Fusion of scoliosis by Harrington distraction rod

Interspinous process and sublaminar wiring compared in 42 cases

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Forty-two consecutive patients with scoliosis who between 1981 and 1988 underwent posterior Harrington distraction rod and interspinous process or sublaminar wiring were retrospectively reviewed. No difference was found between the techniques with respect to age, sex, curve pattern, curve magnitude, levels fused, operative time, blood loss, correction, and loss of correction at the 1-year and 2-year follow-up. The interspinous process wiring was superior to the sublaminar wiring as regards ease of technique, early ambulation, few complications, and a more effective means for maintaining the correction without postoperative immobilization.

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Although Cotrel-Dubousset instrumentation seems to have more advantages for correcting the rotational deformity in the treatment of idiopathic scoliosis, the complicated technique and the expensive instrumentation still frustrate some orthopedic surgeons. During the last decade, the technique of posterior spine fusion with Harrington distraction rod and sublaminar or interspinous process wiring has provided a simple and inexpensive procedure for the treatment of idiopathic scoliosis, and has been widely accepted. In general, the choice of the two methods depends upon the knowledge and experience of the surgeon.

We have compared sublaminar and interspinous process wiring combined with Harrington distraction rodding in 42 cases of idiopathic scoliosis to determine which technique is superior, for this question is not well answered in the literature (Thometz and Emans 1988).

