RECOVERY OF PULMONARY FUNCTION AFTER COTREL-DUBOUSSET INSTRUMENTATION

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The preservation or improvement of pulmoner function in Idiopathic scoliosis is the ultimate goal of surgical treatment.

In this study, we presented 26 patients, 24 adolescants, 2 adults (23 idiopathic, 3 paralytic). Pulmonary functions were measured first, preoperatively, then in the first, third, sixth and 12th months postoperatively and compared. Spirometric methods were used in the evaluation of pulmonary functions.

As a result of this study, marked improvement in vital capacity, vital capacity at the inspiration, vital capacity in the expiration and maximum volunteer ventilation in a short period were demanstrated after CD instrumentation. And also with the correction of rib hump deformity at a rate of % 63,1 C-D instrumentation provides an increase in the anteroposterior diameeter.

The relationship between spinal deformity and respiratory failure has long been established. Hippocrates recognized that a deformity affecting the chest leads to respiratory failure due to reduced lung volumes and the impairment of efficient chest movement. Patients with spinal deformity have been repeatedly shown to have an increased morbidity and mortality from cardiorespiratory failure and to die unexpectedly from seemingly innocuous chest infection due to the lack of any respiratory reserve. Therefore, it is of prime importance for any surgeon treating this condition to understand the assesment of respiratory function and the pathogenesis and treatment of the respiratory problems of scoliosis (1).

The preservation or improvement of pulmonary function in idiopathic scoliosis is the ultimate goal of surgical treatment. Thoracic lordoscoliosis is more common and more productive of respiratory compromise than kyphosis (2,3).

Idiopathic scoliosis is a complex three dimenlional deformity with lordosis or kyphosis, rotation and lateral deviation of the vertebral column (4). With the recognition of the three dimentional nature of the scoliotic deformity, never surgical techniques have been developed which provide correction in more than one plane. Contoured Luque rods can produce an improvement in thoracic kyphosis when the Cotrel-Dubousset Instrumentation (C-D I) system produces true three dimentional correction of the scoliotic deformity. Furthermore, the CD system requires no postoperative cast or brace, which may eliminate an iatrogenic restriction to pulmonary function (5,6,7,8).

This is prospective study to determine the change in pulmonary function following C-D instrumentation in patients with idiopathic or paralytic scoliosis. In ad dition, we researched the relationship between the type of the scoliotic deformity and the changes in pulmo nary functions.

PATIENTS AND METHODS :

In this study, the pulmonary functions of 26 patients who had been operated by CDI technique at An- • kara Social Sequrity Hospital, 1st Clinic of the orthopaedic and Traumatic Surgery, between December 1988 and December 1989 were analysed.

23 of these patients had idiopathic scoliosis whereas three of them had paralytic ones with the sequale of poliomyelitis. 2 of the patients with adult scoliosis had thoracic lordoscoliosis. On the other hand 2 of the patients with adolescent scoliosis had double major curves, 7 of them were rigid kyphoscoliosis and 12 of these patients were thoracic lordoscoliosis. The mean ages of the patients with idiopathic thoracic lordoscoliosis were 14,2 (range 11-19), whereas the mean ages of the patients with rigid kyphoscoliosis were 16,4 (range 12-19) and for the ones with paralytic scoliosis were 12,7 (range 12-13). The mean ages in the adult scoliosis group were 35,5 (range 32-39) and in the patient group wilh the double major curve were 16 (16-16). When all of the patients were included the mean ages were 16,4 (range 11-39). 12 of the patients were male, 14 were female.

Radiographic scoliosis parameters include frontal Cobb measurements.

The proper CDI technique was chosen and per-

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formed in every patients according to the type of scoliosis. In the patients with lordoscoliosis, derotation was performed. In 3 of the patients with rigid kyphoscoliosis, we did halofemoral traction preoperalivcly. In these patients with rigid kphoscoliosis three rods were put in the operation. Prolonged instrumentation were performed in the ones with double major curves. As two of the patients had lordotic posture in the thoracic region, derotation was added to their operations. In the three paralytic patients different CD techniques were performed according to the type of deformity. In all of the patients we did posterior fusion with allograft taken form the crista after decortication. No complications cither intraoparetively or postoperatively did occurded.

