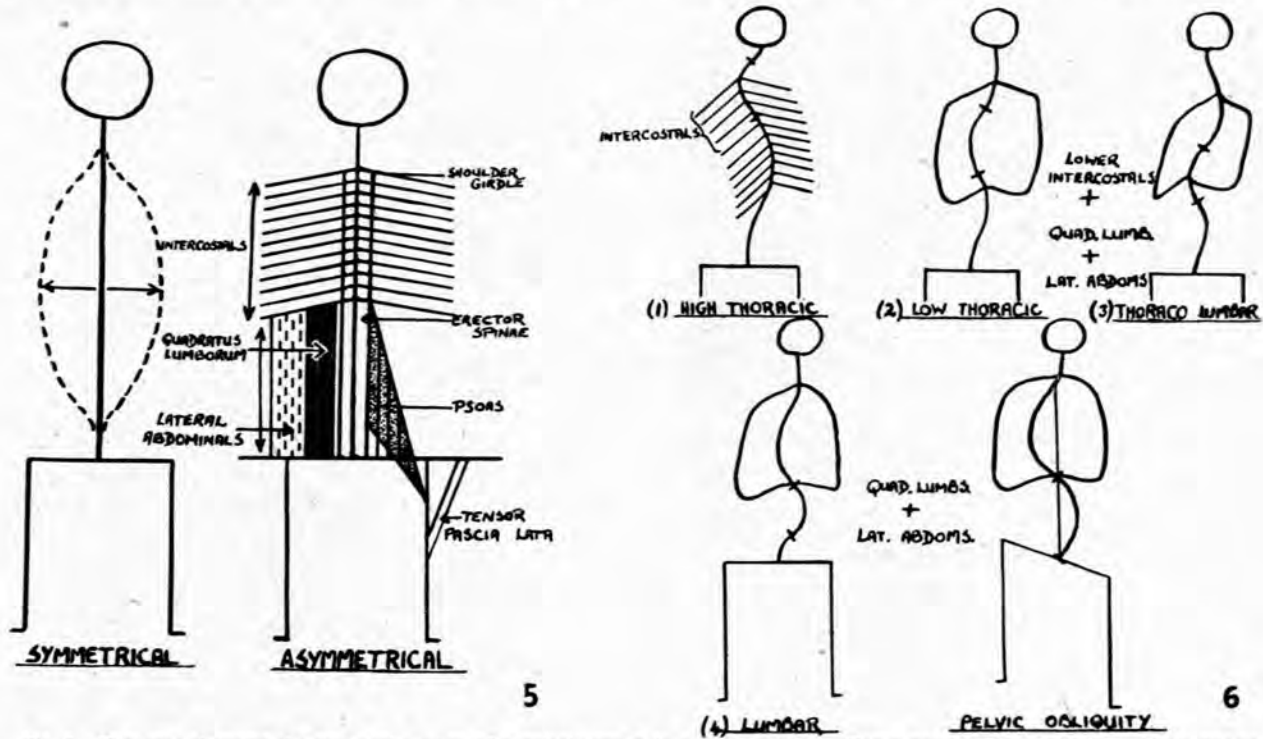


Fig. 5. Diagram showing the two main types of paralytic curve (see text). Fig. 6. Curve patterns in paralytic scoliosis due to asymmetrical involvement of muscle groups.



Fig. 7. Thoracic type of paralytic scoliosis. Fig. 8. Same case showing the 'razor back' type of deformity due to rib rotation. Fig. 9. Same case. X-ray shows curve T3-T10 measuring 104° .

pathic and is typically a long C-curve with secondary compensatory curves. No accurate prognosis can be given in paralytic curves, owing to the difficulty in accurate charting of the affected muscles, but the earlier the onset and the higher the curves (as in idiopathic) and the greater the

muscle imbalance, the worse the prognosis. However, unlike the idiopathic variety, the lumbar and thoraco-lumbar curves may cause great deformity.

3. Neurofibromatosis

A number of cases of neurofibromatosis develop scoliosis. The typical cases develop a short, sharp, acute angulating curve with wedging of vertebrae in the thoracic region. They all progress rapidly, causing severe deformity, and have the worst prognosis of any kind of scoliosis. Paraplegia may be a complication in severe cases (Fig. 4).

