THE MANAGEMENT OF DEROTATIONAL EFFECT OF COTREL-DUBOUSSET INSTRUMENTATION WITH COMPUTERIZED AXIAL TOMOGRAPHY

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There is a general acceptance that primary few surgical techniques aims at the improvement of the rotation de- ' formity. C-D instrumentation makes this improvement with its three dimensional correction.

The rotation angles in 12 patients with idiopathic thoracic lordoscoliosis were measured before and after the operation with CDI. The angles were measured at the apex, one vertebra upper and below. These were the vertebra where the rotation was the greatest. Preoperatively the mean rotation was 20.2 in the sagittal plane. Postoperatively this was reduced to 6,8. That means in the patients operated with CDI and derotated, there is a correction of 33,7 in the primary deformity. In the postoperative follow up, there was no change in the rotational angles.

Surgical treatment of scoliosis during the last 25 years has achieved a significant correction of the fixed lateral curvature of the spine. However, in most instances, these techniques have made little correction of the vertebral rotation.

The traditional Harrington rod alone has little derotational effect, if any. This is mainly because the longitudinal distractive force in a sagittal plane does not yield effective moment necessary for derotation in a transverse plane. The additional use of the Harrington compression system may have some slight corrective effect on derotation (1,2).

Luque's SSI technique has some potanticl for derotation because the force of the wire on the concave side contributes to the corrective moment, but with this method significant derotation can not be expected (3,4).

Cotrel-Dubousset instrumentation has claimed a significant correction in the vertebral rotation and an associated marked reduction in the cosmetic rib hump deformity (5-15).

A prospective study in 12 consecutive patients with flexible thoracic lordoscoliotic curves has been carried out to evaluate the extend of correction of the vertebral rotation by this instrumentation.

PATIENTS AND METHODS :

Twelve patients with idiopathic adolescent thoracic lordoscoliosis were included in this review. The average age at the time of surgey was 13,5 (range 11-19). 8 of the patients were female and 4 of them were male. All af the operations were performed between December 1988, December 1989.

Each patient was assessed by standart radiographs including lateral bending films in order to determine the mobility of the spinal deformity. Height of the rib hump was evaluated. CT films were made through the one upper, one below and apical vertebrae. Correction and derotation was made by CD technique in all patients. Postoperative correction rates and percentages were recorded. Rotation amounts were recorded from preoperative and immediate postoperative months. Values were compared to each other.

CT scans were assessed pre and postoperatively and follow-up time, using the guidelines of Aaro and Dahlborn. Three precise bony landmarks were used namely; (a) the middle part of the sternum, (b) center of the posterior neural arch and (c) the axis of the vertebra (16,17).

The RAml (Rotation Angle Midline) formed between the midline of the torso and the axis of the vertebra which represent the most degree of rotation according to the Midline.

The absolute vertebral rotation was also measured. This was called RAsag (Rotation Angle Sagittal) which was the degree of vertebral rotation in relation to the horizontal plane and theoratically it is prone to inaccuracy due to the variable position of the patient on the CT table. In addition the postoperative height of the rib hump would allow the patient to roll towards the convexity of the spinal deformity in the supine position and would theoratically increase the RAsag and give a false impression of an increase in the vertebral rotation deformity. RAdev is found by substracting RAsag from RAml. Improvement in RAdev is inversely correlated with the improvement in rib hump deformity.

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Table 1 : Average values of the Cobb angles, thoracal kyphosis angles, RAsag, RAml, RAdev of the apex, below and upper vertebrae their correction rates (CR) and correction percentages (CP) preoperative and postoperative measurements.

		Preoperative		Postoperative-CR		Postoperative-CR	
		Average	Range	Average	Range	Average	Range
Cobb Angles		40,8	30-68	18,0	2-32	46,9	6,6-90,9
Thoracal Kyphosis		6,0	(-6)-14	24,1	11-36	---	---
Apex	RAsag	20,2	8,3-28,4	6,8	3,2-12,2	33,7	15,8-49
	RAml	33,0	21,4-46,7	9,1	6,5-20,9	27,6	21,8-42,7
	RAdev	12,8	13,1-18,3	3,7	3,3-8,8	28,9	13,3-35,3
Upper	RAsag	13,2	6,8-14,4	5,7	3,3-10,1	46,7	33,4-58,1
	RAml	25,3	17,8-32,7	8,9	4,6-15,1	38,2	20,1-40,3
	RAdev	13,1	11-18,3	3,2	1,3-5,0	24,4	20,6-48,3
Below	RAsag	14,9	7,5-19,8	5,5	3,3-9,2	36,9	28,8-42,1
	RAml	21,6	17,0-36,7	7,1	4,4-14,1	32,9	29,1-50,1
	RAdev	6,3	9,5-16,9	1,6	1,1-4,9	25,9	28,8-50,1

