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INTRAOBSERVER AND INTEROBSERVER RELIABILITY OF THE RADIOLOGICAL DIAGNOSIS CRITERIA OF SCHEURMANN'S DISEASE

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ABSTRACT

Objective: Scheuermann's disease is diagnosed radiologically. Radiological measurements play role both in diagnosis of the disease and in the planning of the treatment. In this study, the evaluation of the intra-observer and inter-observer reliability of the radiological measurements used in Scheuermann disease was aimed.

Material and Methods: Ten patients with Scheuermann disease diagnosed by both practitioners were evaluated. The wedging angle on the most wedged vertebra and the kyphosis angle of the patients were measured by two different observers two times for 3 weeks apart.

Results: The correlation coefficients for intra-observer reliability in Scheuermann's disease ranged % 84 - % 92.7 in the measurement of kyphosis angle and it was ranged % 70,8 - % 90,5 in the measurement of the wedging angle. The correlation coefficients for interobserver reliability were detected 87.9 % and 89.7 % for kyphosis angle measurements; and 82% and 68.1% for the measurement of wedging angle.

Conclusion: Radiological measurements used in Scheuermann's disease have high intra-observer and interobserver reliability.

Key Words: Scheuermann's disease, Cobb angle, inter-observer and inter-observer validity

Level of Evidence: Retrospective clinical study, Level III.

INTRODUCTION

Scheuermann's disease is the most common cause of rigid kyphosis in adolescents. It was first described by Danish radiologist Holger Werfel Scheuermann in 1921 [17]. It was also called "Osteochondritis juvenile deformans dorsi". In this disease osteochondritis of the secondary ossification centers of the vertebrae is seen.

Scheuermann's disease is diagnosed radiologically. The radiological diagnostic criteria were determined by Sorensen [19]. Sorensen radiological criteria are: at least 3 adjacent vertebrae demonstrating wedging of >5 degrees, spine kyphosis >40 degree in sagittal plan and vertebral end plate irregularity. In addition, radiologically, schmorl nodules, premature disc degeneration, and disc space narrowing are also observed. Patients with Scheuermann's disease also have higher vertebral height [3].

The prevalence of the disease varies between 0.4 % and 8.3 % [10,23]. It is most commonly seen in adolescents aged 12-15 years [22]. About the male/female ratio, ratios like 1:1, 2:1, 7:1 have been reported [13,15,17]. According to recent studies and widespread opinion, prevalence is higher in males than females [16]. Scheuermann's disease is often seen in the thoracic region. The apex of the curvature can be in the mid-thoracic, lower thoracic or thoracolumbar region [8]. This common type is called the classical type. By Edgren and Vanio; atypical, lumbar Scheuermann's disease is described in which similar radiological findings are observed in the lumbar region [5].

The specific etiology of Scheuermann's disease is not fully known. Different theories have been put forward. Developmental defects in collagen aggregation have been suggested to lead to ossification disturbances in vertebral

endplates. About the etiology of the disease, increased secretion of growth hormone, juvenile osteoporosis, recurrent micro trauma, deficiency of vitamin A, poliomyelitis and epiphysitis have been accused [1,15,23]. Some studies have shown that mechanical factors also play a role in the pathogenesis of Scheuermann [10,18]. Children with Scheuermann's disease have been reported to be longer and heavier than healthy individuals. This has been associated with mechanical factors and increased growth hormone. It is also said that the increase in mechanical stress is also effective on kyphotic curvature and symptoms. Genetically, it is assumed to be transferred through autosomal dominant inheritance pattern [2,11].

The disease most often manifests itself with pain and deformity. The treatment is planned according to the kyphosis grade, clinical complaints and the maturity of the patient. In adolescent patients that had not completed the maturity yet, $>50^0$ thoracic kyphosis and $>40^0$ thoracolumbar kyphosis are treated with corset and physical therapy until maturity completion.

Progressive neurological deficit is a definite surgical indication. In addition, surgery may be considered in patients have thoracic kyphosis values of 70^0-80^0, have rapid progressive curvature and unending pain.

As it is seen, the diagnosis of Scheuermann's disease is made radiologically. Radiological measurements play an important role both in the diagnosis of the disease and in the planning of the treatment. In this study, we aimed to test the intra-practitioner and inter-practitioner reliability of the radiological measurements used in Scheuermann's disease.

MATERIAL AND METHODS

Ten patients who were diagnosed with Scheuermann disease by two orthopedic surgeons who were interested in spinal surgery were included in the study. Sorensen criteria were used for the diagnosis of Scheuermann disease. Accordingly, patients were included in the study who determined as having more than 40^0 kyphosis angles and having $>5^0$ wedging on 3 adjacent vertebrae and additionally have vertebral end plate irregularity.

In the patients the wedging angle on the most wedged vertebra and the kyphosis angle were measured. The Cobb method was used to measure the angles. Measurements were made betweenT5 upper endplate and T12 lower endplate for kyphosis angle. For the wedging angle, the most wedged vertebra jointly determined by both surgeons was used and the angle between the upper and lower endplates of this vertebra was measured. Each practitioner measured these two values, unaware of each other's measuring values. Measurements were repeated after 3 weeks. In the second measurements too, the surgeons were unaware of each other's measured values and their initial measuring values.

The intra-observer and inter-observer reliability of the kyphosis angle and wedging angle measurements were statistically calculated.

Statistical Analysis

NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for statistical analysis. While evaluating the study data, the descriptive statistical methods (mean, standard deviation, median, frequency, minimum, maximum) were used and in comparison of quantitative data, for intra-group comparison of variables with no normal distribution Wilcoxon Signed Ranks test was used. ICC was used to calculate the concordance between the observers. Significance was evaluated at $p<0.05$.

