RELATIONSHIP BETWEEN IDIOPATHIC SCOLIOSIS AND FACIAL ASYMMETRY IN YOUNG PATIENTS

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RELATIONSHIP BETWEEN IDIOPATHIC SCOLIOSIS AND FACIAL ASYMMETRY IN YOUNG PATIENTS (Abstract): This study aims to evaluate the relationship between idiopathic scoliosis and facial asymmetry, on a sample of young patients. **Material and methods:** 17 orthopedic patients (1 boy and 16 girls) aged 15-28 years (mean age 20.06±4.575 years) admitted to Medical Rehabilitation Centers in the northeastern region of Romania (Iasi and Bacau cities) between January 2014 and April 2015 were assessed. Orthopedic data were extracted from medical records and radiological examinations, and orthodontic data were obtained from physical and photostatic examinations. Statistical evaluation was performed using *SPSS 16.0* software. **Results:** All patients were diagnosed with idiopathic scoliosis at puberty. Cobb angle of the main spinal curvature was ≤20° in 35.3% of patients, 20-40°(45°) in 17.6% of patients and ≥40°(45°) in 47.1% of patients. Convexity of the major curve was to the right in 88.2% of patients and to the left in 11.8% of patients. 58.8% patients underwent orthopedic treatments and 41.2% surgical treatments. All orthopedic patients presented facial asymmetry (right/left and overall/lower face) and lateral deviation of the head (right/left and mild/moderate). Only 52.9% of patients had malocclusions, patients who underwent orthopedic treatments. We found statistically significant correlations between scoliosis severity and head deviation, malocclusions, Angle classes and anomalies types; between the direction of convexity of the major curve and the types of facial asymmetries; and between types of scoliosis treatments and types of facial asymmetries, malocclusions, Angle classes and types of anomalies ($p<0.05$). **Conclusions:** Our study found in young patients a relationship between idiopathic scoliosis and facial asymmetry. **Keywords:** IDIOPATHIC SCOLIOSIS, FACIAL ASYMMETRY, MALOCCLUSIONS, BODY POSTURE.

Scoliosis is a three-dimensional deformation of the spinal column, defined as a lateral deviation greater than 10 degrees in frontal plane, associated with axial rotation, located at the cervical, thoracic and/or lumbar level (1, 2). There are several different types of scoliosis: congenital, neuromuscular and idiopathic. Idiopathic scoliosis is the most common type of scoliosis and has a multifactorial etiology (genetic predisposition, metabolic, hormonal and biomechanical factors). It can appear at any age and is more common in teenage girls, 90% of cases presenting a right-sided thoracic curve. The prevalence of adolescent idiopathic scoliosis is between 0.47% and 5.2% (3).

The diagnosis of idiopathic scoliosis is made by history, physical and radiographic examination. Postero-anterior X-ray view of the spinal column determines the degree of

severity of spinal curvature by the Cobb method (4). Idiopathic scoliosis is a progressive disease with aesthetic (important asymmetry) and functional consequences (cardiac and respiratory dysfunctions). It requires clinical observation over time to assess the risk of curve progression. Orthopedic treatment (kineto-physiotherapy, braces) does not correct scoliosis, but prevents its progression during the growth period of the patient. The goal of surgical treatment is to restore and maintain alignment, being indicated when the curve exceeds 40 degrees (3, 5).

The perfect bilateral symmetry of the face and the body is rare due to biological variation, being a theoretical concept. Right-left differences are due to functional and morphological asymmetries (6, 7). Slight, invisible, subclinical facial asymmetry is relatively common, being defined as the difference in size between the right and left sides of the face, observed only by the method of composite face photo (8, 9). Severe facial asymmetry occurs in craniofacial syndromes. Asymmetry affects the lower face (lips, chin) more frequently than the middle (nasal pyramid, orbits) and upper face (12). According to transverse discrepancies, facial asymmetry is classified as dental, skeletal, functional and muscular (10). Clinical features are polymorphic, depending on etiopathogenesis. Clinical and radiological diagnostic procedures aim to identify the causal factor, location and affected tissue. However, clinical examination remains the most important diagnostic tool for facial asymmetry (11).

