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OPERATIVE TREATMENT OF SCOLIOSIS WITH THE HARRINGTON INSTRUMENTATION TECHNIQUE

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Preliminary results of treatment of scoliosis with the Harrington instrumentation technique in 80 patients are presented. The curve correction at operation averaged 43.4 per cent with the best results being achieved in idiopathic single curves (49.3 per cent). Most of the patients had been treated conservatively for a long time prior to operation, and the curves were rather stiff. The initial loss of correction was 3.2°, and the overall loss at 2 years postoperatively averaged 6.5° in 28 patients. Complications occurred in 22.5 per cent of the patients, most often at the upper hook site. Serious complications were rare. It is concluded that the Harrington instrumentation technique is an effective means of treatment of scoliosis.

Key words: scoliosis, operative treatment

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The first spinal fusion for scoliosis was done by Hibbs in 1914 (Hibbs 1924). At Sophies Minde Orthopaedic Hospital posterior spinal fusion including the transverse processes and the intervertebral articular facets has been a routine procedure since 1952. Postoperatively the practice has been to encourage early ambulation in a correcting plaster jacket applied 14 days after the operation (Alvik 1964).

With the Harrington technique (Harrington 1962) an internal correction and fixation is possible. This method has now been adopted in most scoliosis centres. It has been used in this hospital since 1972 in combination with the fusion technique used earlier. In addition a preoperative mobilization of the scoliotic spine with physiotherapy has been attempted. The purpose of the present paper is to present the preliminary results.

MATERIAL AND METHODS

The material comprises the first 80 patients operated with the Harrington technique, using the distraction instruments only. Indications for surgery in idiopathic scoliosis have been thoracic or thoraco-lumbar curves of 50° or more, and lumbar or thoraco-lumbar double-primary curves of 60° or more. In congenital and neuromuscular scoliosis a more individual evaluation has been made. Preoperative A-P roentgenograms were taken with the patients standing and used for postoperative comparisons. To judge the flexibility of the scoliosis another roentgenogram with traction in the standing position was taken. The curves were measured by Cobb's technique. Preoperatively the curves were mobilized by the physiotherapists by daily stretching and passive bending for a period of about 14 days. The patients were also given breathing exercises and were drilled in the postoperative treatment regime which was the same as described by Elfstrøm & Nachemson (1973).

The operation was performed in one session with the patient in the knee-elbow position (Alvik 1964). The upper hook was inserted into the intervertebral joint at the upper end of the

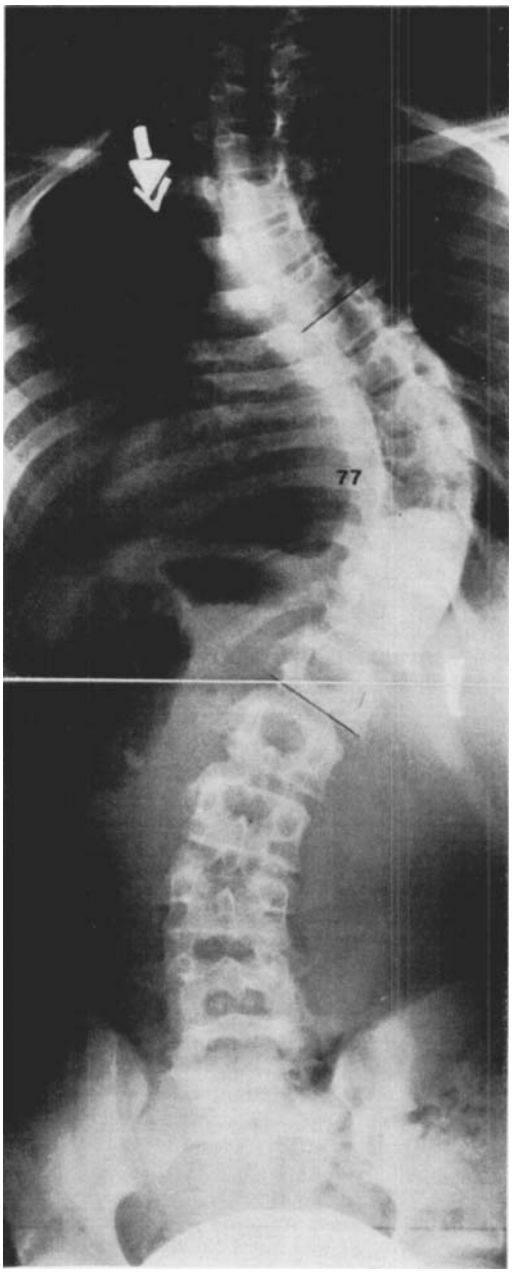

Figure 1 a. A girl, 14 years old, with an idiopathic scoliosis. The curve, right thoracic, is 77°.