23 of the patients were edeouraged to walk on the third postoperative day. And three of the patient were encouraged to walk after the third postoperative day whom had all paralytic scoliosis. 2 of the patients were able to walk on the fourth postoperative day because in this patient we waited for long leg brace. We used no cast or braces for immobilization in all of the patients. All of the patients were examined clincally and radiologically on the first, third and sixth months after the operation. During these controls pulmonary function tests were also performed. The heights of the rib hump, were measured and compaircd with preoperatively and postoperatively.

Pulmonary function was studied by spiromctric tests including Vital Capacity (VC), Vital Capacity during Inspirium (VCIN), Vital Capacity during Expirium (VCEX), Maximum Valuntary Ventilation (MVV), Forced Expiratory Volume in 1 second (FEV1), Forced Expiratory Volume in 1 second and Forced Vital Capacity Ratio (FEV%) preoperatively and in the first, third, sixth months after the operation. The spiromctric determinations, with height corrected by arm span, arc expressed as raw values and as persentage of predicted normal. Statistical analysis was by paired student l-tcst to change in pulmonary function.

The patients were classified in four groups while the results were being analyzed. The first group includ ed the patients with thoracic lordoscoliosis. Two pa tients who had adolescent scoliosis with double major curves were also included in the first group because they had thoracic lordosis. The adult patients were in cluded in the second group. The third group consisted of patients with idiopathic adolescent kyphoscoliosis. And the last group contained three patients with para lytic type. .

We researched if there is a change in the pulmonary function depending on the type of the spinal deformity. We also looked for if there is correlation between the alteration in pulmonary function and the correction of the rib hump deformity.

RESULTS :

The preoperative and postoperative Cobb angles degrees thoracic kyphosis angle degrees, the correction rates and their perscntages in the study group generally and also in different subgroups that we have mentioned before, are seen in Table 1, Table 2 and Table 3.

We obtained correction of the rib hump deformity as 2,3 cm in losdoscoliosis, 2,9 cm. in kyphoscolio sis, 2,8 cm in double major curves, 1 cm in adults scoliosis, 3 cm. paralytic scoliosis averagcly postoper atively; the correction pcrscntages in these groups were 98,1 %, 58,6 %, 87,5 %, 73,1 %, 85,7 : consec utively. (Table 4)

When all patients were included, pulmonary function were found to have improved significantly except in two patients with idiopathic thoracic lordoscoliosis.

($p<0,01$) In these two patients, there was a decrease as much as 2,8 % avcragely on first month control. We establised fat droplets in the urine in these patients. This trancicnl fall in the vital capacity is probably related to fat embolism in pulmonary circulation. However on third month control, these two patients showed a rise in respiratory function (average 4,6 %).

Though there was an increase in pulmonary function in all of the patients on the controls, the rate of increase was different in every group. In these groups, the greatest increase was in the lordoscoliotic group. Vital capacity of 8 patients in whom the control period was 6 months, was found to have improved as 33,6 %. Paralytic scoliotic group and adult scoliotic group followed this group consecutively.

The vital capacity of 6 patients in the kyphoscoliotic group whose sixth month controls were complct-.; ed were found to have increased by only 14,1 % averagely and this was the least increase in all groups.

DISCUSSION :

In the classic Harrington Method, there is no a significant improvement in the pulmonary function. However the three dimentional change in thoracic cage anatomy effected by the Cotrcl-Dubousset system pro-

Table 1 : Preoperative (PR) and postoperative (PO) averages, correction rates (CR) and percentages (CP) of the different kinds of curvatures according to the Cobb method.

		PR	Range	PO	Range	CR	Range	CP	Range
Lordoscoliosis		40,8	30-68	21,4	4-40	18	2-32	46,9	6,6-90,6
Adult Scoliosis		42	40-44	27	22-32	15	12-18	36,2	27,3-45
Double Major Curves	I. Curve	51	40-62	37	22-52	14	10-18	47,5	45-50
	II. Curve	45,5	35-56	27	26-28	18,5	9-28	37,9	25,7-50
Kyphoscoliosis		61,3	40-92	36,1	21-56	21,3	10-43	39,9	25-67,1
Paralytic Type		58	47-70	39,3	22-42	21,3	10-30	35,2	23,8-41,7

Table 2 : Averages of the preoperative (PR) and postoperative (PO) thoracal kyphosis angles and correction rates (CR) of the different kinds of curvatures in sagittal plane.