The interest in finding the relationship between idiopathic scoliosis and facial asymmetry is 50-year-old, being based on the hypothesis of the anatomical and functional relation between the dento-maxillo-facial complex and the spinal column. The results of observational and case-control studies and case reports were inconclusive, and a cause-effect relationship was not found. Some cephalometric studies investigating relationships with posture have mentioned a correlation between facial morphology and head inclination in relation to the spinal column and vertical plane (12).

Our study aimed to investigate the relationship between idiopathic scoliosis and facial asymmetry in a sample of young patients treated in rehabilitation centers, to find the correlations between the characteristics of idiopathic scoliosis and facial asymmetry, and the coexistence of malocclusions in young orthopedic patients.

MATERIAL AND METHODS

We conducted a review of patients with idiopathic scoliosis admitted and treated in Medical Rehabilitation Centers in the Iasi and Bacau cities in northeastern Romania from January 2014 to April 2015. A total of 17 patients, 1 (5.9%) male and 16 (94.1%) females, aged 15-28 years (mean age 20.06 ± 4.575 years), with idiopathic scoliosis were identified. Informed consent was obtained from all patients. Included were only young patients (adolescents and young adults) who had clinical and radiological evidence of lateral spinal curvature and were diagnosed with idiopathic scoliosis. Patients with other spinal conditions, genetic or endocrine syndromes, as well as adults over 30 years of age or those who refused orthodontic examination were excluded from the study.

The following data from the medical records and spinal radiographs of the patients with idiopathic scoliosis included in the study were collected and analyzed: medical history, clinical signs, scoliosis localization, convexity of the spine, Cobb angle, type of treatment and post-treatment out-

comes. The patients were examined clinically and photo statically by the orthodontist in order to establish facial asymmetry by extra-oral examination of the face and head posture; presence/absence of malocclusions (Angle classes, malocclusion and sagittal, transverse or vertical inter-arches asymmetry) by examining the dental arches and occlusion.

Statistical analysis was performed using *SPSS 16.0* software (Chicago, Illinois, USA) for Windows. The data were characterized by descriptive statistics and contingency tables, using the *Pearson Chi-square test* (χ^2). Any *p* value less than 0.05 was interpreted as statistically significant.

RESULTS

According to their medical history, all patients were diagnosed with idiopathic scoliosis at puberty, at the age of 13 to 15 years old. Patients had clinical signs of scoliosis: lateral deviation of the head, shoulder asymmetry, winged scapula (right/left), waist angle deformity (difference between right/left waist angles), hip asymmetry, lateral deviation in frontal plane of the spinal column when the trunk is bent forwards with the occurrence of gibbosity on the side of the convexity of the curve.

The lateral curve of the spinal column was unique ("C" shaped) at cervical level in 2 (11.8%) patients, thoracic level in 9 (52.9%) patients and lumbar level in 1 (5.9%) patient or double ("S" shaped) at the cervicothoracic level in 1 (5.9%) patient and thoracolumbar level in 4 (23.5%) patients. The Cobb angle measured on the postero-anterior spine radiograph was ≤20° in 6 (35.3%) patients, between 20-40°(45°) in 3 (17.6%) patients and ≥40°(45°) in 8 (47.1%) patients. Convexity of the major spinal curve was on the right side in 15 (88.2%) patients and left side in 2 (11.8%) patients. Progression of scoliosis was stopped by orthopedic treatments(kineto-physiotherapy, Milwaukee, Cheneau, Boston braces) in 10 (58.8%) patients and surgical treatments in 7 (41.2%) patients. Post-treatment outcomes were favorable.

