

## OPERATIVE TREATMENT OF SCOLIOSIS WITH HARRINGTON INSTRUMENTATION TECHNIQUE

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Thirty-five patients with scoliosis were treated with posterior fusion including the Harrington instrumentation technique. The operation was followed by a 1-year period of treatment in a Milwaukee brace. The patients had a thoracic or a thoracolumbar curve averaging 74°. The mean initial correction was 45 per cent, and the mean final correction 33 per cent, after 2½ years. There were no cases of pseudarthrosis and only one case of transient paresis. There were no deaths. It is concluded that these results are satisfactory and that the method is a safe one in experienced hands.

*Key words:* Harrington instrumentation technique; operative treatment of scoliosis; scoliosis

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Harrington's technique (Harrington 1962) using internal correction, posterior fusion with opening of the intervertebral joints, has been used at the Orthopaedic Hospital, Århus, since 1972. Postoperatively the patients are kept in a Milwaukee brace for 1 year.

The purpose of this paper is to report the results of the Harrington procedure and of a final follow-up examination which took place, on average, 2½ years postoperatively.

### PATIENTS AND METHODS

The material includes 35 patients with scoliosis, 32 females and 3 males. There were 30 cases of idiopathic scoliosis and five cases of congenital scoliosis. The majority of the idiopathic scolioses were of the adolescent type (Table 1). Seventeen patients had a thoracic curve, 11 a thoracolumbar curve, and 7 a double curve (Table 1). The curves were measured by Cobb's technique (Cobb 1960).

The basis of comparison between the scoliotic curves was the most recent preoperative, erect radiograph. This radiograph was compared with a recumbent radiograph taken just after the opera-

tion; later it was compared with an erect radiograph taken 1 year after the operation, when the Milwaukee brace was discarded, and finally to an erect radiograph taken at the final follow-up.

For about 2 weeks before the operation the patients are treated with traction. Recently Cotrel's traction has been used (James 1976). The operation is performed at one session, the patient prone and with flexed hips. Bone chips are taken from the posterior part of the iliac crest after having osteotomized, and so spared the iliac apophysis. The neural arches and the articular processes are decorticated and the intervertebral joints are opened. The upper hook is placed in the intervertebral joint and under the neural arch at the upper end of the curve. The lower hook is placed in the neural arch about one segment beneath the curve. The force indicating distractor constructed by Nachemson & Elfström (1969) is used in the distraction of the Harrington rod. Bone chips are placed on the decorticated neural

Table 1. Aetiology and level of scoliosis in 35 patients

Idiopathic – Adolescent	23	Thoracic	17
		Juvenile	6
		Infantile	1
Congenital	5	Double curves	7

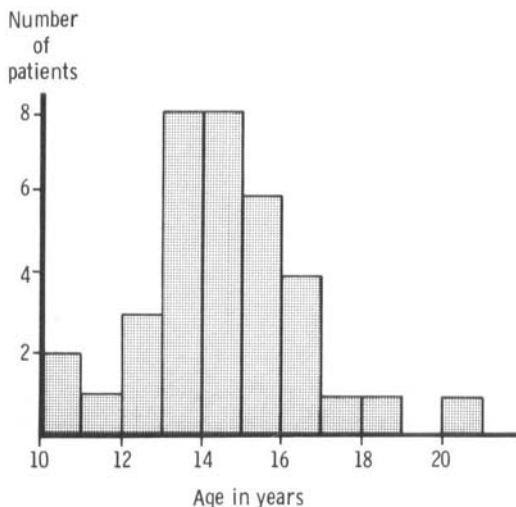


Figure 1. Histogram showing the age distribution of patients at the time of operation (35 patients).

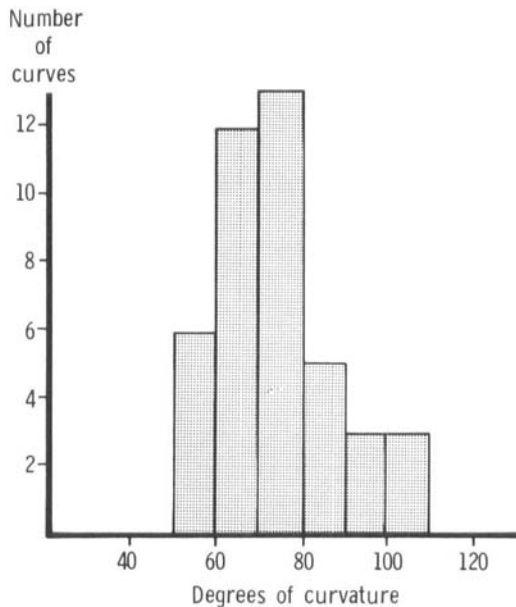


Figure 2. Histogram showing the distribution of curve angles before operation, measured by the method of Cobb.

arches. A final distraction of the Harrington rod is done while closing the wound. A locking wire below the upper hook has not been used.

