Treatment of Adolescent Idiopathic Scoliosis using Cotrel - Dubousset Spinal Instrumentation

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Abstract

Eighteen patients with idiopathic scoliosis who underwent posterior spinal correction and fusion using Cotrel-Dubousset instrumentation between 1991 and 1996, were evaluated for curve correction and complications. Age at surgery averaged 14.7 years. Follow-up averaged 3.7 years. Thoracic curve correction averaged 65 per cent in those with King type III / IV curves and 51 per cent in those with King type II curves. At the recent follow-up, correction loss averaged 12 per cent and 8 per cent, respectively. Lumbar curve correction averaged 31 per cent after instrumentation in type II curves, with a loss of approximately 3 per cent correction at follow-up. Thoracic sagittal contour improved 14° for hypokyphotic patients. Apical vertebral rotation improved an average of 37 per cent after derotation maneuver of the left side rod. No neurologic complications or deep infection occurred. In conclusion, frontal and sagittal thoracic curve correction can be satisfactorily achieved using Cotrel-Dubousset instrumentation.

Key word : Idiopathic Scoliosis, Adult, Treatment, Cotrel - Dubousset

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With the introduction of Cotrel-Dubousset spinal instrumentation in 1982, three-dimensional correction of scoliotic deformities became promising[1,2]. Coronal plane pathology has long been recognized and deformity in this plane was the only dimension in which correction was possible before the advent of this system. The sagittal plane of the deformity is the most important plane to correct,[3-7] but no previous system could effect any significant change in this plane, and they were usually detrimental to it[4,5]. Axial or transverse plane abnormality has also long been recognized. The movement is in rotation and lateral deviation and an accompanying change in the sagittal plane. This posterior derotation system has been rapidly gaining popularity for the surgical correction of idiopathic scoliosis, which allows the surgeon to produce a normal sagittal contour and maximally corrected coronal plane.

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Many published reports[2,8-13] using Cotrel-Dubousset instrumentation have demonstrated the effectiveness of a multiple hook construction for scoliosis correction. We present our results using Cotrel-Dubousset instrumentation for the treatment of adolescent idiopathic scoliosis in Ramthibodi Hospital since 1991.

MATERIAL AND METHOD

During the period of 1991 to 1996, eighteen patients who had idiopathic scoliosis and underwent posterior spinal fusion using Cotrel-Dubousset instrumentation were reviewed. The average follow-up was 3.7 years, with a range of 1.5 to 6 years. Nine patients had right thoracic curves that were classified by the criteria of King et al as type III and one patient as King type IV. Five patients had King type II double curves, in which the thoracic curve was larger and less flexible than the lumbar curve. Three other patients were not included in the King classification ; two had a double major curve and one had a thoraco-lumbar curve.

Fifteen patients were female and three were male. The average age at time of surgery was 14.7 years, with a range of 10 to 26 years. Standing frontal and lateral plane radiographs were obtained pre-operatively at the first week after surgery and at the latest follow-up. Pre-operative side-bending films were examined to determine curve flexibility. Curve magnitude was measured by the Cobb method and the lengths of instrumentation were recorded. Sagittal contour was determined from the lateral radiograph and thoracic kyphosis (between T_5 and T_{12}) was measured from the pre-operative and post-operative radiographs. Vertebral rotation was assessed using the Perdriolle torsionometer, and apical vertebral rotation on the frontal plane radiographs was measured and compared with pre-operative and post-operative radiographs.

RESULTS

The majority of patients in this series had a single thoracic curve pattern (Types III and IV). Patients in this group achieved the greatest curve correction and improvement of trunk balance. Pre-operative thoracic curves averaged 50.8°. The post-operative curves averaged 17.6°, representing a 65.3 per cent curve correction. At the recent follow-up, curve correction loss averaged 6.9° or 12.1 per cent.

Five patients with double curves (type II) underwent selective thoracic fusion with the expectation that the flexible lumbar curve would spontaneously balance the instrumented thoracic curve. The lengths of instrumentation and fusion were fused to their stable vertebrae. Pre-operative thoracic curves averaged 59.2° and the post-operative curves averaged 28.6°, representing a 51.4 per cent correction. At the recent follow-up, curve correction loss averaged 8.2 per cent. Lumbar curve correction was also examined. The pre-operative lumbar curve averaged 36.2° and the post-operative curves averaged 22.2°, representing a 38.7 per cent correction. At the recent follow-up, curve correction loss averaged 2.8 per cent.

Two patients with double major curves, which had rather less flexibility of both thoracic and lumbar curves, underwent a long fusion including both curves in the length of instrumentation. The pre-operative thoracic curve averaged 68° and the lower curve averaged 61°. The post-operative thoracic curve averaged 30°, representing a 56 per cent correction, and the lower curve averaged 23°, representing a 67 per cent correction. At the recent follow-up no curve correction loss was detected.

One patient with a thoracolumbar curve had a pre-operative curve of 43° which was corrected to 30°, or 30 per cent correction. It progressed to 40° after one year post-operatively. Unfortunately the patient lost follow-up and no additive operation was done to improve the current deformity.