Asymmetry of the two hemifaces was established according to the facial midsagittal plane, right hemiface being more developed in 9 (52.9%) patients and the left hemiface in 8 (47.1%) patients. Also, 11 (64.7%) patients had overall facial asymmetry and 6 (35.3%) patients lower face asymmetry. Head inclination was to the right side in 10 (58.8%) patients and to the left side in 7 (41.2%) patients. Also, 10 (58.8%) patients had mild head deviation and 7 (41.2%) patients moderate head deviation. Only 9 (52.9%) patients had malocclusions: 4 (23.5%) patients Angle Class I, 1 (5.9%) patient Angle Class II and 4 (23.5%) patients Angle Class III, associated with dental crowding in 3 (17.6%) patients, inter-arches asymmetry in 3 (17.6%) patients or both in 3 (17.6%) patients.

We found statistically significant differences between: the values of Cobb angle of the major spinal curvature and head deviation (p=0.013), malocclusions (p=0.004), Angle classes (p=0.007) and of anomaly types (p=0.025); between the convexity of the major spinal curvature and the facial asymmetry types (p=0.041); between the scoliosis treatment types of and the facial asymmetry types (p=0.037), malocclusions (p=0.001), Angle classes (p=0.011) and anomaly types (p=0.008). We did not find statistically significant results between the other variables studied: scoliosis localization, right/left facial asymmetry, and head inclination to posture the right/left (p>0.050) (tab. I, II, III).

TABLE I

Statistically significant correlations between Cobb angle and statistical variables

Variables	Angle Cobb						Total		χ^2 test	p value
	≤20°		20-40°(45°)		≥40°(45°)					
	n	%	n	%	n	%	n	%		
Lateral deviations of head									8.743	0.013*
Mild	6	35.3	0	0.00	4	23.5	10	58.8		
Moderate	0	0.00	3	17.7	4	23.5	7	41.2		
Malocclusions									10.812	0.004*
Absent	0	0.00	1	5.9	7	41.2	8	47.1		
Present	6	35.3	2	11.7	1	5.9	9	52.9		
Angle Class malocclusions									17.797	0.007*
Class I	4	23.5	0	0.00	0	0.00	4	23.5		
Class II	1	5.9	0	0.00	0	0.00	1	5.9		
Class III	1	5.9	2	11.7	1	5.9	4	23.5		
Anomalies type									14.432	0.025*
Crowding	3	17.7	0	0.00	0	0.00	3	17.7		
Asymmetry	2	11.8	1	5.9	0	0.00	3	17.7		
Both	1	5.9	1	5.9	1	5.9	3	17.7		
*statistically significant differences when p<0.05										

TABLE II

Statistically significant correlation between convexity of the curve and facial asymmetry

Variables	Convexity of spinal column				Total		χ^2 test	p value
	right		left					
	n	%	n	%	n	%		
Facial asymmetry type							4.156	0.041*
Overall face	11	64.7	0	0.00	11	64.7		
Lower face	4	23.5	2	11.8	6	35.3		
*statistically significant differences when p<0.05								

TABLE III

Statistically significant correlations between scoliosis treatment and statistical variables

Variables	Treatment of scoliosis						Total		χ^2 test	p value
	kinesitherapy		corset		surgical					
	n	%	n	%	n	%	n	%		
Facial asymmetry type									6.600	0.037*
Overall face	3	17.6	1	5.9	7	41.2	11	64.7		
Lower face	5	29.4	1	5.9	0	0.00	6	35.3		
Malocclusions									14.993	0.001*
Absent	0	0.00	1	5.9	7	41.2	8	47.1		
Present	8	47.0	1	5.9	0	0.00	9	52.9		
Angle Class malocclusions									16.469	0.011*
Class I	4	23.5	0	0.0	0	0.00	4	23.5		
Class II	1	5.9	0	0.0	0	0.00	1	5.9		
Class III	3	17.6	1	5.9	0	0.00	4	23.5		
Anomalies type									17.345	0.008*
Crowding	3	17.7	0	0.0	0	0.00	3	17.7		
Asymmetry	3	17.7	0	0.0	0	0.00	3	17.7		
Both	2	11.8	1	5.9	0	0.00	3	17.7		
*statistically significant differences when p<0.05										