After 6 weeks a Milwaukee brace is applied, and the patients ambulated. The brace is worn constantly for 1 year. For an additional 6 months a supporting abdominal corset is used. One and a half years after the operation the patients are allowed to move about freely and to participate in physical activities.

RESULTS

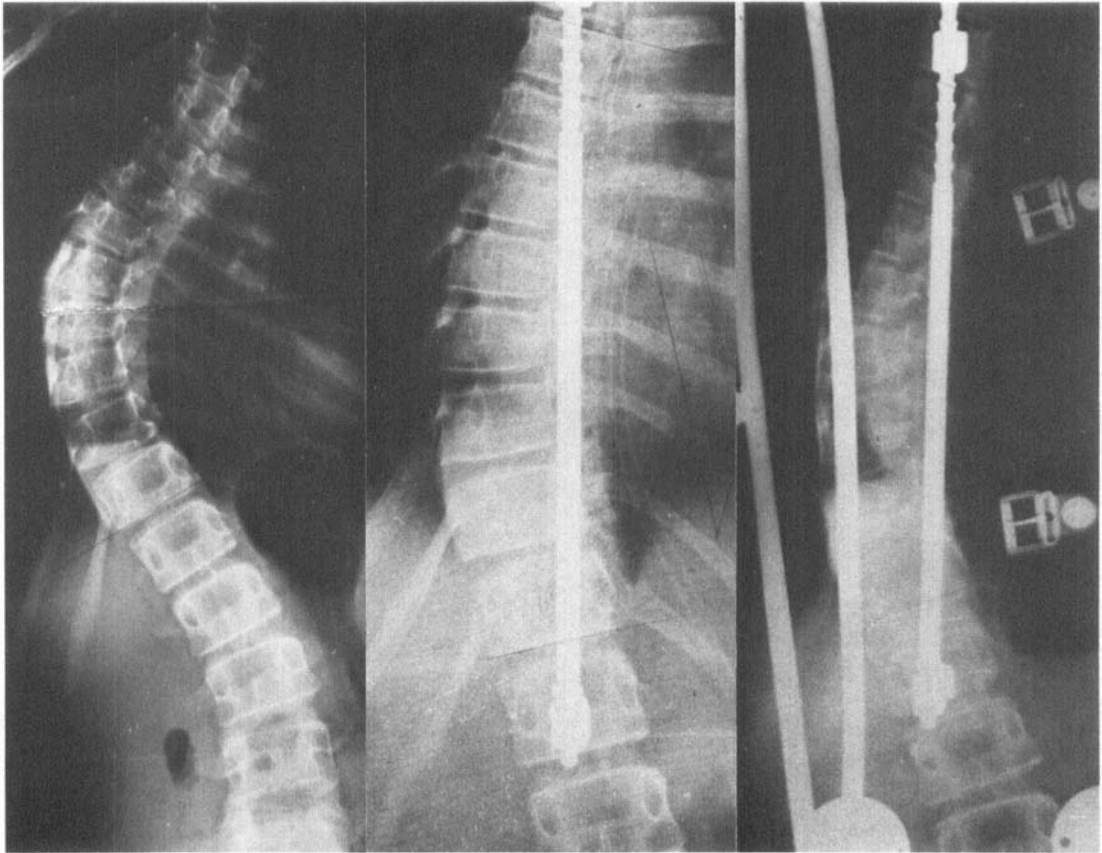
The patients' ages at the time of operation are shown in Figure 1. The mean age was 14 years. One patient was operated upon after cessation of growth - 21 years of age. The mean period of observation before the operation was 4 years. For patients with adolescent idiopathic scoliosis, the mean

period of observation before the operation was 2½ years. Some of the patients were observed initially at other orthopaedic clinics.