RESULTS :

Average of the preoperative Cobb angles of the patients was 40,75 degrees (range 30-68). Thoracal kyphosis angles were between -6 to 14 degrees (average 6 degrees). In the postoperative period there was an average of 18 degrees (2-32) of correction in Cobb angles, it expresses a 46,9 % (6,6% - 90,6%) of correction. Thoracal kyphosis angles reached to an average of 24,1 degrees (11-36). 11 of the patients (91,7%) had thoracal kyphosis angles within the normal ranges and only one of them (8,3%) had a deviation of 0-10 degrees from the normal.

In the preoperative examination, 6 of the patients have (50%) shown rib hump deformity between 0-3 cm. and the remaining six (50%) between 3-6 cm. The range was from 2 to 6 cm (average 3,6 cm). In the postoperative period avarage height of the rib hump was 1,2 cm (range 0-3 cm.). All of the rib hump deformities were corrected as much as 2,3 cm. (94,1%) ranging between 1 to 4 cm. (25% - 100%).

In the CT films taken before the operation average values for RAsag, RAml and RAdev of apex vertebrae were respectively 20,2 degrees, 33,0 degrees and 12,8 degrees. In the postoperative period correction rates of RAsag, RAml and RAdev were respectively 33.7, 27.6 and 28.9 percent. Average RAsag, RAml and RAdev of the upper vertebra were 12.2, 25.3 and 13.1 degrees respectively and postoperatively, average correction ratio were 46.7%, 35.2% and 24.4%. For the below vertebra the values were 14.6 degrees, 21.6 degrees and 6.7 degrees respectively and correction rates were 36.9,32.9 and 23.9 degrees respectively. (Table 1).

In the statistical analyses we found a meaninigfull differences between the preoperative and postoperative rotations (Table 1). There was a direct correlation between the improvement of the rib hump deformity and derotation. Derotation of the neighbouring vertebras are more important than the derotation of the apical vertebra for the correction of the rib hump deformity.

During the controls we observed loss of neither correction nor derotation.

DISCUSSION :

Spinal deformit in scoliosis is not a curve in one plane but a three dimensional deformity and this fact can not be overlooked. The patients should be biomachanically evaluated in three anatomic planes : frontal, sagittal and transverse. The movement of the vertebra in the progression of scoliotic deformity consists of rotation around its axis and revolutional displacement in a transverse plane. In CD instrumentation a derotational moment works on the vertebra when a force vector towards the back is transferred though the rod to the hook lodged in a pedicle on the concave side. At the same time, the vertebra changes its place to the physiological position, just like the revolutional movement of the earth (7).

In 1988 Akbarnia et al. reported correction rates of RAsag, RAml and RAdev respectively 22, 17, 11 percent. Rib hump was also corrected in an average of 28 percent (15). Peterson ct al. reported a 26% correction in RAsag and 26% correction in RAml(5). Negata et al. reported a 25.9% correction of RAsag and 24.2% correction of RAml, they also reported no correction

of rotation by Harirngton technique (7). Mitchell and Mitchell, Armstrong. Armstrong-Luque reported a study comparing the results of Luque and CD technique and conclided that derotation obtained by CDI is more than the one obtained by Luque method.

In our study we confirmed that CD technique corrects rotational deformity effectively. Also the correction rates were slightly more than the ones reported in the literature. We correlated this results to the fact that in our cases thoracal angles were less than 15 degrees. In 1987 and 1989 Bridwell reported that if the thoracal postural angle is less than 15 degrees then the derotation maneuver is much more effective, if this angle is more than 25 degrees, than the derotation maneuver has a little effectiveness (8,12).

In our report we present 91.7 % correction rates of thoracal postur angles. While performing derotational effect CD technique also corrects the lateral curvature and thoracal postural angles. Correction of the rib hump deformity (71.4%) is parallel to the correction of the rotational deformity. Therefore in our study we confirmed that the cosmetical apperarance is progressed with the derotation and correction of the thoracal deformity.

As a result with CDI a corrective effect was achieved each of the three anatomic planes.

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