FIVE YEAR RESULTS OF CDI IN SURGICAL TREATMENT OF
IDIOPATHIC SCOLIOSIS

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ABSTRACT:

In this study, results of idiopathic scoliotic patients who were treated with CDI at the Ankara University, Department of Orthopaedic surgery and traumatology was compiled during November 1989, September 1995.

Mean age was 16.7 years (9.6 – 35.6) and mean follow-up period was 57 months (40–71). Thirty patients were female and eight patients were male. Distribution of the patients according to King classification were King I, II, III, IV, V respectively; 2 (45.25), 2 (48.5), 24 (46.3), 3 (48), 3 (525).

Results were evaluated in the frontal, sagittal and axial plane. Average correction was 45.35% and was highest in thoracic (448.9), thoracolumbar (461.4) single curve. Greater correction was observed in hyperkyphotic and hypokyphotic patients compared to normokyphotic patients. Average horizontal plane correction was 17.74.

At the end of the follow-up period, the average loss of correction was 11.4 degrees in frontal plane. In the sagittal plane analysis, there was an average 7.2 degrees increase in kyphosis. An important loss of correction was not observed in horizontal plane.

CDI is a rigid system which provides three planar correction however, if the implants are not supported by appropriate posterior fusion, the complications such as implant failure and loss of correction would be inevitable. It will be possible to get a good result in the long term, if the preoperative planning is well made, if the posterior fusion application is carried out in compliance with its technique and if spinal monitorisation or wake-up test is applied when there is an opportunity.

Key Words: Idiopathic scoliosis, Cotrel-Dubousset instrumentation, long term results.

INTRODUCTION

Idiopathic scoliosis is the most common of all forms of lateral deviation of the spine. It occurs during the growth period and customarily divided into four categories: infantile, juvenile, adolescent and adult (33).

The goals of treatment in idiopathic scoliosis are: three plane correction of the curve and, maintenance of this corrected status. Restoration of mechanical balance is also important (19).

Cotrel-Dubousset instrumentation (CDI) system was developed between 1978 and 1983. This technique with multiple hooks and transverse connecting device offers a rigid fixation and correction of the rotational deformity (1, 8, 9, 19).

MATERIAL AND METHOD

Among the patients with idiopathic scoliosis, cotrel-dubousset instrumentation (CDI) and fusion was performed in 38. In this study; age, sex, King classification, rotational status assessed by Perdriolle torsiometer and the follow-up results of the patients were evaluated.

We performed a thorough systemic and neurologist examination, investigation the previous operations if present, was performed, and postural deformity and the pattern and amount of the curve was evaluated. In all patients AP and lateral standing films and bending films in supine position were obtained. After the evaluation as described above, preoperative plans were done (28).

In all patients, one stage posterior procedures have been performed. The curves including the upper and lower stable vertebrae were instrumented (28). Autogenous iliac bone grafts were used. Icmovac drains were not used in any of the patients. Third generation cephalosporins were given during the induction and for 48 hours postoperatively. Spinal monitoring or wake-up were not performed in any of the patients. The operative time and blood loss was documented. In the postoperative second day all patients were allowed to sit and in the fourth day to walk. The postoperative films were taken in all patients.
The pre and postoperative status of the patients were evaluated. The patients were asked to come for follow-up examinations in the postop. 1.5, 4.5, 12 months and after then respectively. Physical, neurological and radiographic examinations were performed in the follow-up visits.

Thirty of the patients were female and 8 were male (F/M = 3.75). The ages ranged between 9 and 34 years and mean age was 15.7 years.

According to King classification, we had 2 type I, 7 type II, 24 type III, 3 type IV and 2 type V curves. The mean follow-up time was 60 months (43-75). Among the 38 patients 10 had previous conservative treatment. The chief complaint among the patients was deformity (in all patients). In 10 cases pain and in 2 cases dyspnea was present. There was anamnesis of scoliosis in four patients’ families.

In 2 patients who have rigid scoliosis by physical and radiological examination, preoperative halo-femoral traction was applied.

The average operative time was 3.45 hours and average blood loss of is 3.23 units per procedure. In seven of the patients, postoperative external immobilisation (TLSO) was used. The indications for using TLSO are excessive scoliosis, inadequate operative technique and the presence of osteoporosis. Frontal and sagittal plane analysis was measured according to Cobb method and axial plane analysis was measured according to Perdriolle method (33, 35).