4. Congenital

Many types of abnormality may occur in the spine, such as hemi-vertebra, fused vertebra, spina bifida. The degree of scoliosis varies from mild to severe, as one hemi-vertebra may cancel out another. Nearly all double curves (except compensatory) are congenital. Prognosis based on X-rays is often impossible, and the curves have to be watched carefully.

Kypho-scoliosis¹⁰

In structural scoliosis, although there is often an apparent kyphosis due to the hump caused by rib rotation, there is no actual alteration in the anterior-posterior direction of the vertebrae. However, very occasionally a true kyphosis is associated with a structural lateral curvature, when the condition is called kypho-scoliosis.

TREATMENT OF SCOLIOSIS

Treatment may be conservative or operative.

A. Conservative Treatment

1. *Physiotherapy* in the form of exercise will improve posture but, whilst breathing exercises are useful, physiotherapy will have no effect on a structural curve. However, in paralytic curves exercises are useful to improve the par-

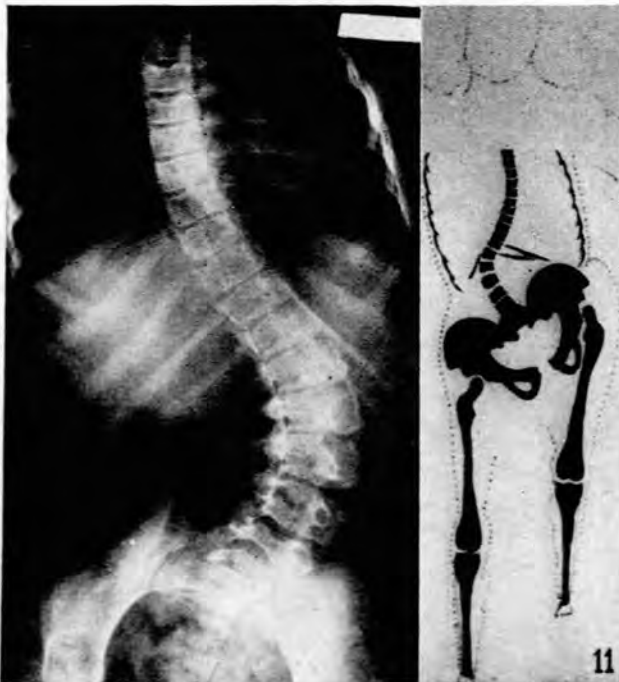


Fig. 10. Lumbar type of paralytic scoliosis. A typical long curve T9-S1 = 53° . Fig. 11. Diagram showing a scoliosis associated with tilting of the pelvis.

tially paralysed muscles, but will seldom help after 18-24 months if these muscles are used in everyday activity.



Fig. 12. An infant immobilized in a Dennis Browne metal night splint.

2. *Correcting plaster beds and splints* may be used in infants, such as the Merck-Jansen bed, or the Dennis Browne metal night splint, but neither is of use in older children (Fig. 12).

3. *Plaster jackets and spinal supports* in older children should be avoided as far as possible, as they are only an encumbrance and fail to control the progress of the deformity. There are two exceptions, however:

Firstly in a case where there is a rapidly progressing curve and the patient is too young to operate on, the Milwaukee Brace of Blount¹¹ is of great value and will control the curve or slow down its rate of increase. Constant distraction of the spine combined with local pressure is obtained by means of a moulded leather pelvic support connected to occipital and chin pieces by extensible anterior and posterior uprights. A lateral pressure pad exerts pressure at the apex of the curve (Figs. 13 and 14).

Secondly, in paralytic curves, when there is a collapsing type of curve without severe scoliosis, the patient is unable

to sit up or stand, and a posterior spinal support with axillary crutches is necessary.

B. Operative Treatment: Correction and Fusion

The operative correction consists of correction and fusion of the major curve in a turnbuckle plaster jacket.