Sagittal plane correction was also achieved. The thoracic contour improved after surgery from an average of 18.1° pre-operatively to 25.8° post-operatively. However, the patients with pre-operative sagittal curves from T_5 to T_{12} of less than 15° (hypokyphotic deformity), had significant post-operative change. Improvement averaged 14°, from 4.3° pre-operatively to 18.3° post-operatively.

Changes in vertebral rotation were evaluated using the Perdriolle technique. The edges of the apical vertebral body and the pedicle shadow were marked and the Perdriolle torsionometer was used to measure the rotation. Improvements in rotation were noted. Pre-operative rotation averaged 20.5° and post-operative averaged 12.9°, with 37.1 per cent correction of rotation.

No neurologic complications or acute infections occurred. One patient had a lower hook dislodge which caused curve correction loss 3

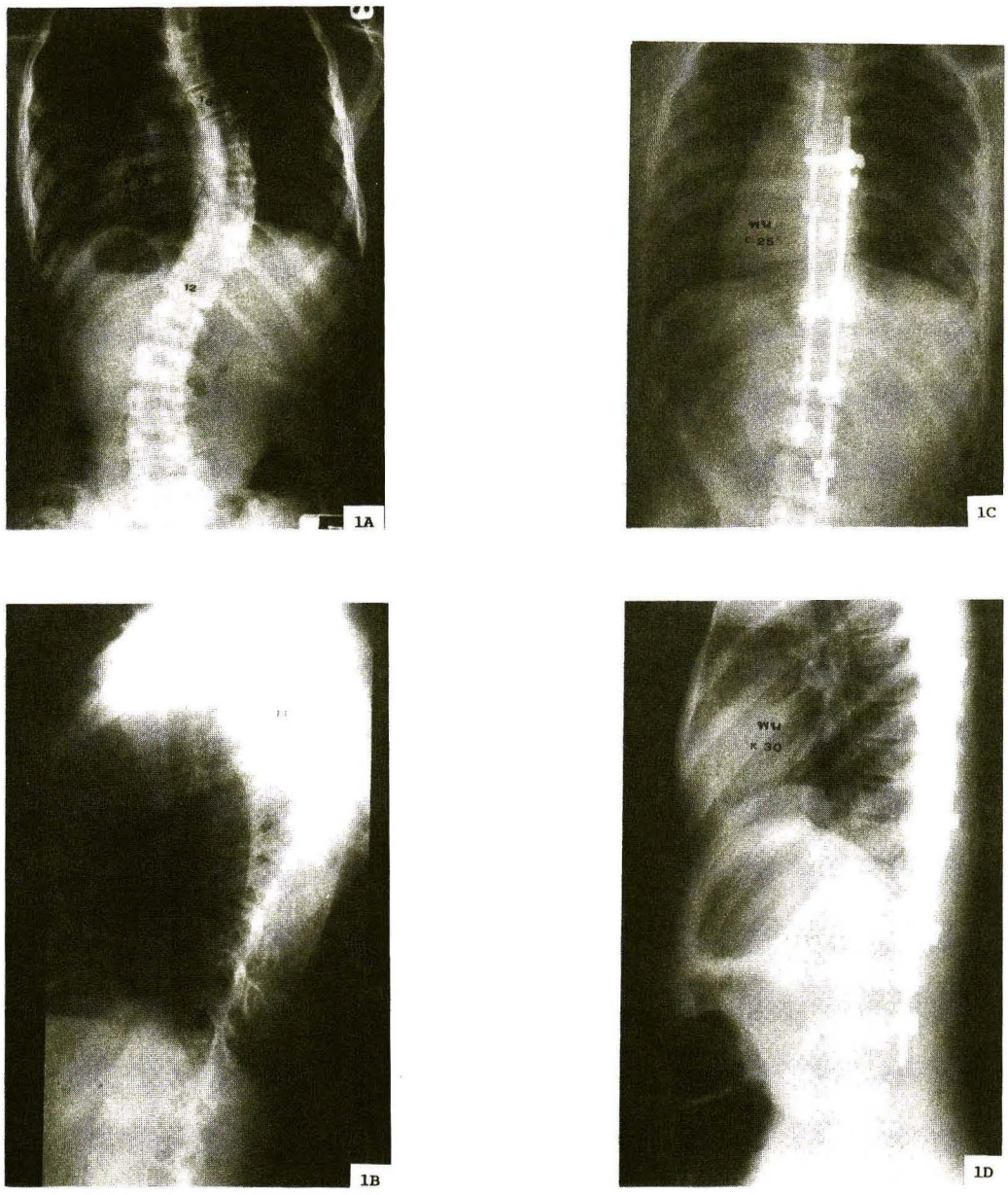

Fig. 1. A and B : A patient with right thoracic scoliosis (King type III) demonstrates typical thoracic lordosis. T_{12} is the end vertebra. The sagittal profile of the upper lumbar is normal. C and D : The implant pattern to the end vertebra results in excellent balance. The sagittal contour has been reconstructed.

months after surgery. Revision surgery was required and eventually a solid fusion was achieved. One pseudarthrosis occurred and resulted in loss of curve correction. This female patient had a craniopharyngioma and required long term replacement of steroids. The lower hooks in the lumbar spines were cut off due to osteoporosis and the pedicle screws had to be replaced to secure the fixation. Massive autogenous bone graft was substituted and a solid fusion was finally achieved.

