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COMPARING RADIOLOGICAL OUTCOMES OF SHARP AND ROUND KYPHOSIS PATIENTS

KESKİN VE YUVARLAK KİFOZLU HASTALARIN RADYOLOJİK SONUÇLARININ KARŞILAŞTIRILMASI

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SUMMARY:

Study Design: Retrospective, radiological and clinical analysis of patients with sharp and round thoracic and thoracolumbar kyphosis.

Methods: Whole spine anteroposterior and lateral radiographs of patients with thoracic and thoracolumbar sharp and round kyphosis were obtained before surgery and at the final follow-up. The pelvic and spinal parameters were measured.

Results: 40 patients with kyphosis were included. Mean age was 19.6 and mean follow up period was 26.4 months. Patients divided into two groups as: 20 patients with sharp kyphosis (mean age: 20.1) and 20 with round kyphosis (mean age: 19.6). There was not significant difference for patient age, follow up period and risser scores between two groups. ($p > 0,05$)

Conclusion: In patients with increased thoracal kyphosis with changed pelvic parameters, surgical correction and instrumentation must include both thoracal and lumbar spine

Key words: kyphosis, spinopelvic sagittal alignment, schuermann kyphosis

Level of evidence: Retrospective clinical study, Level III

ÖZET

Çalışma *dizaynı:* Retrospektif, yuvarlak ve keskin açılı torakolomber kifoz hastalarının radyolojik ve klinik analizi

Metod: Tüm spinal AP ve lateral grafiler preoperatif ve son kontrolde alındı. Pelvik ve spinal parametreler ölçüldü.

Bulgular: 40 kifoz hastası çalışmaya dahil edildi. Ortalama yaş 19.6, ortalama takip süresi 26.4 aydı. Hastalar iki gruba ayrıldı: 20 keskin açılı kifoz (ortalama yaş 20.1) ve 20 yuvarlak açılı kifoz(ortalama yaş 19.6). Hasta yaşı, takip süresi ve risser skorları için iki grup arasında belirgin fark yoktu. ($p > 0,05$)

Sonuçlar: Artmış torakal kifoz ve değişen pelvik parametrelere sahip hastalarda, cerrahi düzeltme ve enstrumantasyon torakal ve lomber omurgayı içermelidir.

Anahtar kelimeler: Kifoz, spinopelvik sagittal dizilim, Scheuermann kifozu

Kanıt düzeyi: Retrospektif klinik çalışma, Düzey 3

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INTRODUCTION:

Spine has physiologic kyphosis and lordosis angles as balancing each other. These angles varies in each person[7]. Pelvic parameters identify sagittal pelvic morphology[1,3]. These parameters change in growing period and finally become fixed in adults. In the current literature there are some clinical studies addressing clinical importance of pelvic parameters. Results are negatively affected when these parameters are not considered in correcting spinal deformities[7].

The aim of this study was presenting effects of upper spinal sagittal deformities on pelvic parameters and lumbar lordosis.

PATIENTS AND METHODS:

There were 72 patients evaluated in our hospital for kyphosis and had surgical treatment for kyphosis between October 2009 and March 2011.

40 patients (mean age 19.6 years, mean follow up 26.4 months) fulfilled the inclusion criteria of the present study retrospectively. All included patients had undergone posterior instrumentation with pedicle screws and fusion.

Patients with a history of multiple operations, mental disorder, scoliosis greater than 15 degrees excluded from the study.

After the patients and/or parents provided written informed consent, patients were scheduled for surgical correction of spinal deformities.

Patients were divided into two groups as: Group 1 with sharp angled kyphosis patients (20 patients, mean age 20.1, 7 men and 13 women) and Group 2 with round angled Scheuermann kyphosis patients (20 patients, mean age 19.6, 14 men and 6 women). There was not significant difference for patient age, follow up period and risser scores between two groups. ($p > 0,05$) But, we found female predominance in the sharp kyphosis group and male predominance in the Scheuermann kyphosis group. It was statistically significant (Table-1).