curve and the distal hook was usually placed on the lamina of the second vertebra below the end of the curve, except in lower lumbar curves where the lamina of the first vertebra below was chosen. A posterior fusion including all posterior elements between the hooks was also performed. After inserting the rod the curve was corrected with the force-indicating distractor (Nachemson & Elfstrøm 1969) applying a force of about 40 kilopond. Only one rod was inserted in double as well as in single curves (Figure 1). A large amount of bone graft was used, usually both from the iliac crest and from the bone bank; in a few cases autogenous or homogenous

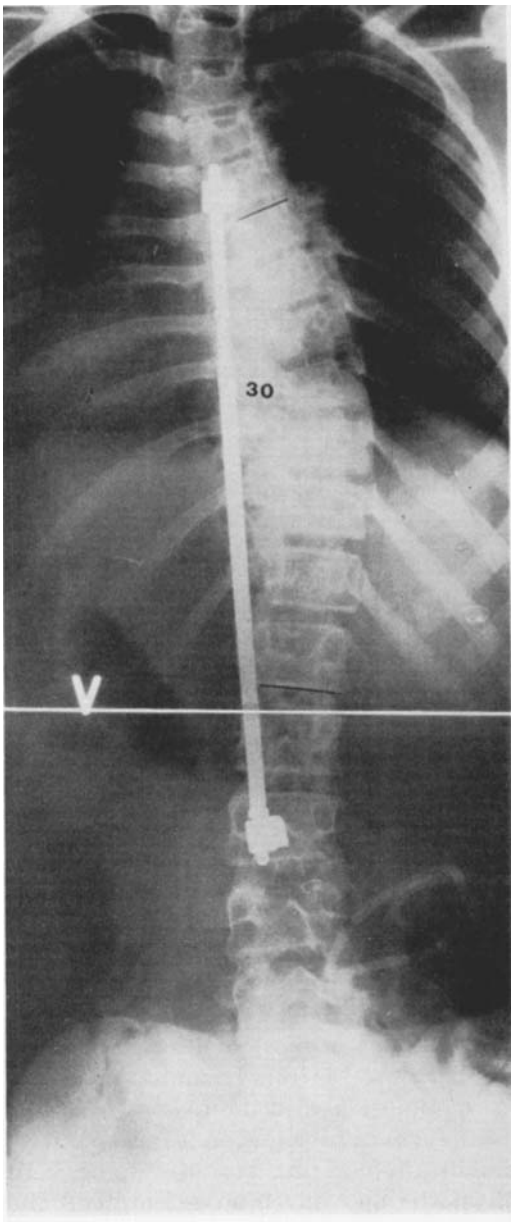

Figure 1 b. Supine roentgenogram made at the end of the operation shows correction to 30°.

bone only was used. The wound was closed tightly without drainage except on the donor side of the iliac crest. At the end of the operation a roentgenogram was taken with the patient in the supine position. The amount of correction of the scoliosis obtained by the operation was defined as the difference in degrees between this and the preoperative roentgenogram taken in the standing position.

Antibiotics were not used routinely but all patients were given sulphonamides from the third day postoperatively to prevent urinary infection from continuous bladder drainage during the first week.

Postoperatively the patients were nursed in the supine position without external support for 4 to 5 weeks, those with the lower hook site on the third lumbar vertebra or below for the longest period. Before ambulation the patients were supplied with a well-fitted Milwaukee brace, and before discharge a standing roentgenogram was taken. The Milwaukee brace was worn day and night for 11 months, followed by a weaning period of 6 months.