1. *In Idiopathic Scoliosis*, if the curve pattern and the age of onset are considered together, an accurate prognosis is possible. Correction and fusion should be carried out *for the prevention of future deformity*; and, as there are no symptoms in the idiopathic variety, the indications are mainly cosmetic. Occasionally where there are severe chest deformities and a low vital capacity operation is indicated to prevent pulmonary and cardiovascular complications. Less than 5% of cases of idiopathic scoliosis need operation, and these consist almost entirely of the thoracic group, where the prognosis is bad and severe deformity may develop if untreated. When the deformity is established, the depression of the shoulder and prominence of the hip can be corrected, but the projecting rib hump remains. In a mature child a curve of 65-80° is ugly enough to warrant correction on clinical appearance alone. In a young patient, before deformity is serious, correction is relatively easy and more complete, but it is advisable to delay operation until the age of approximately 10 years to avoid interference with spinal growth or the production of a kyphosis, although in severe rapidly-progressing curves earlier operation may be necessary. Thus in a curve of 55-60° in a child of 10 years, correction and fusion would be indicated because of the bad prognosis.

2. *In Paralytic curves* 50% need operation. These curves are unstable and the treatment of the stability of the spine is more important than the correction of the deformity.

(a) *In a flail collapsing spine* scoliosis may develop late owing to gravity and may also be indicated in order to

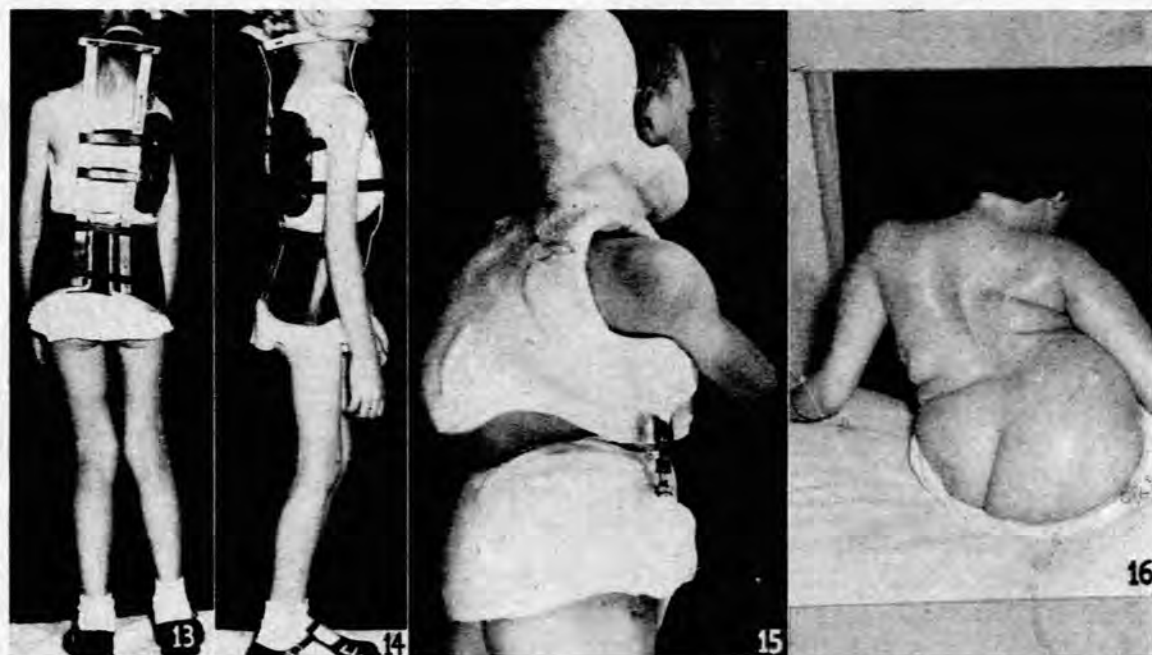


Fig. 13. A Milwaukee brace: posterior view. Fig. 14. A Milwaukee brace: side view. Fig. 15. A distraction jacket designed by Stagnara. Fig. 16. A severe collapsing paralytic curve, necessitating fusion from T2 down to sacrum.

give a rigid link between the trunk and leg. In the latter type, before fusion to the sacrum is performed it is important to establish that the patient has active hip flexors present. If these are absent and the patient has to rely on the lateral abdominals to elevate the pelvis in order to swing the leg clear of the ground in walking, fusion of the spine to the sacrum will stop all walking. However, in a severe case with flail legs and spine, fusion to the sacrum may be indicated to make the patient a good sitter, and allow working at a desk without a back support (viz. Fig. 16).

