COMBINED IDIOPATHIC KYPHOSIS AND SCOLIOSIS

AN ANALYSIS OF THE LATERAL SPINAL CURVATURES ASSOCIATED WITH SCHEUERMANN'S DISEASE

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A radiological study of 50 patients with thoracic Scheuermann's disease revealed two types of lateral spinal curvature. A total of 43 lateral curves was present in 35 of the patients. Thirteen were apical at the same level as the Scheuermann's kyphosis and were due to vertebral-body wedging in the coronal plane; these curves had a mean Cobb angle of 15° , occurred with equal prevalence in boys and girls and were directed equally to right and left. Thirty curves occurred in regions of compensatory lordosis (mean 5.6°) situated above or, more commonly, below the Scheuermann's kyphosis. These scolioses had a mean Cobb angle of 16° , were more often convex to the right than to the left and were significantly more prevalent in girls than in boys.

The presence of these kyphoses and scolioses in the same spine, separated by only a few vertebrae, emphasises the importance of the sagittal plane in idiopathic spinal deformities and strongly suggests that idiopathic scoliosis and Scheuermann's disease share a common pathological process.

In both idiopathic kyphosis (Scheuermann's disease) and idiopathic scoliosis there is an abnormality of vertebral shape in the median sagittal plane. In Scheuermann's disease the apical vertebral bodies are wedged, with posterior height greater than anterior height, producing the kyphotic deformity (Scheuermann 1920). This is a rotationally stable configuration, since the axis of rotation of a kyphosis is situated anteriorly and the deformity therefore exists largely in one plane only. In idiopathic scoliosis, however, the vertebral bodies are wedged in the opposite direction, with anterior height greater than posterior height, so that there is a lordosis at the apex of the curve (Dickson *et al.* 1984; Deacon, Flood and Dickson 1984). This is a rotationally unstable situation and the lordosis readily rotates to one side, producing a scoliosis as a secondary deformity in the coronal plane.

Scheuermann's disease and idiopathic scoliosis both occur in otherwise normal growing children. They have similar prevalence rates and both exhibit a familial tendency (Sorenson 1964; Wynne-Davies 1968; Dickson 1983). It has been reported that a mild scoliosis is not

uncommon in patients with Scheuermann's disease (Sorenson 1964; Bradford, Moe and Winter 1975) although the characteristics of these scolioses have not been accurately determined. Since these two idiopathic deformities have similar epidemiological features and share the common denominator of sagittal plane asymmetry, we decided to study the lateral spinal curvatures associated with Scheuermann's disease.

PATIENTS AND METHODS

Fifty patients with thoracic Scheuermann's disease who were attending the scoliosis clinics at Leeds and Hull were studied. All the patients satisfied both clinical and radiological criteria for the diagnosis of Scheuermann's disease—that is, there was a fixed increase in the normal thoracic kyphosis, with vertebral-body wedging of 5° or more over three consecutive levels on lateral radiographs (Sørensen 1964). None of the patients had any significant leg-length inequality. There were 22 boys and 28 girls and their ages ranged from 10.4 to 19.1 years, with a mean of 14.9 years (girls 14.3 years, boys 15.4 years). Anteroposterior and lateral radiographs of the thoracic and lumbar spines were obtained in the erect position in all cases. The spinal curves in both coronal and sagittal planes were measured and recorded using Whittle's adaptation of Cobb's method (Whittle and Evans 1979). In addition, for each curve the apical and end-vertebrae were recorded. The presence and direction of rotation also were noted. Statistical significance was determined using the chi-squared and Fisher's exact probability tests.

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RESULTS

Details of the Scheuermann's deformity in the 50 patients are shown in Table I. The size of the kyphosis was similar for both boys and girls, with a similar number of vertebrae being wedged to the same extent. Lateral spinal curves were present in 35 (70%) of the patients. There was no significant correlation between the presence or size of a lateral curve and the overall size of the Scheuermann's kyphosis or the severity of vertebral wedging in the sagittal plane ($P < 0.05$). There were 43 lateral curves in all and these were of two types.

Thirteen of the lateral curves had their apex at the same level as that of the Scheuermann's kyphosis; their characteristics are detailed in Table II. They occurred with equal prevalence in both sexes and their convexities were directed almost equally to right and left. These lateral curves were due to asymmetry of the kyphosis with vertebral-body wedging in both coronal and sagittal planes. Few of these curves had any rotation and where rotation was present it was such that the spinous processes were directed towards the curve convexity, indicating that it was a kyphotic region of the spine which had rotated.

Thirty of the lateral curves were situated either above or below the apex of the kyphosis; their characteristics are detailed in Table III. They were significantly more common in girls than in boys ($P < 0.02$), though there was no significant difference between the sexes in either the size or the direction of the curve ($P > 0.05$). All these scolioses were associated with rotation; the spinous processes were directed towards the concavity of the curve, indicating that they were occurring in regions of lordosis which had rotated. This was confirmed when their lateral profiles were examined. Measurements in the sagittal plane of the apical three vertebrae in the scolioses revealed a mean lordosis of 5.6° .

Fifteen of the scolioses were apical in the thoracic spine and these showed the greatest right-sided predominance (11R, 4L); nine were thoracolumbar (5R, 4L) and six were apical in the lumbar region (3R, 3L). Twenty-three were below the Scheuermann's kyphosis and seven above. In eight cases there was an asymmetric kyphosis in association with a scoliosis, though 22 of the scolioses were adjacent to kyphotic deformities with no lateral deviation. Nineteen scolioses were greater than 10° in size (Table III) and these were commoner in girls and were significantly more often convex to the right than to the left ($P = 0.05$).

