Operative Treatment of Adolescent
Idiopathic Thoracic Scoliosis
Harrington–DTT Versus Cotrel–Dubousset Instrumentation

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Radiographic outcome and complications of Harrington–DTT (H) and Cotrel–Dubousset (CD) instrumentation of idiopathic adolescent thoracic scoliosis were compared retrospectively. The patient material consists of 55 consecutive patients in the H group and 52 consecutive patients in the CD group. The mean age at operation was $15 \pm 2$ years (range, 11–19 years) in both groups. The follow-up interval was $43 \pm 18$ months (range, 17–91 months) in the H group and $28 \pm 11$ months (range, ten to 53 months) in the CD group ($p = 0.0001$). The preoperative radiographic measurements (Cobb angle of primary and secondary curve, apical rotation, thoracic kyphosis, lumbar lordosis) were fully comparable in both groups. The mean correction of the primary curve at the follow-up evaluation was 47% in both groups. Apical rotation of the primary curve remained almost unchanged in both groups. Rotation of the secondary curve increased significantly in the CD group. Thoracic kyphosis was unchanged in the CD group but decreased in the H group. Spinal balance worsened in 29% of the H cases and in 44% of the CD cases. There were no neurologic complications in either of the groups. Intraoperative lamina fractures (four cases) and postoperative hook dislodgement (five cases) occurred only in the CD group. One distraction rod breakeage occurred in the H group. Three reoperations were performed in the H group, nine in the CD group.

Scoliosis treatment in Finland is centralized at the Orthopaedic Hospital of the Invalid Foundation in Helsinki, serving a population of nearly five million. The use of instrumentation, a single Harrington distraction rod, was introduced to the authors' institution in 1966. At the beginning of the 1980s, the standard instrumentation for idiopathic thoracic scoliosis was a Harrington–DTT (H) construct (Fig. 1). Cotrel–Dubousset (CD) instrumentation (Fig. 2) has been used routinely since 1986. The purpose of this retrospective study is to compare the radiologic outcome and the complications of the two instrumentation systems.

MATERIALS AND METHODS

The clinical records and radiographs of all patients younger than the age of 20 years operatively treated for idiopathic thoracic scoliosis (King types 2, 3, and 4) at the Orthopaedic Hospital of the Invalid Foundation in Helsinki during the years 1983 to 1985 (H) and 1987 to 1989 (CD) were reviewed. Patients with double curves, treated by the combined anterior/posterior approach, neuromuscular disorders, Marfan’s syndrome, and neurofibromatosis were excluded from the study. In the H group, there were 55 patients, 44 females and 11 males, with a mean age at operation of $15 \pm 2$ years (range, 11–19 years). The CD group consisted of 52 patients, 45 females and seven males, with a similar mean age of $15 \pm 2$ years (range, 11–19 years). The Harrington operations were performed by five surgeons. The instrumentation consisted of a standard Harrington dis-
traction rod at the concave side with a bifid upper hook secured by a C-washer and a blunt supralaminar lower hook. A Wisconsin compression system was placed on the convex side with one transverse hook above and one below the apex of the curve. It was connected to the H rod by means of a device for transverse traction (DTT). All CD patients were surgically treated by the two senior authors according to the guidelines given by its inventors. The basic right thoracic hook pattern with concave rod rotation was used in 47 patients, a modified hook pattern as described by Shulman and Clark was used in five cases. The fusion technique, including decortication of the laminae, facet joint cleaning, and use of autogenous bone strips from the posterior iliac wing was similar in both operation groups. No prophylactic antibiotic treatment was given. The H group was mobilized approximately one week postoperatively, wearing a Milwaukee brace for 12 weeks. The CD patients left their beds at the third postoperative day, using no external support.

The mean follow-up interval in the H group was 43 ± 18 months (range, 17–91 months) and in the CD-group, it was 28 ± 11 months (range, 16–41 months; p = 0.0001). Posteroanterior and lateral radiographs on long cassettes taken preoperatively and at the last follow-up examination were available from all patients. Corresponding radiographs were available for 53 patients, but in the H group only for 33 patients at
examination. The radiographic measurements were performed by an independent observer. From the posteroanterior view, the Cobb angles of the primary and secondary (lumbar) curve were measured. Apical rotation of both curves was estimated in 52 cases of the H group and in 29 cases of the CD group using the method of Pedriolle. In the remaining cases, the hardware of the instrumentation covered the apex vertebra, making rotation measurements impossible at follow-up evaluation. The number of instrumented vertebrae (NVV) and the lowest instrumented vertebra (LIV) were established. Spinal balance was measured as the perpendicular distance of T1 from the center sacral line (CSL). The spine was considered to be balanced if this distance was less than 5 mm to the left or to the right. Balance was considered to be improved or worsened if there was a change of more than 4 mm toward or from the CSL at the follow-up examination as compared with the preoperative film. From the lateral radiographs, thoracic kyphosis from T4 to T12 and lumbar lordosis from L1 to L5 were measured.

The following data were collected from the patients' records: duration of operation, intraoperative blood loss, and complications. For statistical work, the Student's t-test, the paired t-test, and the chi-square test were used.
shorter instrumentation area or is attributable to the different mechanical principle of correction remains unclear. Balance problems related to CD have been described before, and their mechanism is still controversial.\cite{5,6,7,10} It was surprising that no statistical difference between the two groups concerning operation time and intraoperative blood loss was found. Obviously the CD procedure is more complex, and the operation time should be correspondingly longer. The explanation for the results in this series seems to be that four of the five surgeons who performed the Harrington operations were not very experienced in spine surgery. The number of complications was higher in the CD group. Intraoperative lamina fractures and late infections were seen only in the CD group. It is noteworthy that in two of the three cases of late infection all bacteria cultures were sterile. Perhaps in these cases, symptoms arose from patients' reactions to the implant. Dislodgement of the bottom hook at the convex side of the CD construct was seen in five patients of the present series. During implantation of the rods, the authors followed the instructions of the inventors of the system not to bend the middle part of the convex side rod into kyphosis to create forward pressure to the apical derotation. This rod creation, however, causes a pull-out force into the posterior direction acting at the infilaminar bottom hook, leading in some cases to hook dislodgement. The authors solved this problem in the later cases by bending also the convex rod into slight kyphosis.

Based on limited experience with the small patient groups analyzed here, the main advantages of the CD instrumentation for treatment of adolescent idiopathic thoracic scoliosis if compared with Harrington-DTT seem to be that thoracic kyphosis can be preserved, spinal motion segments can be saved, and no external support is needed postoperatively. The capability of CD to derotate the apex of the primary curve could not be demonstrated. The CD instrumentation seems to conceal a certain danger of worsening spinal balance and transferring rotation to uninstrumented parts of the spine. Being a more complex system it has, of course, a longer learning curve and involves a higher risk of causing mechanical problems. Whether its advantages will ultimately make up for its shortcomings remains to be seen.

REFERENCES