Thoracic kyphosis between T3-T12 and lomber lordosis between L1-L5 were measured.

RESULTS

Among all patients the mean frontal Cobb angle was 49.7 (32-80) degrees preoperatively and 27.16 (4-60) postoperatively. The average correction was 22.54 (45.35%) degrees. In the thoracic curves, mean frontal Cobb angle was 48 (32-76) degrees preoperatively and 24.5 (4-60) postoperatively. Average correction is 25.5 (48.9%) degrees. Satisfactory correction couldn't be achieved in double major curves because of the rigid scoliosis. Mean correction was 22.9 (40.1%) degrees in primary curve and 16.5 (37%) degrees in secondary curve of double major scoliosis. The average correction was 35.63 (61.4%) degrees in the thoracolumbar single curves.

In the sagittal plane analysis, we categorized the patients as hypokyphotic, normokyphotic and hyperkyphotic. Among the hypokyphotic 18 patients, increase of the kyphosis in sagittal plane was 4.8 (34.28%) degrees. In normokyphotic 18 patients, the decrease of the kyphosis was 1.05 (3.7%) degrees and in 2 hyperkyphotic patients, the decrease of the kyphosis was 7 (16.6%) degrees.

Rotational analysis was performed with Perdriolle method from the apex of the primary curve (33,35). Among all patients the mean preoperative rotational angle was 25.02 degrees; the postoperative angle was 20.58 degrees and the correction was 4.44 degrees (17.74%).

In the one year follow-up frontal plane analysis, 6.13 degrees loss of correction was noticed. In the axial plane there was a rotational increase of 0.28 degrees. Sagittal plane evaluation showed an increase in kyphosis in both hypokyphotic and normokyphotic patient groups but no change was observed for hyperkyphotic patients. Average increase in kyphosis was 1.59 degrees. In tables 1, 2 and 3 the analyses of the patients in three plane were documented.

In the average 5 years follow-up, in the frontal plane analysis, an 11.44 degree loss of correction was noticed in axial plane there was an increase of 1.69 degrees of the rotational deformity. Sagittal plane evaluation revealed an average of 7.2 degrees increase in the kyphosis of normo, hypo and hyperkyphotic patients. All three plane evaluation of the patients were documented in Table I, II and III.

In the physical and radiological examinations of the patients, there were no evidence of pseudarthrosis. It has been observed that loss of correction appeared mostly in patients who had complications and particularly in he first two years following the operation. If the loss of correction still exist, it means that the technique of posterior fusion was not sufficient during the operation. We think the hook dislocation, loss of correction and improvement in thoracic kyphosis occur due to this insufficient posterior fusion. Not facing any broken rod in spite of high loss of correction is the sign of a rod distortion or implant loosening.

Complications, those concerning general medical status of the patients and the implant were observed.

General complications were early minor neurological deterioration in one, infection in one, aseptic hae-
matoma in one, post transfusional anemia in one, late spastic paraparesia in one and thoracolumbar local kyphosis in one patient.
Table 1. Frontal Plane Analysis

<table>
<thead>
<tr>
<th>Curve Type</th>
<th>Preop. Cobb Angle</th>
<th>Bonding</th>
<th>Postop.</th>
<th>Mid Term Follow-up Mean 1 year</th>
<th>Final Follow-up 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracal</td>
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<tr>
<td>(n = 24)</td>
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<tr>
<td></td>
<td>48° (32-76)</td>
<td>31.9° (6-68)</td>
<td>24.5° (4-60)</td>
<td>30° (6-62)</td>
<td>34.4° (8-68)</td>
</tr>
<tr>
<td>Thoracolumbar</td>
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<tr>
<td>(n = 6)</td>
<td>55.3° (54-56)</td>
<td>36.6° (32-42)</td>
<td>19.7° (14-32)</td>
<td>26.6° (14-40)</td>
<td>31° (14-54)</td>
</tr>
<tr>
<td>Double Major</td>
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</tr>
<tr>
<td>Curve (Primary)</td>
<td>57.1° (38-80)</td>
<td>43.3° (14-62)</td>
<td>34.2° (14-54)</td>
<td>42° (14-66)</td>
<td>53.11° (24-70)</td>
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<tr>
<td>(n = 11)</td>
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<tr>
<td>Double Major</td>
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</tr>
<tr>
<td>Curve (Secondary)</td>
<td>44.5° (32-64)</td>
<td>28.4° (8-60)</td>
<td>28° (12-46)</td>
<td>33.6° (12-60)</td>
<td>35.4° (16-60)</td>
</tr>
<tr>
<td>(n = 11)</td>
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<tr>
<td>Average</td>
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</tr>
<tr>
<td>(n = 56)</td>
<td>49.7° (32-80)</td>
<td>33.9° (6-68)</td>
<td>27.16° (4-60)</td>
<td>33.29° (6-66)</td>
<td>38.6° (8-70)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31.67% (12-87%)</td>
<td>45.35% (12-87%)</td>
<td>33.01% (12-87%)</td>
<td>22.33% (12-87%)</td>
</tr>
</tbody>
</table>