(b) *Unstable paralytic curves* need correction and fusion firstly if the curve is rapidly progressing in a young case and the prognosis is bad because of severe muscle imbalance (the fusion should be left until the child is as old as possible but it may have to be done at an early age if there is rapid deterioration); and secondly if symptoms are produced such as pain from back fatigue or ribs pressing in the pelvis or if there is displacement of abdominal viscera or kinking of the ureter. Unstable curves become stabilized after cessation of growth of the spine, i.e. after the appearance of Risser's sign, and in some cases this may occur even earlier. In stable curves, further deterioration does not occur, or if it does, is only slight, and operation is for cosmetic reasons.

(c) In *high thoracic paralytic curve* correction is difficult, and fusion should be carried out early, before deformity arises.

(d) *The lumbar and thoraco-lumbar paralytic curves*, unlike the idiopathic, may become very severe and cause great deformity, but they are easy to correct, although difficult to fuse successfully.

(e) *Pelvic obliquity*. Soft-tissue stripping of the contracted lateral abdominal muscles on the concave side, from the crest of the ilium, may be necessary in severe paralytic curves, before correction can be obtained in a plaster jacket. The weaker muscles on the convex side may be reinforced by strips of fascia lata from the iliac crest to the 9th or 10th rib by Meyer's method,¹² or by the more

recent method of Clark,¹³ in which the tensor fasciae latae and the ilio-tibial band is turned upward and attached to the 9th rib to give a dynamic reinforcement.

3. Nearly all cases of *neurofibromatosis* need operation because of their rapidly developing thoracic curves.

4. *Congenital Scoliosis*. Usually conservative treatment is adequate, but occasionally correction and fusion is indicated. Alternatively, stapling of the thoracic spine or excision of a hemi-vertebrae in the lumbar region has been attempted, but these methods are not generally advised.

5. *Kypho-scoliosis*. In kypho-scoliosis early correction and fusion is indicated, because of the very bad prognosis, and here there is no fear of producing a lordosis by early fusion.

METHOD OF CORRECTION AND FUSION

This consists of fusion of the whole of the primary curve or curves. Before correction and fusion can be attempted the *Mobility of the curves* must be determined in order to ascertain the degree to which it is possible to correct the primary curve, since it is essential to maintain the head over the pelvis so as to keep the patient well balanced. This is determined from the bending film taken originally, and determines the amount of stiffness in the secondary or compensatory curves (Fig. 17).

If, for example the patient has a 90° primary curve and a 45° upper and a 45° lower secondary curve, the bending film may show that these two curves correct to only 15° and 10° respectively in bending, owing to stiffness. The primary curve can then only be corrected to 15°+10° i.e. 25° if the head is to be kept over the pelvis. If the spine is over-corrected, for example to the straight position, as has been done in the past, the result may be disastrous; the patient will look like the leaning tower of Pisa.

In a case of paralytic scoliosis, a tilt film with a 3-inch block under the buttock on the convex side of the lower secondary curve must also be done to be sure that the spine