DISCUSSION

In our study we evaluated clinically and photo statically a group of Romanian patients diagnosed with idiopathic scoliosis to establish the relationships between the features of scoliosis (location, convexity of the major curve, Cobb angle and treatment) and the features of facial asymmetry (right/left, overall/lower face, head deviation) and the presence/absence of malocclusions (Angle class, crowding and/or sagittal, transverse or vertical inter-archers asymmetry), presenting some new aspects regarding the inclusion and analysis of these statistical variables.

Most of the study patients were women (94.1%) diagnosed with idiopathic scoliosis at puberty, as it was the case with other studies (12). Patients were assessed orthodontically by clinical and photostatic examinations as they were admitted and treated for their orthopedic condition. Kim *et al.* (4) were conducted their study on frontal and lateral cephalograms, because patients with scoliosis presented to orthodontic clinic. In our study, all our patients had facial asymmetry (right/left and overall/lower face), as other studies have reported (12, 13). Also, all our patients showed right/left and mild/moderate head inclination. In scoliosis, the head changes its inclination in relation to the spine, so that it can compensate for the spine deviation and maintain the orthostatic position. Scoliotic curves in frontal plane and lateral head inclination in posture contribute to the development of various dentofacial asymmetries (14). Body posture and cervical muscles are closely associated with the function of the head and mandible support system (15).

In the patients studied, not all of them had malocclusions. Most common were Angle Class I and III malocclusions (23.5%), dental crowding and occlusal asymmetries (sagittal molar and cuspid, mandibular lateral deviation, unilateral crossbite, canted occlusal plane, and infraocclusions). From our observations, these malocclusions were present only in the orthopedically treated patients (58.8%) and not in the surgically treated ones. In the literature, there are not recent study about the relationship between scoliosis and facial asymmetry, and our data cannot be compared.

Regarding head deviation, presence/ absence of malocclusions, Angle classes and types of anomalies differed depending on the severity of scoliosis. Also, the types of facial asymmetry correlated with the direction of convexity of the major spinal curve. Differences were also found in the types of facial asymmetries, presence/absence of malocclusions, Angle classes and types of anomalies depending on the treatment of scoliosis. All these correlations are original results that are not found in previous literature studies.

The spinal column provides the main support for all segments of human body (head, mandible, shoulders, trunk, hips, legs and feet). When the spinal column is misaligned, whole-body posture is influenced, and all body segments become misaligned as they are taking up unequal muscle loads (16). After surgical correction of spinal deviation, the adaptation of subjacent muscles is slow, with the persistence of functional asymmetries through neuromuscular mechanisms, thus explaining the presence of facial asymmetry and head inclination in posture even after the treatment of scoliosis.

This research may improve the study of young patients with idiopathic scoliosis, because unlike previous studies it identified a relationship with facial asymmetry and the presence/absence of malocclusions. Similar future studies may also find other ways to investigate these patients, so that our data to be comparable.

CONCLUSIONS

In our study, all orthopedic patients presented facial asymmetry (right/left and overall/lower face) and lateral head deviation in posture (right/left and mild/moderate) and only those who received orthopedic treatments (kineto-physiotherapy, braces) presented malocclusions (more commonly Angle Class I and III, dental crowding and interarches asymmetry). The value of Cobb angle correlated statistically with head deviation in posture, presence/absence of malocclusions, Angle diagnostic classes and types of anomalies; the direction of convexity of the major spinal curve was statistically correlated with the types of facial asymmetry; the orthopedic/surgical treatment of scoliosis correlated statistically with the types of facial asymmetry, presence/absence of malocclusions, Angle classes and types of anomaly. These aspects suggest that the interdisciplinary concepts of young people diagnosed with idiopathic scoliosis should be extended, both for the complete and complex skeletal treatment, as well as for the neuromuscular rehabilitation body segment posture.

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