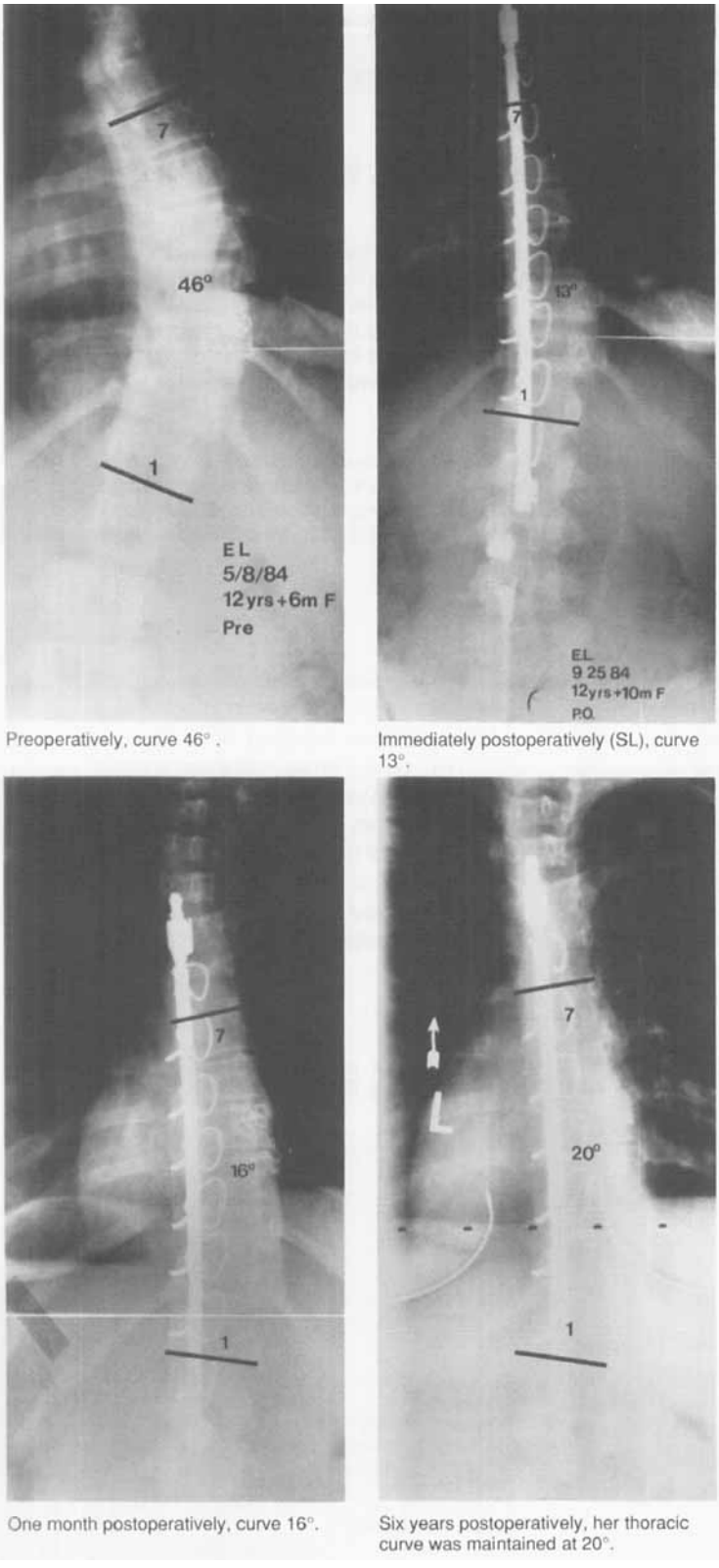
Patients and methods

Forty-two consecutive patients who had undergone posterior instrumentation and fusion for the treatment of idiopathic scoliosis between 1981 and 1989 were retrospectively reviewed (Table 1). All the operations had been performed at our center by or under the direct supervision of the senior author (F. William Schroeder). The fusion levels were determined by preoperative bending films. A standard midline incision with subperiosteal dissection followed by decortication, facet fusion, and posterior iliac crest bone grafting was performed in all the patients.

Instrumentation consisted of a single Harrington distraction rod in patients with a single major curve. In patients with double major curves, each curve was instrumented with a single Harrington distraction rod (Wilson et al. 1971). From 1981 to 1988, a variation of the sublaminar wiring (SL) technique as described by Luque (Luque and Cardosa 1976) was used to provide segmental fixation in 21 patients (Figure 1). From

Table 1. Clinical data for scoliosis patients treated by sublaminar wiring (SL) or intraspinous process wiring (IP). Mean (range)

	SL	IP
Number of cases	21	21
Adolescent/adult	14/7	17/4
Sex (M/F)	1/20	0/21
Age at surgery	18 (13–28)	16 (11–32)
Major curve pattern Single/double	16/5	17/4
Levels fused	10.9 (8–14)	10.5 (6–13)
Levels wired	6.7 (3–11)	8.6 (4–13)
Operative time (min)	234 (195–280)	214 (160–290)
Blood loss (L)	1.4 (0.6–3.5)	1.2 (0.3–2.3)
Postoperative care Braced/unbraced	16/5	3/18
Ambulation (days)	7.3 (4–12)	4.6 (2–7)
Length of hospital stay (days)	12 (8–27)	8.5 (6–11)
Duration of follow-up (months)	39 (21–108)	25 (19–60)



Preoperatively, curve 46°.

Immediately postoperatively (SL), curve 13°.

One month postoperatively, curve 16°.

Six years postoperatively, her thoracic curve was maintained at 20°.

Figure 1. A 12-year-old girl with a thoracic curve.

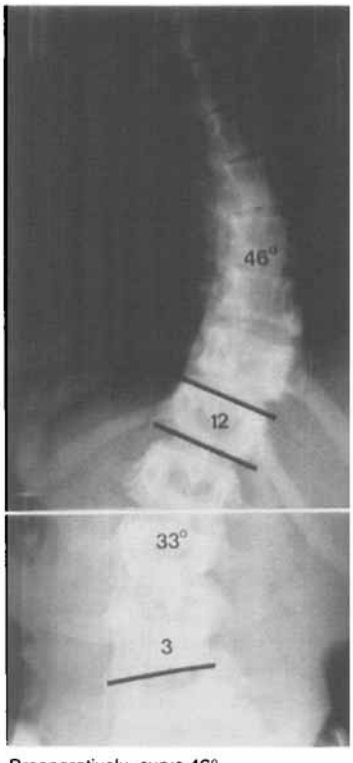
1984 to 1989, the interspinous process wiring technique (IP) as described by Drummond (Drummond et al. 1984, Guadagni et al. 1984) was used in 21 patients (Figure 2). Sixteen of the 21 SL patients and 3 of the IP patients were treated postoperatively in plastic thoraco-lumbo-sacral orthoses. The remaining patients were not braced during the postoperative period. All the patients were mobilized early post-operatively.

The hospital and clinic records were reviewed and data were collected as regards age, sex, curve pattern and magnitude, fusion levels, levels wired, operative time and blood loss, time to ambulation, length of hospital stay, complications, and any problems or complaints voiced during follow-up visits. The follow-up ranged from 16 months to 9 years, with the average being 39 months in the SL group and 25 months in the IP group. The preoperative and 1-month, 1-year, and 2-year (when available) postoperative radiographs were reviewed. The Cobb method (Cobb 1948) was used by 2 observers to record the levels and magnitude of the curves. The integrity of the implants and the quality of fusion were also assessed. The Student's *t*-test was used to compare the two groups. The calculation of postoperative correction and loss of correction followed the formula:

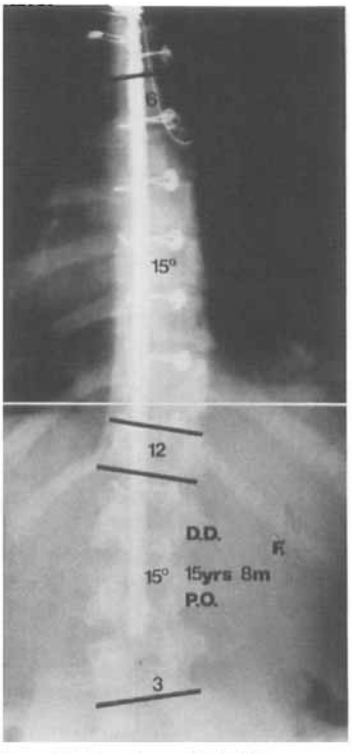
$$\text{Percentage correction} = \frac{\text{preop. curve} - \text{follow-up curve}}{\text{preop. curve}} \times 100$$

$$\text{Percentage loss of correction} = \frac{\text{initial postop. curve} - \text{follow-up curve}}{\text{initial postop. curve}} \times 100$$

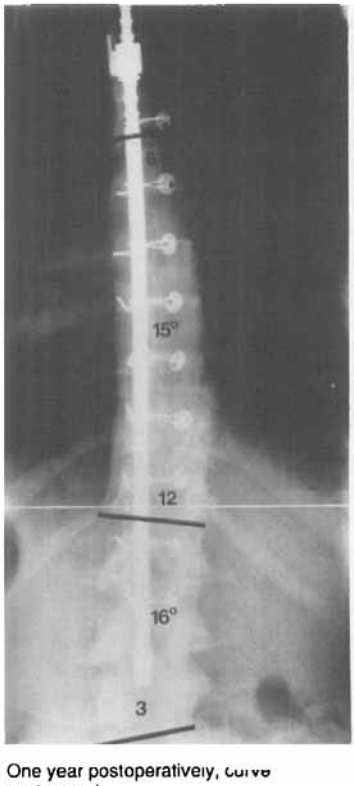
A comparison was also made between the 16 braced cases in the SL group and the 18 unbraced cases in the IP group to determine if postoperative bracing had an effect in loss of correction in the two groups.



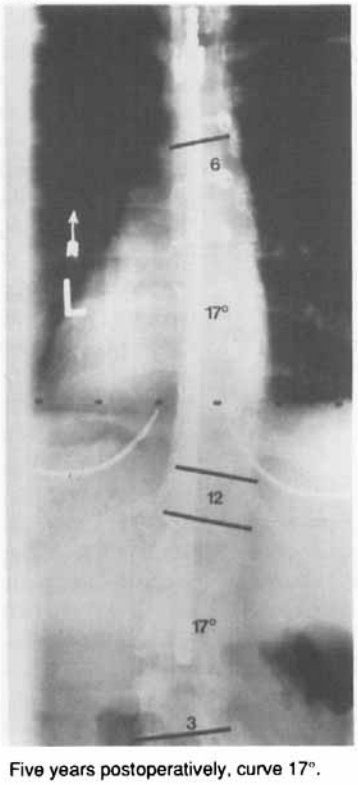
Preoperatively, curve 46°.



Immediately postoperatively (IP), curve 15°.



One year postoperatively, curve unchanged.



Five years postoperatively, curve 17°.

Figure 2. A 15-year-old girl with a thoracic curve.

Results

There were no differences between the two groups with respect to sex, age, curve pattern, levels fused, operative time, and intraoperative blood loss. The IP group, however, had a shorter mean time to ambulation, 4.6 days, and a mean hospitalization of 8.5 days, as compared with 7.3 days and 12 days, respectively, in the SL group.

Complications, while infrequent, were noted to occur more commonly in the SL group, with back pain occurring in 5 cases versus 1 in the IP group. All the patients responded to conservative management consisting of physical therapy and nonnarcotic analgesics. No case required narcotic analgesia for long-term pain control. One SL case developed loosening and displacement of the upper hook with pain necessitating removal of the hook and the upper rod. One case in the unbraced IP group suffered a clavicle fracture after falling from her bicycle 3 weeks postoperatively. Transient neurologic symptoms occurred in 2 patients, 1 in each group: viz., an axillary nerve palsy and neck numbness, both of which resolved over a period of about 1 month. Neither complication appeared to be related to the type of instrumentation employed.

The radiographic parameters in the two groups were quite similar (Tables 2 and 3), and this applied also to the comparison of braced and unbraced patients (Table 4).

In evaluating the loss of correction within the first year postoperatively and the second year postoperatively, there were differences in the braced SL group patients. However, in the IP group patients without postoperative bracing, there was a difference from immediately postoperatively to 1 year, but no difference from 1 year to 2 years postoperatively (Table 4).