RESULTS

The aetiology of the scoliosis, the sex distribution of the patients and the type of curves are given in Tables 1 and 2. The percentage of females was highest in the idiopathic group which comprised 64 of the 80 patients. The majority of the patients (51) had thoracic single curves. Thirteen had thoraco-lumbar double curves. When calculating curve correction both curves were included. Thus a total of 93 primary curves were investigated.

Table 1. Aetiology of the scoliosis and the sex distribution in 80 patients treated with the Harrington technique.

Aetiology	Female	Male	Total
Idiopathic scoliosis			
Infantile	2	2	4
Juvenile	15	3	18
Adolescent	33	9	42
	50	14	64
Congenital	5	4	9
Miscellaneous *	4	3	7
Total	59	21	80

* Neuromuscular, neurofibromatosis and Marfan's syndrome.

Table 2. Curve type in 80 patients with scoliosis treated with the Harrington technique.

Thoracic	single curves	51
Thoraco-lumbar	single curves	15
Lumbar	single curves	1
Thoraco-lumbar	double curves	13
Total		80

The mean age of the patients at operation was 15 years 3 months (range 9–35 years). Only three were more than 20 years old. The mean age when the spinal disorder was discovered was 8 years 9 months, and the mean age when the patients were referred to our hospital was 11 years 2 months. All but ten patients had been treated conservatively prior to operation, 46 for more than 1 year (average 4 years 9 months).

The mean curvature was 71.6° (Table 3). The mean correction on the radiograms taken with traction was 9.7°. Physiotherapy increased this correction by an average of 3.8°. Although small, the difference is significant, $P < 0.01$. The curve correction by operation was 31.1°, 43.4 per cent; in the idiopathic group 46.8 and in the congenital group 29.1 per cent. Comparable height measurements before and after operation were available in 37 patients. The average increase in height was 3.8 cm (range 1.5–8).

The initial loss of correction, i.e., loss before discharge, was 3.2° (Table 4), and the overall loss when the weaning period of the Milwaukee brace started at 11 months after operation was 5.6°. The loss of correction 2 years after operation was 6.5° (28 patients) which gives a final correction of 34.5 per cent.

On the average, 11 vertebrae were fused (range 8–14). Mean operation time was 3 hours 20 min (range 2.20–4.20) and average blood replacement during

Table 3. Curve correction with the Harrington technique in 80 consecutive operations for scoliosis (Mean ± S.D.)

Aetiology	Patients no.	Curves no.	Preoperative curves: Standing degrees	Preoperative curves: Correction by traction standing degrees	Curve correction by operation: Degrees	Curve correction by operation: Per cent
Idiopathic:						
All curves	64	75	69.2 ± 14.9	9.8 ± 8.1	32.4 ± 8.8	46.8
Single curves	53	53	68.2 ± 15.4	11.1 ± 8.6	33.6 ± 8.5	49.3
Congenital:						
All curves	9	10	82.6 ± 19.8	10.6 ± 7.9	24.0 ± 11.1	29.1
Single curves	8	8	87.0 ± 19.1	13.3 ± 6.4	26.0 ± 11.5	29.9
Miscellaneous:						
All curves	7	8	81.9 ± 26.8	5.8 ± 5.0	27.8 ± 8.3	34.8
Single curves	6	6	79.5 ± 31.3	7.7 ± 6.0	33.8 ± 8.9	42.5
Total:						
All curves	80	93	71.6 ± 17.2	9.7 ± 8.0	31.1 ± 9.4	43.4
Single curves	67	67	71.4 ± 18.5	11.2 ± 8.2	32.4 ± 9.2	45.4

and after operation was 1156 ml (range 300–2700).

Complications occurred in 18 patients (22.5 per cent) (Table 5). In five, one having a double curve, hook displacement or laminar fracture occurred during the first postoperative weeks. The initial loss of correction in these patients varied from 14 to 23°. One patient was reoperated after 18 days. A laminar fracture was found at the upper hook site. Proximal displacement of the rod in the upper hook (half notch) occurred in three patients, two while ambulant in the Milwaukee brace. The correction loss in these cases varied between 7 and 17°. Neurological complications were encountered in two patients. A 13-year-old girl with a slight heredo-ataxia and a thoracic curve of 61°, reduced to 45°, had for the first 2 months after the operation faecal and urinary incontinence. Her complaints regarding the nervous disorder increased somewhat after the operation. The other patient was a 17-year-old boy with a left-sided idiopathic thoracic scoliosis of 115°. The scoliosis was reduced to 66°. Since the operation he has had hyperhidrosis and gooseflesh reaction in a segmental, 15 cm wide belt on the right side of the thorax corresponding to the fourth thoracic nerve segment.