Preoperatively the Milwaukee brace had been used in 23 of the 35 patients. The preoperative curve varied between 51 and 106° the average being 74° (Figure 2). The mean correction afforded by the operation was 33°, corresponding to a correction of 45 per cent. This correction varied from 13 to 61 per cent. In the 1st year after the operation the average loss of correction was 8° varying from 0 to 22°. In six cases the hook slipped one notch down the Harrington rod. This in four cases

Table 2. Results in 42 curves

	Degree			Percentage of preoperative curve		
	min.	max.	average	min.	max.	average
Initial correction	10	51	33	13	61	45
Loss in Milwaukee brace during post-operative year	0	22	8			
Loss after removal of brace	0	9	0.7			
Total loss	0	22	8.7			
Final maintained correction	1	46	24	1	51	33



A: Before operation. B: On the day of the operation. C:  $4\frac{1}{2}$  months after the operation.

Figure 3. 13-year-old girl with an idiopathic scoliosis.

The initial curve measured  $66^\circ$ . The curve was corrected to  $29^\circ$ ,  $4\frac{1}{2}$  months later the curve had relapsed to  $40^\circ$ . Note the changing position of the lower hook on the neural arch.

contributed to a loss of correction from  $11$  to  $22^\circ$  during the 1st year. In other cases the lower hook changed its position on the neural arch, and this may have contributed to a loss of correction (Figure 3). After the 1st year the loss of correction was minimal, averaging  $0.7^\circ$ .

At the final follow-up, from  $1\frac{1}{2}$  to  $4\frac{1}{2}$  years after the operation, average  $2\frac{3}{4}$  years, a mean correction of  $25^\circ$  or 33 per cent had been obtained (Table 2).

Complications were few. One patient had a transient paresis of the right leg and another patient a transient sensory disturbance. Pseudarthrosis was not observed. In four cases the initial correction was minimal, because the scoliotic curve was very rigid.

This applied to three cases of idiopathic scoliosis and to one case of congenital scoliosis only. In one case, an idiopathic scoliosis, a correction of only  $13^\circ$  was obtained. During distraction the upper neural arch fractured so that the hook had to be placed one vertebra higher.

## DISCUSSION

An initial correction of 45 per cent corresponds with that obtained in materials such as Pigott's (1976) and Bjerkreim's (1976), while in other materials a larger initial correction was obtained (Nordwall (1973), 56 per cent; Goldstein (1969), 64 per cent; and Dickson & Harrington (1973), 64 per cent).

The reason for a larger initial correction may be a smaller initial curve, which means lesser rigidity and lesser rotation and makes a better correction possible (Goldstein 1969). Therefore it is recommended that the patients are sent to a qualified orthopaedic surgical department at an early stage.

A certain loss of correction after the operation will occur as a result of growth of the spine. The postoperative loss of correction reported varies (Goldstein (1969), 3.2 per cent; Leider et al. (1973), 5°; Nachemson (1976), 6°; Bjerkreim (1976) 6.5°; and Dickson & Harrington (1973), 8°). In this material the loss averaged 8.7°.

There were two essential reasons for loss of correction, dislodgement of the upper hook of the Harrington rod in six cases, and in some cases displacement of the lower hook on the neural arch (Figure 3). Both Pigott (1976) and Bjerkreim (1976) have reported a considerable loss of correction in cases where the locking wire is omitted. The locking wire is now used routinely.

In all the patients a cloudy structure of organized mature bone, corresponding to the bone chips, was seen at the 1-year check-up, and no cases of pseudarthrosis were detected on ordinary X-rays. There have not been signs of deep infection or of deep thrombosis.

A final improvement of 33 per cent of the initial curve corresponds with results obtained by others (Nordwall 1973, Pigott 1976 and Bjerkreim 1976) and this result is obtained with few actual complications. All patients had a visible, but acceptable rib hump after the operation. Only a modest derotation, measured according to Nash & Moe (1969), took place at the operation.

If one compares the results of today, using the Harrington instrumentation technique, with earlier operative treatment (Buus & Pilgaard 1977), a considerable improvement concerning maintenance of curve correction is seen.

After conclusion of this material the post-operative period of bed rest has been shortened to 2–3 weeks, and this has not

changed the results. Using Harrington's instrumentation technique, with posterior fusion and a Milwaukee brace for 1 year post-operatively, a good correction of severe scoliotic curves may be obtained, without major complications. It is, however, desirable for scoliosis patients to be operatively treated before the curve becomes too severe (about 50–60°).

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