Table 2. Radiographic data (degrees). Mean (range)

Curve	SL	IP
Preoperative	50 (36–65)	53 (46–67)
Postoperative		
One month	20 (9–38)	23 (15–37)
One year	22 (11–38)	24 (15–37)
Two years	25 (15–39)	25 (16–37)

Table 3. Postoperative correction and loss of correction (degrees, *percentages*). Mean (range)

	SL	IP
Postoperative correction		
One month	30 (16–40)	30 (16–47)
	63 (43–76)	*58 (35–71)*
Two years	27 (7–40)	28 (14–43)
	56 (19–66)	*52 (28–67)*
Postop. loss of correction		
One year	2.8 (–2–7)	0.83 (–2–5)
	5.6 (–3.5–16)	*2.3 (–5–13)*
Two years	3.5 (0–13)	2 (–1–13)
	7.5 (–3.5–24)	*2.4 (–1.6–26)*

Table 4. Postoperative correction and loss of correction with or without brace (degrees, *percentages*). Mean

	SL (braced)	IP (unbraced)
Number of cases	16	18
Preoperatively	50	49
Postoperative correction		
One month	29 *59*	26 *53*
One year	27 *54*	23 *47*
Two years	23 *47*	23 *47*
Postop. loss of correction		
One year	2.2	2.8
Two years	5.8 *20*	3.1 *12*

Discussion

The clinical value of segmental spinous instrumentation for the treatment of idiopathic scoliosis has been documented by many authors. Harrington distraction rods and segmental instrumentation exert a corrective force in two dimensions: straightening the deformity longitudinally and rotationally. Further, Wenger et al. (1982) reported that Harrington distraction rods and sublaminar wires can prevent the development of kyphosis with longitudinal loading. On the contrary, other authors like Silverman et al. (1984) used Harrington distraction rods and sublaminar wires to treat lordosis. Generally, this technique has been accepted by the orthopedic community. In 1984, Drummond and coworkers published a new approach to segmental fixation by means of interspinous process wiring. Their study showed that compared with previous methods of segmental spinal instrumentation the IP system was somewhat better with respect to blood loss, operative time, days to ambulation, days to discharge, percentage correction, and loss of correction. In 1985, Thompson and coworkers did another comparative study between Harrington rodding with sublaminar wires and Luque rodding with sublaminar wires and noted no significant differences in degrees and percentage of correction. In 1988, Thometz and Emans reported on 40 patients with SL & IP instrumentation. The two groups were approximately equal in correction, but the loss of correction at follow-up in the IP group was 3°, less than the 6° loss in the SL group. However, the follow-up duration in both groups was quite short, which may affect final outcomes.

The materials and methods in our series are similar to Thometz's group, but the results in our study were somewhat different. Our data showed that the patients in the IP group had earlier ambulation and shorter hospitalization as compared with the SL group. The operative time and blood loss in the IP patients seem to be superior to those in the SL group, although the differences between them were not significant. However, the postoperative correction and loss of correction at follow-up were about the same in the two groups. We feel that the better outcome of the IP procedure in this series resulted from improvement of the IP surgical technique, which is also technically easier to perform than the SL technique.

It was interesting to note that the majority of IP patients without postoperative immobilization only had a small loss of correction at 1 and 2 years, and that there was no difference between unbraced patients in the IP group and braced patients in the SL group. This implies that the SL technique is somewhat inferior to the IP technique in maintaining correction. This data supported Drummond's good results in IP patients treated without bracing, as well as his findings of a more rapid return to normal status. Although Mielke et al. (1989) emphasized immobilization as a critical factor in maintaining correction, our results showed no necessity for postoperative bracing in the patients treated with the IP technique.

Many authors have noted the high risk of acute neurologic injury in segmental spinal instrumentation. In Thompson's group, the overall incidence was 16 percent, and they felt that the major risk factor for neurologic injury is surgeon inexperience with sublaminar wire passage in the epidural space. In our series of 42 patients, there were only 2 cases of

transient neurologic symptoms, neither of which was related to wire passage. We agree that the chief problem of neurologic injury is caused by inexperience, which explains the variant incidences reported by different authors. Another complication in our series was back pain, which occurred in 6 cases. We consider that the sublaminar wires and traumatic cicatrices within the spinal canal may be the potential factors that led to back pain as a late complication.

In conclusion, we believe that for the treatment of idiopathic scoliosis the interspinous process wiring technique in combination with Harrington distraction rodding and fusion is superior to the sublaminar wiring technique. It appears to be a technically simpler and safer procedure that has proved effective in maintaining curve correction while allowing early unbraced mobilization.

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