	PR	Range	PO	Range	CR	Range
Lordoscoliosis	6,9	(-6)-14	36,3	20-40	27,3	20-44
Adult Scoliosis	14	6-22	29	18-40	15	12-18
Double Major	15	10-20	40	40-40	25	20-30
Kyphoscoliosis	60,1	45-86	42,9	34-56	-16,9	(-5) - (-38)
Paralytic Type	14,7	6-26	33,3	26-36	17,7	14-30

Table 3 : Postoperative thoracal kyphosis angles. (Number / Percentages)

	LS*	AS**	DM***	KS****	PS*****	TOTAL
Became to normal	11/95,2	1/50	2/100	6/87,5	1/33,3	21/80,8
0-10 degrees deviation	1/4,8	-/-	-/-	1/14,3	-/-	2/7,7
10-20 degrees deviation	-/-	1/50	-/-	-/-	1/33,3	2/7,7
20-30 degrees deviation	-/-	-/-	-/-	-/-	1/33,3	1/3,8
Total	12/100	2/100	2/100	7/100	3/100	26/100

* Lordoscoliosis, ** Adult scoliosis, *** Double Major Curves, **** Kyphoscoliosis, ***** Paralytic Scoliosis.

Table 4 : Averages of the preoperative (PR), Postoperative (PO) heights of the rib hump deformity, correction rates (CR) and percentages (CP) of the different kinds of curvatures. (CM)

	PR	Range	PO	Range	CR	Range	CP	Range
Lordoscoliosis	3,6	2-5	0,6	0-2	2,3	1-5	98,1	80,1-100
Adult Scoliosis	3	1-4	1,3	1-3	1,1	1-3	73,1	60-80
Double Major	3,3	2,5-4	0,5	0-1	2,8	2,5-3	87,5	75-100
Kyphoscoliosis	4,7	2-10	1,9	3-4	2,9	2-7	58,6	33,3-100
Paralytic Scoliosis	4	2,5-7	1	0-3	3	2,5-4	85,7	57,1-100

vides the anatomic basis for the realization of the improvement of pulmonary function demostrated in the recent studies. (5,6) On the other hand Gebstein, Oren, Hallel researched the effect of the CD techniques to pulmonar capillary perfusion and they proposed that postoperative better equalization between lung distrubation of ventilation to perfusion improves the work of breatihing and the lung functions (7).

Shufflcbarger et al reported results of the spirometric test in 46 idiopathic lordoscoliotic patients in whom CD techniques were performed. According to this study, they proposed that there were improvement in vital capacity as 15 % in one month after the operation in adolescent patients. On the third month after the operation 40 % averagcly improvement were established in the same group. But, in adults, there were no changes in the first month after the operation. In addition, they established increase of the pulmonary function results in 50 patients with idiopathic thoracic lordoscoliosis in whom CD techniques were performed. They established an significant improvement in pulmonary functions statistically. According these results, they proposed that this improvement was mainly due to the three dimentional changes in chest configuration which restore a normal diaphragmatic function (8).

In this study, the pulmonary functions of 26 patients in CD techniques were performed were analysed. Almost in whole patients, a significant improvement was observed on the first month after the operation. Pulmonary function were improved almost completely on the 6th month after the operation in thoracic lordoscoliotic group. The results of this group were best in this study. We suggest that this concept is depending on three dimentional correction of CD techniques. Because derotation effect of CD system corrects rib hump and chest diameter becomes to normal values. We also suggest that anatomic correction and providing thoracic balance is playing a role on a significant improvement in pulmonary function of patients with paralytic (C-Typc) scoliosis. In the kyphoscoliotic patients group, lateral curvature was less corrected than the remaining groups, but thoracic posture angles were corrected significantly. So, we conclude that, for this reason, pulmonary function of these patients were improved importantly in spite of these improvements are less than the other groups. Depending on these results, we propose there is a correlation between the alteration in pulmonary function and the type of the spinal deformity.

As a result, in this prospective study, we established that CD techniques provided a significant improvement in pulmonary function in the scoliotic patients. We proposed that this improvement was demostrated:

1. As CD method provided normal thoracic posture.

2 . As CD system provided rigid internal fixation with the significant correction in lateral curves.

3 . As CD techniques corrected rib hump deformi ty and provided improvement in chest diameter by its derotational effect,

4. As no postoperative immobilization (cast or brace) was employed, there was no iatrogenic restriction to ventilatory mechanics. For this reason, the Cotrel-Dubousset Method rapidly achieves the primary goal of scoliosis surgery, improvement of pulmonary function, it must be chose for every scoliotic deformities.

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