Table 4. Loss of correction after surgery in scoliosis using the Harrington technique (Mean ± S.D.).

Aetiology	Initial loss degrees	Total loss at 11 months degrees	Total loss at 2 years: Degrees	Total loss at 2 years: No.	Residual correction at 2 years after surgery Per cent
Idiopathic	3.3 ± 4.7	5.5 ± 6.2	6.4 ± 6.1	23	37.6
Congenital	2.6 ± 3.2	4.4 ± 5.4	2.0	1	
Miscellaneous	3.0 ± 2.7	6.5 ± 5.0	7.5 ± 9.7	4	25.6
All cases	3.2 ± 4.4	5.6 ± 5.9	6.5 ± 6.3	28	34.5

Table 5. Complications in 80 patients operated with the Harrington technique.

Complication	No. of patients
Upper hook displacement or laminar fracture	5
Rod displacement in hook	3
Neurological	2
Urinary bladder infection	4
Ureter stone	1
Icterus (unknown aetiology)	1
Pneumonia	1
Wound infection (superficial)	1
Gastro-intestinal retention	1

DISCUSSION

The curve correction obtained by the Harrington rod technique in the present material was largest in the idiopathic group, being 49 per cent for single curves. The degree of correction obtained in congenital scoliosis was rather small, 29 per cent. The reason is obviously the presence of anatomical malformations preventing a satisfactory straightening of the curves. In idiopathic scoliosis a correction of about 50 per cent is usual (Nordwall 1973). Our results are in agreement with this.

Most of our patients had been treated conservatively for a long time, during which their curves had increased (average $29.1° \pm 22.1°$) and stiffened. Preoperative mobilization with physiotherapy had little effect on the flexibility of the curves. The loss of correction after operation was within reason (Table 4) and in agreement with other reports (Leider et al. 1973, Nordwall 1973).

The complication rate in the present series, 22.5 per cent, as well as in other series (Dickson & Harrington 1973, Leider et al. 1973, Nordwall 1973) is high. Two of our patients had neurological complications. MacEwen et al. (1975) reported an incidence of neurological complications, most often involving the spinal cord, of 0.7 per cent in a large series. Complications at the hook sites: laminar fractures, hook displacement and rod displacement in the hook, occurring in 10 per cent of our patients, led to an obvious loss of correction. Displacement of the hook seems to be relatively frequent even in the hands of experienced surgeons (Leider et al. 1973, Dickson & Harrington 1973). Two of our patients with this complication got out of bed at night shortly after surgery and a third caught pneumonia accompanied by severe coughing during the first postoperative week. The small degree of loss in correction occurring in most curves is probably due to erosion at the hook sites. A snugly-fitting Milwaukee brace or plaster cast is essential to relieve load on the rod and thus reduce erosion. Loss of correction may also be caused by continual growth of the spine before fusion is consolidated. Complications are more frequent in younger children. Letts & Bobechko (1974) stressed that Harrington instrumentation is contraindicated in children under 10 years. Only one of our patients belonged to this group.

Other complications including four urinary bladder infections responded promptly to adequate medical therapy. Antibiotics were not given prophylactically despite the fact that all operations lasted for more than 2 hours. However, there was only one case of superficial infection, and this was without influence on the further course of the treatment. Nor were wound haematomas any problem. So far we have not had any cases with pseudoarthrosis but only 28 patients have been observed for a period of 2 years or more.

The average final results of spinal fusion in our earlier series of idiopathic scoliosis, without internal correction, was a curve of the same magnitude as before surgery (E. Ronglan, personal communication). Similar results are obtained with conservative treatment (Nordwall 1973).

With the Harrington instrumentation technique the initial correction is very good and the late loss of correction tolerable. The total complication frequency is high, but serious complications are relatively rare considering the scope of the operation.

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