Scoliosis elasticity assessed by manual traction

49 juvenile and adolescent idiopathic cases

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We assessed preoperative curve elasticity in 49 consecutive patients with juvenile or adolescent idiopathic scoliosis who were operated on with Harrington distraction rods. Preoperatively, the curve was determined from posteroanterior radiographs taken in the standing position and in the supine position, with traction. In the latter, the radiographs were taken at the moment of maximal traction when one technician applied traction to the ankles and another to the wrists. The scoliotic curve in the 10 patients with juvenile scoliosis averaged 59° and 32° in the standing and supine positions with traction, respectively. Immediately postoperatively, the curve averaged 19°. 39 patients with adolescent scoliosis had a scoliotic curve which averaged 58° in the standing position and 32° in the supine position with traction. The mean postoperative measurement was 21°. These findings suggest that manual traction is a simple and reliable means of predicting the minimal correction of the scoliotic curve to be expected, using Harrington distraction rods.

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A preoperative estimate of spinal elasticity in children with juvenile or adolescent idiopathic scoliosis allows the surgeon to determine the degree of postoperative correction possible when distraction forces are applied. Furthermore, measures of elasticity indicate the extent of structural changes which are present in the primary scoliotic curve, as well as in the compensatory curves of the spine. This assists the surgeon in distinguishing the structural from the compensatory curves. It helps estimate the length of the fusion area necessary and determine whether the secondary curves also require fusion (Kleinman et al. 1982).

Various techniques for determining the degree of elasticity of scoliotic curves have been described (Letts et al. 1975, Miller and Green 1976, Bjerkreim et al. 1982, Edgar et al. 1982, Kleinman et al. 1982, Moe 1987). They include anteroposterior radiographs in the standing and supine positions, lateral bending radiographs, and radiographs in the supine or prone position under traction, using a number of methods and specially designed devices. Radiographs taken during manual traction, with or without the use of lateral push film has been thought to be an effective and simple means of assessing spinal elasticity in patients with idiopathic scoliosis (Kleinman et al. 1982).

We assessed the efficacy of manual traction for determining spinal elasticity and predicting the correctability of the scoliotic curve in patients with juvenile or adolescent scoliosis.

Patients and methods

During the period from 1982 to 1992, we treated 49 patients with idiopathic scoliosis, using Harrington distraction rods with or without compression and posterior spinal fusion. There were 10 children with juvenile scoliosis (6 girls and 4 boys) and 39 children with adolescent scoliosis (28 girls and 11 boys). Their mean age at surgery was 12 (10–17) years.

2 children had double structural curves which required instrumentation and fusion of both curves. 32 single curves were classified as thoracic, of which 5 were in juveniles and 27 in adolescents, 9 as thoracolumbar (2 juveniles and 7 adolescents) and 6 as lumbar (3 juveniles and 3 adolescents).

The preoperative radiographic examination, included standing posteroanterior and lateral radiographs, posteroanterior radiographs in the standing position with lateral bending to both sides, anteroposterior radiographs in the supine position with traction, and an anteroposterior radiograph of the pelvis for determination of the Risser sign (Zaoussis and James 1958, Moe 1987). With the exception of the radiographs taken during traction, posteroanterior radiographs were preferred so as to avoid undue amounts of radiation to the breasts. An additional radiograph was taken immediately postoperatively. The radiographs during traction were taken with the assistance of two technicians who applied maximal manual trac-

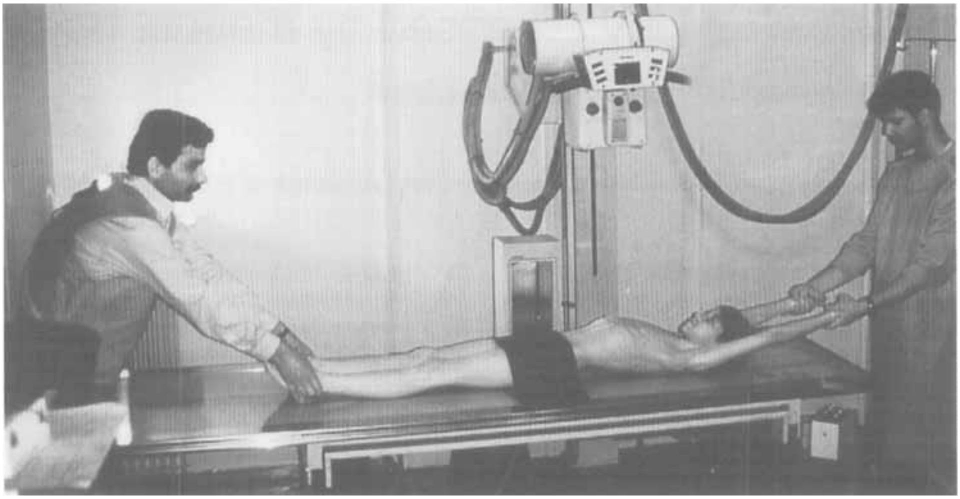

Figure 1. Anteroposterior radiograph of scoliotic spine was obtained by applying manual traction to the wrists and ankles.

tion to the ankles and wrists while the patient was lying supine (Figure 1). The traction was well accepted by most children; traction which caused pain was avoided.

The scoliotic curves were measured from radiographs, using the Cobb (1948) method. An average of 7 vertebrae was included in the thoracic curves (apical T8), 9 in the thoracolumbar curves (apical T12) and 5 in the lumbar curves (apical L2). The Harrington factor which estimates curve progression (Lonstein and Carlson 1984) was determined by dividing the magnitude of the scoliotic curve by the number of vertebrae included in the curve; it averaged 8.6 for the thoracic curves, 6.1 for the thoracolumbar curves and 10.1 for the lumbar curves.