Radiographic measurements and evaluation:

All participants had pure kyphosis on the postero-anterior and lateral radiographs. The cervical lordosis, thoracic kyphosis, lumbar lordosis, scoliosis angles (Cobb method), pelvic tilt, sacral slope, pelvic incidence, coronal balance and sagittal balance were determined on pre- and postoperative radiographs. For the coronal plane balance measurement, the difference between the central sacral vertical line and the line passing through the center of C7 was measured. In the sagittal plane, the difference between the line passing through the center of C7 body and posterior superior angle of the sacrum was measured. Pre- and post-operative x-rays were shown to all patients and informed about the correction amount and cobb angles that achieved with the surgery.

Statistical analysis:

The data were analyzed with statistical software (IBM SPSS Statistics for Windows, Version 22.0, IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean, median, standard deviation (SD) and percentiles for continuous variables, and as number and percentages for categorical variables. Mann Whitney U test was used for comparing continuous variables for two groups when data did not follow a normal distribution. Wilcoxon test was used for non-parametric data comparing two related samples or repeated measurements. Categorical variables were analyzed through the Chi-square and Fisher's exact tests. Statistical significance was established if $p \leq 0.05$.

RESULTS:

All patients had surgical correction with posterior instrumentation with polyaxial pedicle screws and fusion surgery.

In group sharp C2-7 servical lordosis was preop 15.8 and postop 21.1 that there was significantly difference between. In group round C2-7 servical lordosis was preop 20.6 and postop 27.5 that there was significantly difference between too.

Table 1. Patient demographics and followup period

		Group-Sharp			Group-Round			p
		Mean±s.d./n-%	Median	Min-Max	Mean±s.d./n-%	Median	Min-Max	
Age (y)		20,1 ± 7,9	18	8 - 38	19,6 ± 3,9	19	14 - 27	0,703
Sex	Male	6 27,8%			14 70,0%			***0,009***
	Female	14 72,2%			6 30,0%			
Follow-up (mo)		27,6 ± 17,8	24	12 - 84	26,5 ± 8,6	27	6 - 37	0,660
Risser sign		4,1 ± 1,5	5	1 - 5	4,8 ± 0,7	5	2 - 5	0,085

Chi-square test / Independent samples t test

Thoracal kyphosis was evaluated as T2-5, T5-12, T10-L2 locally and T1-12 globally. Pre and postop sagittal parameters of group sharps' values can be seen on Table-2, there was significant difference at only the T10-L2 local kyphosis measure. Pre and postop sagittal parameters of group rounds' can be seen on Table-3, there were significant difference between pre and postop op measurements of T2-5, T5-12 locally and T1-12 globally. There was significant difference at lumbar lordosis of group sharps' but not at group round. There was not any significant difference between pre and postop measurements of Sacral Slope, Pelvic Incidence and Pelvic Tilt in both groups (Table-2,3).

Table 2. Pre and postop sagittal parameters of group sharps' values

Group-Sharp	Pre-Op								Post-Op							p
	Mean±s.d.			Med.	Min-Max				Mean±s.d.			Med.	Min-Max			
Cor, Balance (cm)	-0,8	±	2,8	-0,5	-6,5	-	5,0		-1,4	±	2,4	0,0	-9,0	-	1,3	0,433
CL (C2-C7)	15,8	±	14,0	11	0	-	47		21,1	±	17,9	15,5	3,0	-	74,0	***0,031***
TK (T1-T12)	45,2	±	31,8	42	2	-	123		40,9	±	20,4	36,5	9,0	-	88,0	0,552
T2-T5	10,5	±	12,0	6	1	-	45		14,7	±	14,0	10,0	1,0	-	56,0	0,185
T5-T12	32,6	±	29,8	25	2	-	91		29,8	±	16,1	27,0	11,0	-	68,0	0,983
T10-L2	45,2	±	34,0	45	2	-	135		15,9	±	16,7	10,5	1,0	-	69,0	***0,001***
LL (L1-S1)	44,7	±	17,5	42	10	-	76		41,2	±	11,8	40,5	8,0	-	68,0	0,601
Pelvic Tilt	13,3	±	7,6	13	3	-	30		11,9	±	9,4	10,5	2,0	-	39,0	0,334
Sacral Slope	30,1	±	13,0	29	3	-	55		32,3	±	10,1	34,0	1,0	-	46,0	0,492
Pelvic incidence	50,0	±	14,8	49	29	-	90		45,7	±	10,0	46,0	27,0	-	70,0	0,177
Sg,Balance(cm)	-3,3	±	6,1	-3,0	-22	-	3,4		0,1	±	3,6	1,2	-5,8	-	5,3	0,051