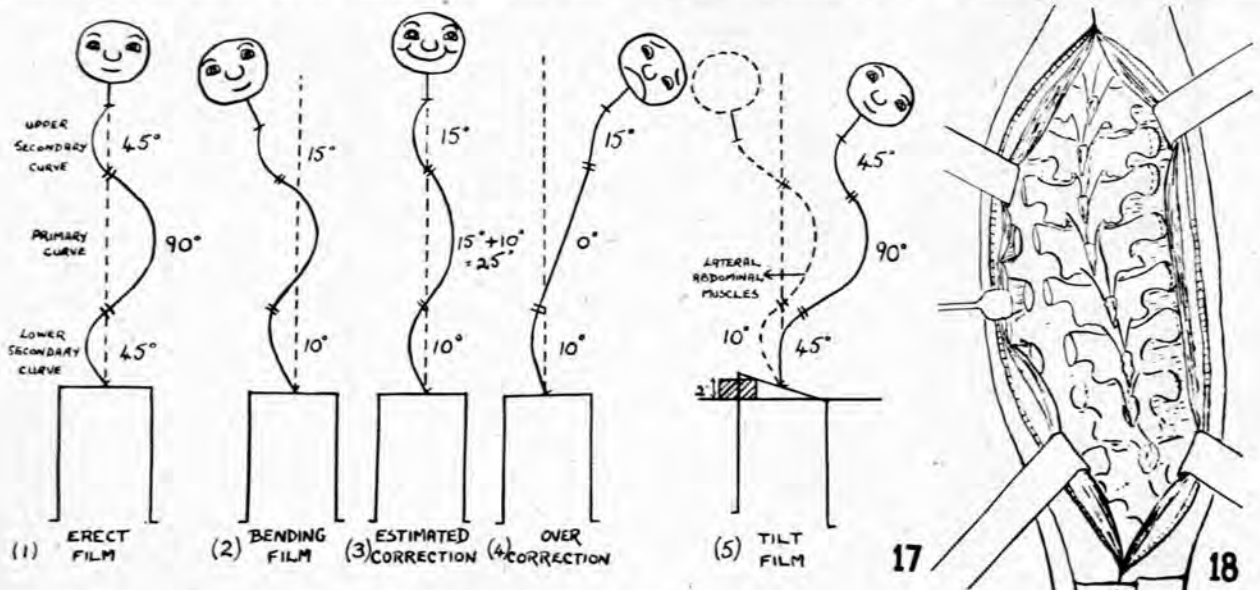


Fig. 17. Diagram illustrating the use of bending and tilt films in estimating the theoretical amount of correction possible. Fig. 18. Spinal fusion, showing wide decortication of the laminae, tipping off of the apophyses of the transverse processes, and removal of all soft tissue between the processes.

can be held to the full extent of its mobility, as shown in the bending film, by the weak lateral abdominal muscles (in this particular case held over to a position 10° short of the vertical). If this cannot be done, the fusion must include all the secondary curves down to the sacrum.

Technique of Correction

Correction of the primary curve is achieved by means of a *Risser turnbuckle jacket* (Fig. 19). Felt pads are applied over the bony prominences and over the apex of the curve to prevent undue pressure on the skin (Fig. 20). The jacket is applied standing, with head traction by means of a halter to straighten out the secondary curves, and also to give a good fit for the jacket. It is a full spinal jacket with shoulder straps; the leg on the side of the primary curve is included down to the knee (Fig. 21). Anterior and posterior hinges are placed on the side of the convexity, well lateral to and opposite the apex of the curve, and the turnbuckle screw is placed on the concave side. When the plaster is dry it

is useful in correcting the high paralytic thoracic curves, which the Risser jacket fails to correct. It is also used in the combined lumbar and thoracic curve with a double primary curve, and also for correcting kypho-scoliosis. However, there are more risks of pressure sores with this type of jacket than a Risser (Fig. 15).

The *localizer body cast* has been developed by Risser in recent years as an alternative to the turnbuckle jacket.¹⁴ This is a plaster cast applied on a special frame with head and pelvic traction, whilst localized pressure is exerted postero-laterally over the rib angulation, forcing the apex of the curve under the ends of the curve and thereby producing correction. It may be used for conservative treatment or for correction and spinal fusion, and its main advantage is early ambulation.

Technique of Fusion

The method of fusion advocated is that which has been developed by J. I. P. James at the Royal National Ortho-



Fig. 19. Application of a Risser jacket, showing patient standing with a thoracic curve marked on skin. Fig. 20. Risser jacket, showing application of felt pads over pressure points, and head traction. Fig. 21. Risser jacket: plaster of Paris being applied. Fig. 22. Risser jacket, showing correction of curve by a turnbuckle. Fig. 23. Risser jacket: correction has been completed, and a window cut over spine for operation.

is cut transversally at the apex of the curve. Correction by elongating the turnbuckle is rapid at first but will later become slower. No discomfort should be produced at any time (Fig. 22). A paralytic curve may correct in a few weeks, but an idiopathic may take up to 10 weeks, and in old patients full correction of the primary curve to the estimated degree may not be possible. When the end-point of correction has been obtained it will be found that the patient tends to slip out of the jacket, instead of being further corrected. Complications are rare with careful nursing, apart from minor pressure sores.