RESULTS

In the measurement of the wedging angle of the most wedged vertebra measured by both two practitioners, the degree of concordance at the 70.8 % level (GOOD) between the first measurement and the second measurement of the first surgeon was statistically significant. (p=0,008; p<0,01). The concordance between the first and second measurements of the second surgeon at the 90.5% (Excellent) level was found to be statistically significant (p=0,001; p<0,01).

It was observed that the first surgeon and the second surgeon had an 82 % (Excellent) concordance between the first septal angle measurements (p=0,001; p<0,01). The first surgeon and the second surgeon were observed to have a concordance of 68.1 % (good) between the measurements of the second wedging angle (p=0,013; p<0,05) (Table-1).

Table-1. Evaluation of the Wedging Angle Measurements of the Surgeons.

First Measurement		The Wedging Angle			*Value*	*ICC*
		Second Measurement	Difference	*p*	*p*	
1. Surgeon	Ort±Ss	14,60±2,32	15,00±1,49	0,40±1,51	Z:-1,006	0,708
	Min-Maks (Medyan)	11-19 (14,5)	13-17 (15)		*[a]0,314*	*0,008***
2. Surgeon	Ort±Ss	14,50±2,76	14,80±2,49	0,30±1,16	Z:-0,791	0,905
	Min-Maks (Medyan)	9-19 (15)	10-18 (15)		*[a]0,429*	*0,001***
	ICC	0,820	0,681			
	p	*0,001***	*0,013**			

[a]Wilcoxon Signed Ranks Test *ICC: Intraclass Correlation Coefficient* **p<0,05* ***p<0,01*

In the T5-T12 kyphosis angle measurements, 84 % (Excellent) concordance between the first and second measurements of the first surgeon was statistically significant (p =0.001; p <0.01). 84 % (Excellent) concordance between the first and second measurements of the second surgeon was statistically significant (p = 0.001; p <0.01).

There was a concordance at the 89.7 % (Excellent) level between the first surgeon and the second surgeon in the first kyphosis angle measurements (p = 0.001, p <0.01). The first surgeon and the second surgeon showed a 87.6% (Good) level of concordance between the measurements of the second kyphosis angle (p = 0,015, p <0,05) (Table-2).

DISCUSSION

The Cobb method is the most important method used to identify coronal and sagittal planar deformities and is described as the gold standard [6-7,12]. The Cobb method was originally described for the evaluation of scoliosis in anterior-posterior radiography. The method used to assess the kyphosis angle on the lateral radiograph is therefore referred to as 'modified Cobb' method. The Cobb method is used to diagnose Scheuermann's disease, follow the progression of the curve, select treatment and evaluate the effectiveness of the treatment. The use of this method at each stage of the disease increases the importance of intra- and inter-observer reliability of the method. Intra- and inter-observer reliability of the Cobb method in coronal plan deformities was investigated in a lot of studies and generally good and excellent reliability levels were found [4,14]. There are also studies investigating the reliability in the sagittal plan of the Cobb method. But there is no specific study tested the reliability of this method in measuring especially kyphosis angle and wedging angle that used to diagnose of Scheuermann's disease.

In our study, the kyphosis angle was measured between T5 and T12, and intra-observer and inter-observer reliability was found high. In similar studies, good and excellent levels of reliability were found in the measurements of kyphosis angle between T5 and T1 However, in one study, the intra-observer reliability (ρ = 0.22-0.65, poor to fair) and interobserver reliability (ρ = 0.33-0.47, low) of the kyphosis measurements between T2 and T5 were found significantly lower than those between T5-T12 [9,24]. It has been said that the superposition of upper ribs, scapula and humeral head region, may cause this in radiography to happen.

Again, in this study the intra-observer and inter-observer reliability of the wedge angle has been found between 0.75 and 0.926, that is, high reliability. In the literature, no similar study for the wedging angle in Scheuermann patients attracts the attention.

Ulmar et al. [21] tested intra and interobserver reliability of vertebral, segmental, and local kyphosis angle measurements in patients with thoracal and lumbar burst fractures. They repeated the measurements on both radiography and computerized tomography.

According to the results of the study, they reported that they found good and excellent interobserver and intra-observer reliability in all categories. In another study, intra and interobserver reliability of vertebral wedging rates and segmental Cobb angle in three groups of patients, including Scheuermann kyphosis, postural kyphosis, and healthy, were tested [20]. In all groups, they found a fairly high reliability. In this study, also, the ratio of vertebral wedging rate over 0.8 and segmental cobb angle over 20 degrees, was found to be highly correlated with Scheuermann disease.

In our study, the kyphosis angle and the wedging angle from the Sorensen criteria used in the diagnosis of Scheuermann's disease were assessed. As a result, in diagnosing Scheuermann's disease both kyphosis angle and wedging angle had high intra-observer and interobserver reliability.

Table-2. Evaluation of the Observers' 'Kyphosis Angle Measurements' on the Wedged Vertebra

First Measurement		Kyphosis Angle			*Value*	*ICC*
		Second Measurement	Difference	*p*	*p*	
1. Surgeon	Ort±Ss	72,40±5,15	71,40±4,97	-1,00±2,83	Z:-1,181	0,840
	Min-Maks (Medyan)	63-80 (73)	62-79 (72,5)		*[a]0,237*	*0,001***
2. Surgeon	Ort±Ss	71,90±7,50	71,40±6,85	-0,50±2,84	Z:-0,669	0,927
	Min-Maks (Medyan)	58-81 (74)	60-82 (73)		*[a]0,503*	*0,001***
	ICC	0,897	0,676			
	p	*0,001***	*0,015**			

[a]Wilcoxon Signed Ranks Test *ICC: Intraclass Correlation Coefficient* **p<0,05* ***p<0,01*

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