Table 2. Sagittal Plane Analysis

<table>
<thead>
<tr>
<th>Thoracic Kyphosis</th>
<th>Preop.</th>
<th>Postop.</th>
<th>Mid Term 1 Year</th>
<th>Final Follow-up 4 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypokyphosis &lt;20 Degrees (n = 18)</td>
<td>14° (4-18)</td>
<td>18.8° (4-32)</td>
<td>19.66° (10-32)</td>
<td>26.5° (3-45)</td>
</tr>
<tr>
<td>Normokyphosis =20-40 Degrees (n = 18)</td>
<td>28.33° (20-38)</td>
<td>27.28° (12-40)</td>
<td>29.77° (12-46)</td>
<td>34.44° (18-60)</td>
</tr>
<tr>
<td>Hyperkyphosis &gt; 40 Degrees (n = 2)</td>
<td>42° (41-43)</td>
<td>35° (34-36)</td>
<td>35° (34-36)</td>
<td>38° (37-39)</td>
</tr>
<tr>
<td>Average (n = 45)</td>
<td>22.26° (4-43)</td>
<td>23.66° (4-40)</td>
<td>25.25° (10-46)</td>
<td>30.86° (3-60)</td>
</tr>
<tr>
<td>Lumbar Lordosis</td>
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<tr>
<td>Hypolordosis &lt;35</td>
<td>15.48° (+24-25)</td>
<td>-22.48° (-6-36)</td>
<td>-23.13° (-6-36)</td>
<td>-25.38° (-6-36)</td>
</tr>
<tr>
<td>increase</td>
<td>increase</td>
<td>increase</td>
<td>increase</td>
<td>increase</td>
</tr>
</tbody>
</table>

Complications concerning with implants were as follows, upper pedicular hook dislocation in two, pedicular screw dislocation in one, bilateral lower laminar hooks dislocation in one, irritation of the skin in three and convex side upper transverse hook and lower pedicular screw dislocation in one patient.

The patient who suffered from neurological injury was fully improved three months later.

In one patient, lower end of the rod was cut and lower hooks were removed because of dislodgement of the lower hooks at the postoperative second month. This patient experienced late spastic paraparesis postoperatively at two year and her implants were removed completely, because of progression of the paraparesis at the postoperative third year. The improvement of spasticity of this patient was considered because of the implant and improvement and thoracal kyphosis and after removal of the implant, the spasticity disappeared.

The patient that had thoracolumbar junctional kyphosis, is still under control. The patients who had aseptic haematoma and post transfusional anemia, have recovered completely. Upper hook dislodgement was observed in two patients, hooks were removed in one and the other is being followed up.

The patient in whom pedicular screw was dislocated, fusion mass
ions con-
implants vs. upper s dislo-
cavicular ation in lower dislo-
ication of rare and upper ok and er screw one pa-
ent who neuro-
was fully months
nt, low-
read was books because of the at the h. This le par-
year moved ression toper-
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phosis int, the
olumb-
under ase-
sed issue de-
ly, as ob-
were is he-
icular mass
ticularly thoracic curves. We ob-
tained 48% average correction rate
in our series. Best correction ob-
tained in thoracolumbar and thoraco-
lumbar and thoracic single curves
was 58% and 50% respectively (In
Table 1). The loss of correction on
frontal plane was reported to be
between 1-5 degrees and 14.4% in
the different studies (7, 10, 11, 13, 14,
16, 18, 21, 22, 23, 24, 25, 39).