When correction is finished the gap in the plaster is filled in, hinges and turnbuckle are removed, and a window is cut over the spine for operation (Fig. 23). A metal marker is placed over one spinous process and an X-ray is taken to determine the vertebral level.

The *distraction jacket* designed by Stagnara, of Lyons,

paedic Hospital, London. The mechanical force which, after fusion, tends to cause relapse of the curve is a lateral angulating one, and so the aim is to produce a broad, wide fusion area of the whole of the primary curve to combat this. This entails a complete lateral exposure of the spine as far as the apophyses of the transverse processes and meticulous removal of all intervening soft tissue. Profuse haemorrhage results, and it is essential to begin blood transfusion before the operation starts, or severe shock from blood loss may ensue.

If possible the operation is done in one stage, and in a young patient 8 or 9 vertebrae can be fused at one step, but occasionally 2 or even 3 stages are necessary. A large supply of refrigerated stored bone must be available. Boiled bone may be used as an alternative, but it is believed, though this is not yet known for certain, that consolidation of the graft may then take longer than when fresh bone is used.

The operation area is towelled off and the site of the original metal marker is preserved on the skin by means of methylene blue, to act as an indicator of the level of spinal processes. A straight skin incision is used from top to bottom of the curve, and the skin flaps are undermined with diathermy. Subperiosteal stripping of the spinous processes, laminae and transverse processes is performed, and the apophyses of the transverse processes are tipped off, to allow the spinal muscles to be retracted as far lateral as possible (Fig. 18). The spinous processes are then removed and the laminae and transverse processes are completely decorticated with a rougine. In older children a power-driven burr may be used instead, and this diminishes shock.

A deep, wide, raw bed is left and this is covered with a large mass of bone chips from the bone bank.

Finally silver clips are placed on the spinous processes above and below the fusion as a radiographic guide, and the wound is closed in layers.

The patient is kept recumbent for 6 months in the Risser jacket, and then is allowed up in a polythene jacket. Alternatively, a Milwaukee brace may be used, particularly if relapse is feared, as in high thoracic cases.

One year after operation bending films of the primary curve are taken to exclude a pseudo-arthrosis and, if satisfactory, all support is abandoned.

Two other operative techniques have been introduced recently but, although they may be indicated in certain cases, as yet they are not recommended in routine work:

Firstly, Allan,¹⁵ of Birmingham, uses a jack which is inserted between the transverse processes on the concave side; the jack is opened, correcting the curve; and finally spinal fusion is performed without post-operative plaster fixation.

Secondly, Roaf,¹⁶ of Oswestry, corrects the apex of the curve by removing a wedge of bone from the convexity of the curve, including laminae, pedicles, transverse processes and adjacent portions of two vertebral bodies and intervening disc.

Results of Fusion

The greater the curve, the greater is the force tending to cause relapse after operation. The average relapse following operation is about 25°. This is usually due to pseudo-

arthrosis of the graft, which occurs in about 10% of fusions or else to a too limited fusion of the primary curve.¹⁷ The preliminary results of fusion are encouraging, but final assessment of this method of treatment cannot yet be made in a large enough group of cases, until all these spines operated on have ceased to grow, but there is every indication that the present method of managing scoliosis will produce good results and prevent the development of the hideous deformities, which are still only too common.

To Summarize the Treatment of Scoliosis

1. Scoliosis should be dealt with in a special clinic where adequate facilities and time are available. The patients should be checked every 3-6 months until growth of the spine has ceased.

2. In idiopathic scoliosis 5% of the cases need early fusion and correction, mainly in the thoracic type at the age of 10, in which the prognosis is bad.

3. Of paralytic curves 50% need operation because of instability, production of symptoms or deformity, and early fusion is especially indicated in the thoracic type.

4. Nearly all cases of neurofibromatosis need early operation, but this is only rarely necessary in scoliosis of the congenital type.

I wish to express my thanks to Mr. J. I. P. James, of the Royal National Orthopaedic Hospital, London, for his help and encouragement and his permission to publish Fig. 15; and to Mr. G. T. du Toit, of Johannesburg, and Mr. R. C. J. Hill, of Durban, for allowing me the use of their clinical cases.

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