DISCUSSION

These measurements characterise the coronal plane curves associated with Scheuermann's disease and demonstrate that while a lateral curve in the form of an asymmetric kyphosis, due to vertebral-body wedging in both coronal and sagittal planes, is not unusual (Fig. 1), a true idiopathic scoliosis is more common (Figs 2 and 3). These idiopathic scolioses occur in regions of

Table I. Details of kyphoses (giving the mean and standard deviation or range)

	Number	Percentage	Kyphosis angle (degrees)	Number of vertebrae	Wedging of vertebrae (degrees)	Thoracic kyphosis (degrees)
Boys	22	44	33 ± 13	4 (3-7)	8.2	45 ± 12
Girls	28	56	35 ± 13	4 (3-8)	8.8	50 ± 13
Whole group	50	100	34 ± 13	4 (3-8)	8.5	48 ± 13

Table II. Details of the lateral curvatures associated with the kyphosis

	Number	Percentage	Cobb angle (degrees)		Curve convexity	
			Mean	Range	Left	Right
Boys	6	27	14.5	6-30	2	4
Girls	7	25	14.7	4-32	4	3
Whole group	13	26	14.6	4-32	6	7

Table III. Details of scolioses above or below the kyphosis

			Cobb angle (degrees)		Curve convexity	
	Number	Per- centage	Mean	Range	Right	Left
<i>All magnitudes</i>						
Boys	9	41	14.1	8-30	6	3
Girls	21	75	16.4	5-32	13	8
Whole group	30	60	15.7	5-32	19	11
<i>Scoliosis > 10° only</i>						
Boys	5	23	18.2	12-30	5	0
Girls	14	50	20.6	12-32	10	4
Whole group	19	38	19.9	12-32	15	4

rotationally unstable lordosis above or below the Scheuermann's kyphosis and are therefore true lordoscolioses. These lordoscolioses have the typical right-sided and female predominance characteristic of adolescent idiopathic scoliosis and, as might be expected, these features become more evident with increasing size of the curve. Measurements of the lateral profiles of their apices confirmed the presence of a lordosis, as is always the case in idiopathic scoliosis.

Although these measurements were made on lateral radiographs of the patients and not true laterals of the rotated apices of the scolioses, and therefore undoubtedly underestimate the true size of the apical lordosis, the error introduced is only slight, since the curves were mostly of small magnitude with only small amounts of rotation. Indeed, the scolioses associated with Scheuermann's disease seldom progress to such a size

Fig. 1

Fig. 2

Fig. 3

Figure 1—Anteroposterior radiograph showing a mild lateral curvature; this is at the level of a Scheuermann's kyphosis and is due to vertebral wedging in the coronal plane. Note the absence of rotation. Figure 2—Lateral radiograph showing Scheuermann's kyphosis in the mid-thoracic region with a compensatory lordosis below. Figure 3—Anteroposterior radiograph of the same patient showing scoliosis below the region of kyphosis. Note the rotation with the posterior elements directed towards the concavity.

that surgical correction is required, since the adjacent region of increased kyphosis maintains the axis of spinal rotation relatively anteriorly and thus protects against rotation. In addition, and of more importance, the mean age of onset of Scheuermann's disease is late in the adolescent period and this limits the potential for the scolioses to progress with growth. A further consequence of the rotational stability of kyphoses is that the Scheuermann's deformity remains in the sagittal plane and vertebral wedging proceeds inexorably with growth, so that a severe kyphosis can result. In contradistinction, the lordosis of idiopathic scoliosis is rotationally unstable and moves progressively further from the sagittal plane, giving relief of compression on the posterior regions of the growth plates and the amount of vertebral wedging is less marked (Fig. 4).

The characteristics of the Scheuermann's kyphosis and the degree of vertebral-body wedging in these patients are similar to those of previously reported series. Although a review of the literature (Sørensen 1964) would seem to suggest an equal sex incidence, our group contained a greater number of girls than boys as did the more recent series. This may indicate that girls complain of kyphosis more readily than boys—perhaps because in most cases Scheuermann's disease is merely a cosmetic deformity (Kling and Hensinger 1984).

Fig. 4

Lateral radiograph of patient with adolescent idiopathic scoliosis. Note the lordosis due to vertebral-body wedging posteriorly with end-plate changes similar to those seen in Scheuermann's disease.

Although both Scheuermann's disease and idiopathic scoliosis are due to asymmetry in the sagittal plane, the exact nature of the underlying pathological changes producing these deformities remains obscure. Widely regarded as being multifactorial in origin, it is clear that the lesion must lie in the vertebral growth plate. This study demonstrates that it is not unusual for closely adjacent vertebrae to exhibit wedging either anteriorly, posteriorly or laterally, thus producing deformities in both the sagittal and coronal planes. That these kyphoses and scolioses occur in the same spine with their apices separated by only a few vertebral levels confirms the importance of asymmetry of vertebral shape in the sagittal plane in the production of idiopathic spinal deformities and strongly suggests a common underlying pathological process. It is not necessary, however, to consider this process as truly pathological; it may merely be secondary to the biomechanical consequences of sagittal spinal shape at opposite extremes of a normal spectrum occurring in adolescence (Willner 1981).

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