Wilcoxon test

Table 3. Pre and postop sagittal parameters of group rounds' values

Group-Round	Pre-Op								Post-Op							p
	Mean±s.d.			Med.	Min-Max				Mean±s.d.			Med.	Min-Max			
Cor, Balance (CM)	-0,7	±	1,9	0,0	-4,3	-	4,3		0,3	±	2,9	0,0	-3,7	-	10,8	0,053
CL (C2-C7)	20,6	±	13,1	20	2	-	45		27,5	±	15,4	29,0	1,0	-	60,0	***0,046***
TK (T1-T12)	72,9	±	13,1	68	53	-	102		51,7	±	11,5	51,0	28,0	-	73,0	***0,000***
T2-T5	14,9	±	9,4	13	1	-	39		28,7	±	10,7	29,5	11,0	-	46,0	***0,001***
T5-T12	59,3	±	16,1	57	35	-	89		26,0	±	11,7	24,5	7,0	-	56,0	***0,000***
T10-L2	14,7	±	10,8	14	2	-	37		10,7	±	6,4	9,5	1,0	-	26,0	0,155
LL (L1-S1)	57,0	±	15,0	55	29	-	85		43,6	±	13,7	44,0	15,0	-	64,0	***0,001***
Pelvic Tilt	9,7	±	7,1	8	2	-	25		12,4	±	7,5	12,0	2,0	-	32,0	0,126
Sacral Slope	36,9	±	12,1	35	19	-	62		35,1	±	10,1	35,5	20,0	-	53,0	0,313
Pelvic incidence	47,8	±	12,0	47	28	-	72		48,0	±	12,5	46,0	31,0	-	74,0	0,609
Sg,Balance(cm)	2,3	±	5,0	2,8	-8	-	9,0		1,9	±	4,0	1,0	-4,4	-	9,8	0,687

Wilcoxon test

DISCUSSION:

Kyphosis deformity is defined as convexity, which is increased angulation of spine in the sagittal plane. Scoliosis Research Society identifies thoracal kyphosis upper limit of 45 degrees[6]. In the Scheuermann kyphosis, 3 or more spinal segments are affected. In each segment, there are more than 5 degrees of local kyphosis due to endplate irregularities[3,8]. Sharp angled kyphosis is a serious form of kyphosis due to congenital, traumatic or infectious etiology. Three or less spinal segments are affected[3,8].

Radiologic degree of the deformity, clinical and cosmetic complaints and patient age must be considered before surgical correction is determined. Goals of the treatment are restoration of sagittal alignment, cosmetic satisfaction and decompression of neural elements if compressed[5,9]

Increased kyphosis is balanced with increased lordosis[5]. In our study, lumbar lordosis was decreased in both groups but this decrease was statistically significant in round kyphosis group not in sharp kyphosis group.

In the Scheuermann kyphosis group, T1-12 kyphosis angle was decreased postoperatively but there was significant increase in T2-5 kyphosis postoperatively ($p<0.005$).

In the sharp kyphosis group, T1-12 kyphosis angle was decreased postoperatively. T2-5 kyphosis angle increased postoperatively. But this increase was not statistically significant. These are associated with compensation from upper mobile segments. Also, these changes were correlated with more mobile segments available except deformity in the sharp kyphosis group and less mobile segments available except deformity in the round kyphosis group.

In this study we found only statistically significant difference in cervical lordosis (T10-L2) and lower thoracal kyphosis between pre and postoperative periods. We concluded this was associated with T10-L2 location of the deformity apex in the sharp kyphosis patients.

However, there was significant difference for all measured parameters (cervical lordosis, thoracal kyphosis and lumbar lordosis) between pre and postoperative periods except lower lumbar kyphosis.

In group 1 and 2, we identified increased mean cervical lordosis. This increase was statistically significant in both groups ($p<0.005$).

In the literature, pelvic parameters were not associated with kyphosis. Pelvic incidence was associated with lumbar lordosis[3-4]. In our patient cohort, there was not significant difference between pre and postoperative pelvic parameters. With these results we conclude that sagittal correction of thoracal kyphosis, either round or sharp kyphosis, does not affect pelvic parameters.

In patients with increased thoracal kyphosis with changed pelvic parameters, surgical correction and instrumentation must include both thoracal and lumbar spinal segments.

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