DISCUSSION

The introduction of the Cotrel-Dubousset system in the correction of spinal deformities has revolutionized the efficacy of spinal correction and arthrodesis. It has provided a safe and versatile method for treating idiopathic scoliosis in three-dimensional correction without the need for post-operative bracing.

In our study of young patients with idiopathic scoliosis, curve correction that was achieved at surgery varied depending on the curve pattern encountered. Patients with single thoracic curves (types III and IV) consistently achieved greater curve correction than those with double curves (type II). Those with single thoracic curves improved 65 per cent after surgery compared to those with King type II curves in which 51 per cent improvement of the thoracic curve was achieved. With follow-up, the amount of correction loss in thoracic curves was approximately 12 per cent in single thoracic curve and 8 per cent in King type II curves. These findings are consistent with results reported by others[10-14].

We also agree with Bridwell about the need for distinguishing the King type II curve from a double major curve[15,16]. In double major curve patterns, the thoracic and lumbar curves are roughly equal in their structural nature, and both curves should be included in the fusion. The distinction between a type II and a double major curve should be based principally on the standing long cassette coronal film. The relative rotation of the apical vertebrae and relative apical deviation from the plumbline are the most important criteria. Two patients with double major curves in our study achieved satisfactory curve correction, averaging 56 per cent correction for the thoracic curve and 67 per cent for the lumbar curve.

In patients with right thoracic scoliosis and significant hypokyphosis, with a preoperative sagittal curve from T_5 to T_{12} less than 15°, improvement in sagittal kyphosis was achieved at times by a 90° turn of the left-side rod. We also found that the thoracic kyphosis improved by radiographic measurement an average of 14°, from 4.3° to 18.3°. But no significant change was noted for patients with thoracic kyphosis of more than 15°. This suggests that significant improvement in the thoracic sagittal curve is usually possible with Cotrel-Dubousset instrumentation if a derotation maneuver is performed.

Significant improvement in rotation, with an average of 37 per cent correction, was noted and improved clinical rotational appearances were seen after instrumentation. The assessment of vertebral rotation could be done by several methods, including computerized tomography. The Perdriolle torsionometer is a simple method and provides finer degrees of measurement of rotation from the plane radiographic projection of the scoliotic spine. We used the torsionometer to measure vertebral rotation, and achieved spinal derotation after Cotrel-Dubousset instrumentation for scoliosis consistent with other studies[2,11,12,14].

Neurologic complications were not noted in our series and there have been no reports of pseudarthrosis in the most recent follow-ups. There has been only one case of dislodging of the pedicle hooks due to osteopenia. No deep wound infections or delayed deep infections have been noted.

Our study has demonstrated that Cotrel-Dubousset instrumentation provides long-lasting correction of spinal deformities. Frontal and sagittal thoracic curve correction has been satisfactorily obtained.

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การรักษาหลังคดด้วยเครื่องมือ Cotrel–Dubousset

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ได้รวบรวมผู้ป่วยจำนวน 18 ราย ที่มาตรวจที่โรงพยาบาลรามาธิบดี ด้วยเรื่องหลังคด และได้รับการผ่าตัดแก้ไขและเชื่อมกระดูกสันหลังด้วยเครื่องมือ Cotrel–Dubousset ตั้งแต่ พ.ศ. 2534 – 2539 อายุเฉลี่ยของผู้ป่วยขณะรับการรักษาคือ 14.7 ปี ได้ติดตามผู้ป่วยเป็นระยะเวลาโดยเฉลี่ย 3.7 ปี ในกลุ่มที่เป็น King ชนิดที่ 3 และ 4 สามารถแก้ไขหลังคดได้เฉลี่ยร้อยละ 65 และในกลุ่มที่เป็น King ชนิดที่ 2 สามารถแก้ไขได้เฉลี่ยร้อยละ 51 ส่วนหลังคดที่ระดับเอวในกลุ่ม King ชนิดที่ 2 สามารถจะแก้ไขได้เองเฉลี่ยร้อยละ 38 สำหรับการโก่งของกระดูกสันหลังสามารถแก้ไขให้มีมุมโก่งมากขึ้นได้โดยเฉลี่ย 14° และการหมุนกลับของกระดูกสันหลังสามารถแก้ไขได้เฉลี่ยร้อยละ 37 ผู้ป่วยทั้งหมดไม่มีอาการแทรกซ้อนทางระบบประสาท และไม่มีการติดเชื้อภายหลังผ่าตัด ซึ่งผลการศึกษานี้แสดงว่าเครื่องมือ Cotrel–Dubousset สามารถจะแก้ไขสภาวะหลังคดได้ทั้งในระนาบ sagittal และ coronal โดยให้ผลการแก้ไขเป็นที่น่าพอใจ

คำสำคัญ : กระดูกสันหลังคด, ผู้ใหญ่, การรักษา, Cotrel – Dubousset

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