The operation included soft tissue debridement of both the concave and convex sides of the curve, facet fusion, decortication, bone grafting and spinal fixation using Harrington distraction instrumentation, with or without compression rods (Moe 1987). A wake-up test was always performed to assess the patient's neurological condition after the placement of the distraction rod.

Results

The average preoperative scoliotic curve in the standing position in all 49 patients was 58°. The average curve measured during manual traction was 32° and the immediate postoperative scoliotic curve averaged 20°. Scoliotic curves appeared to be more easily corrected in girls (67%) than in boys (53%). The amount of correction achieved with manual traction and surgery varied according to the curve pattern (Table 1). The average postoperative correction, compared to the standing measure, was 61% for thoracic curves, 65% for thoracolumbar curves and 58% for lumbar curves. Double structural curves achieved a correction of 69%.

The 10 patients with juvenile scoliosis had an average preoperative measurement for all curves in the

Table 1. Cobb angle (degrees) according to curvature pattern and correction (percent) achieved immediately postoperatively in all patients. Mean (range)

Curve pattern [a]	Number of patients	Preoperative Cobb angle		Postoperative Cobb angle	
		Standing	Supine with traction	Standing	Correction
T	32	59 (38–150)	35 (19–101)	23 (10–90)	61 (40–74)
T-L	9	56 (39–100)	31 (13–76)	20 (8–36)	65 (64–80)
L	6	43 (40–70)	26 (14–60)	18 (11–38)	58 (46–73)
DS	2	90 (83–120)	40 (35–46)	28 (22–34)	73 (72–74)

[a] T thoracic, T-L thoracolumbar, L lumbar, DS double structural.

Table 2. Mean Cobb angle (degrees) according to curvature pattern and mean correction (percent) achieved immediately postoperatively in juvenile patients

Curve pattern [a]	Number of patients	Preoperative		Postoperative	
		Standing	Supine with traction	Standing	Correction
T	5	59	29	15	74
T-L	2	55	30	27	51
L	3	47	23	16	66

[a] T thoracic, T-L thoracolumbar, L lumbar.

Table 3. Mean Cobb angle (degrees) according to curvature pattern and mean correction (percent) achieved immediately postoperatively in adolescent patients

Curve pattern [a]	Number of patients [b]	Preoperative		Postoperative	
		Standing	Supine with traction	Standing	Correction
T	27	56	32	21	62
T-L	7	55	23	17	69
L	3	67	38	24	64

[a] T thoracic, T-L thoracolumbar, L lumbar.
[b] The 2 patients with double structural curves are not included.

standing position of 59° (40°–100°). This was corrected in the supine position with manual traction to 32° (14°–76°) and the average postoperative curve was 19° (6.0°–38°). The amount of correction achieved following surgery varied according to the curve pattern (Table 2). Overall, the average postoperative correction of the juvenile scoliosis was 67%, compared to the 46% estimated by manual traction preoperatively.

In the 39 patients with adolescent scoliosis, the average preoperative curve in the standing position was 58° (39°–82°). Manual traction corrected the curve to an average of 32° (14°–55°), while the postoperative curve was 21° (8.0°–43°). As observed in the juvenile patients, those with adolescent scoliosis also demonstrated an amount of correction postoperatively which varied according to the curve pattern (Table 3). The average postoperative correction, compared to the scoliotic curve measured in the standing position, was 64%.

The results in both groups of patients indicate that manual traction reliably estimates the minimum correction achievable with the Harrington system. The findings suggest that an average of 12° further correction (approximately 20%) of the measures obtained with preoperative traction can be safely achieved following surgery with the Harrington distraction system.

Discussion

Several methods for estimating spinal elasticity have been used, including traction in combination with the use of a traction force indicator (Miller and Green 1976), the application of pressure to the convex side of the scoliotic curve (Kleinman et al. 1982), and lateral bending (Lonstein and Carlson 1984). Manual traction, such as we performed, is simple and requires no elaborate devices.

Our findings indicate that the estimate of spinal elasticity obtained with manual traction provides a reliable measure of the minimum amount of correction of the spinal curve which can be expected using the Harrington system and according to the curve pattern of the scoliotic spine. An additional correction of about 12° (about 20%) can be safely obtained immediately postoperatively, compared to estimates obtained preoperatively with traction. It should be noted, however, that it is important that the wake-up test and intraoperative monitoring of spinal cord function using somatosensory evoked potentials be performed in order to ensure safe correction of the spinal deformity (Vanzelle et al. 1973).

Although Cotrel's (1975) dynamic traction is ineffective both for preoperative correction of scoliosis and enhancing surgical correction (Nachemson and Nordwall 1976), the method provides a usable estimate of the correction achievable at surgery (Bjerkreim et al. 1982), compatible with the findings in our study. However, dynamic traction is a cumbersome and uncomfortable procedure for the patient. The use of posteroanterior radiographs of the spine, obtained while manual pressure is applied to the apex of the curve by the examining physician (prone-push technique), provides a reliable estimate for predicting the correctability of the scoliotic curve (Kleinman et al. 1982). Unlike that study, however, we found that the results varied according to the location of the curve and the sex of the patient. Moreover, Miller and Green (1976) noted that radiographs taken during traction and lateral pressure on a Risser table (single traction-pressure radiographs) were better for estimating correctability than lateral bending was.

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