Theoretically, loss of correction
is not seen after the fusion is com-
pleted (Mean 6 months) (5). In our
patients, the loss of correction was
average 6.13 degrees at mean one
year follow-up, and at this time our
correction rate was average 35% on
the frontal plane. During the five
year follow up period, the loss of
correction was gradually increased
and at the end of this period the correction loss was
11.4 degrees on frontal plane. The correction rate was
27%.

In the sagittal plane analysis, an average rate of 4%
-150% correction was stated (2, 12, 17, 20, 22, 23, 27,
30, 34, 39). In the hypokyphotic patients (less than 20
degrees of the kyphosis between T3-T12), a great
amounts of correction rates have been reported (6, 16,
20, 22, 23, 30, 39). In the normokyphotic patients, this
rate was not significant; on the contrary, there was a
small amount of reduction on kyphosis angle (4, 6, 16,
20, 22, 39). This condition was similar in our series.

Horizontal plane correction rates have been reported
between 16-56% (2, 10, 11, 12, 17, 20, 21, 25, 27,
29, 38, 40). In our series correction rate was 17.74.
Important correction loss was not reported after sixth
month (11). This condition was similar in our patients.
Our horizontal plane correction was found to be
10.99% at the end of the five year period. It is neces-
sary to note that, the longer the follow-up, the more
thoracic kyphosis occurred, but the majority of patients
remained in the normal range.

This increase in thoracic kyphosis and the loss of
frontal plane correction brings to mind the inadequacy
of the fusion technique during surgery, there was no
broken rods but we observed rod distortion and im-
plant loosening.

<table>
<thead>
<tr>
<th>Curve Type</th>
<th>Preop.</th>
<th>Postop.</th>
<th>Mid Term</th>
<th>End Follow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracal (n = 24)</td>
<td>25°</td>
<td>20.66°</td>
<td>20.91°</td>
<td>21.03°</td>
</tr>
<tr>
<td></td>
<td>(5-42)</td>
<td>(5-35)</td>
<td>(5-35)</td>
<td>(5-48)</td>
</tr>
<tr>
<td>Thoracolumbar (n = 3)</td>
<td>31.33°</td>
<td>21.73°</td>
<td>22°</td>
<td>22.28°</td>
</tr>
<tr>
<td></td>
<td>(30-40)</td>
<td>(14-28)</td>
<td>(14-28)</td>
<td>(3-36)</td>
</tr>
<tr>
<td>Double Major Curve</td>
<td>25.9°</td>
<td>21.4°</td>
<td>21.4°</td>
<td>24.77°</td>
</tr>
<tr>
<td>(Primary) (n = 11)</td>
<td>(10-45)</td>
<td>(10-42)</td>
<td>(10-42)</td>
<td>(12-42)</td>
</tr>
<tr>
<td>Double Major Curve</td>
<td>22.5°</td>
<td>19.3°</td>
<td>19.9°</td>
<td>22.5°</td>
</tr>
<tr>
<td>(Secondary) (n = 11)</td>
<td>(14-35)</td>
<td>(12-28)</td>
<td>(15-28)</td>
<td>(16-30)</td>
</tr>
<tr>
<td>Average (n = 56)</td>
<td>25.02°</td>
<td>20.58°</td>
<td>20.86°</td>
<td>22.27°</td>
</tr>
<tr>
<td></td>
<td>(5-45)</td>
<td>(5-42)</td>
<td>(5-42)</td>
<td>(5-48)</td>
</tr>
</tbody>
</table>

Table 3. Rotational Analysis
Case I. 13+0 years old female patients. King IV Curve. Correction rate is 75% on the frontal plane. Pre operative and Five years later control radiograms.
Case II. 16-4 years old female patients. King Type II curve. Frontal plane correction rate are 57% on thoracic and 29% on lumbar region. Preoperative, postoperative and five years later control radiograms.
Case III. 26 + 2 Years old female patients. King type III, curve. Frontal plane correction rate is 80% and horizontal plane correction rate is 50%. Preoperative and postoperative radiograms.
CONCLUSION
CD is a rigid system that provides three planar correction. As much as the system is rigid, if the implant are not supported by adequate posterior fusion technique correction loss is inevitable. Good preoperative planning and careful surgery, supported by spinal monitoring if possible, are fundamental prerequisites in order to avoid postoperative imbalance and neurological complications.

REFERENCES


