sciendo

ARS Medica Tomitana - 2021; 3(27): pag. 125 - 130
doi: 10.2478/arsm-2021-0023

VISUAL AND VESTIBULAR IMPAIRMENT AND IDIOPATHIC SCOLIOSIS – ARE THEY RELATED?

Vladareanu Liliana[1,2,3], Hangan Tony[4,5], Chirila Sergiu[4], Dantes Elena[1,4,6]

[1] Medical Doctoral School, Ovidius University of Constanța, Romania
[2] Techirghiol Balneal and Rehabilitation Sanatoriumm, Techirghiol, Romania
[3] Fiziozone Constanța, Private Medical Rehabilitation Clinic, Constanta, Romania
[4] Faculty of Medicine, 'Ovidius' University of Constanța, Romania
[5] County Clinical Emergency Hospital "Sf. Apostol Andrei", Constanta, Romania
[6] Clinical Hospital of Pneumophtisiology, Constanta, Romania

Liliana Vladareanu
email: liliana.vladareanu@sbtghiol.ro

ABSTRACT

Scoliosis is a tri-dimensional lateral curvature of the spine of 10° or more, with a rotational component. The most common form of scoliosis in the population is adolescent idiopathic scoliosis (AIS). As its name states, it has no known direct cause, even if, over time some evidence for multiple linked causes has been provided

There is some evidence accumulated pointing to an association between AIS and posture control, where vision and vestibular systems are both involved

We analysed the links between the curvature of the spine, its evolution and possible visual and vestibular impairment on 44 children with scoliosis.

A postural aetiology of scoliosis in the visually and vestibular impaired population could be implied, since all the cases that could be defined as scoliosis and not as a scoliotic attitude (Cobb > 10º) were positive for the Fukuda Stepping Test and more than 60% of the patients that had a Cobb angle value higher than 15º had a type of visual impairment (myopia).

Keywords: scoliosis, vestibular impariment, visual impairment

Introduction

Scoliosis is a tri-dimensional lateral curvature of the spine of 10° or more, with a rotational component. The most common form of scoliosis in the population is adolescent idiopathic scoliosis (AIS). As its name states, it has no known direct cause, even if, over time some evidence for multiple linked causes has been provided. The biggest problem is that almost two-thirds of AIS patients have curvature progress before reaching skeletal maturity. The definition of curvature progress is more than 5º in Cobb angle in 6 months, with the correct brace and physical treatment provided (1). Until now, no direct link has been made between the first detected curvature, progression of the curvature, and any visual or vestibular impairment of the patient. Curvatures that are bigger than 40º when the patient has reached skeletal maturity will likely continue to grow, and curvatures that are lower than 30º are not likely to progress during adulthood (2). Curves larger than 45º can be associated with long-term adverse health issues, such as heart and lung disease or dysfunctions correlated with trunk deformity. Therefore, it is important to find more ways of detecting the cases with a higher risk of progression, detect them as early as possible and/or correct as much as possible from the associated pathology that we

find that has evidence for being linked to AIS (3). There is some evidence accumulated pointing to an association between AIS and posture control, where vision and vestibular systems are both involved (4). An association between scoliosis and ocular troubles is present in many diseases (e.g., cerebral palsy, autism) (5,6), and an association between scoliosis and vestibular troubles is suspected, but not yet proved beyond doubt (1). No association between the visual-vestibular systems together and idiopathic scoliosis has been investigated yet. The vestibulo-ocular reflex (VOR) is a reflex functioning to stabilize the gaze and ensure clear vision during activities of daily living; it is well characterised and defined, showing great adaptation as a response to behavioural requirements. Because the VOR has relatively simple pathways, it makes a great model for bridging the gap that might exist between its cells, neuronal circuits, and the behavioural response it elicits. It is also a reflex that connects the two systems mentioned before: the ocular (visual) system and the vestibular one. In its case, the vestibular system has a critical role in providing postural equilibrium when both self-generated movements and external movements (disturbances) are involved. It has a simple clinical test that can be used for evaluation in most cases: the Fukuda Stepping Test (FST). If any disturbances are found they can be addressed with minimal means of intervention during physical therapy sessions (2,3).

Putting all the above information together, we found it interesting to check if there are any links between the curvature that was found at presentation, its evolution (progression/ regression/ stabilisation) and the fact that the patient might have visual and vestibular impairment.

Material and Methods

A retrospective cross-sectional study involving a small group comparison was performed. We checked how many patients from the group had visual impairment, how many had minor vestibular impairment, how many had both impairments.

Data was taken from Fiziozone's archives from the last 2 years (Jan 2020 – Jan 2022) for children who presented to evaluate spine misalignment.

Inclusion criteria were age between 7 and 18 years with no neurological associated pathology, no posttraumatic spine deformities, and no known vestibular pathology. Exclusion criteria were ages below 7 and over 18, any secondary vestibular, visual, traumatic pathology present after the first assessment was done.

This study included a database of 44 children, and descriptive statistical analysis was performed using Microsoft Excel with the rendering of statistical information using tables and graphs. We checked which children wore glasses or had an undiagnosed visual impairment and which had a positive Fukuda Test, or which had both.

Trunk deformity was assessed by measurement of any trunk hump by the forward bending test. In addition, all children who had evidence of trunk deformity underwent standard stitching radiographs of the spine, measuring the Cobb angle, Nash-Moe rotation quotation, Risser bone maturity score at the beginning of the evaluation and 6 months after the first assessment.

When evaluated, children and their parents were asked if the child was currently wearing glasses and for what type of visual impairment if the answer was "Yes". If the answer was "No", then the children and their parents were asked when the last time they had undergone an ophthalmological control.

Results

The 44 children in the group had ages ranging from 7 to 16 years old as shown in the chart below, with a Standard deviation of 1,82. The median age for the whole group was 10 years and 8 months, the girls' group was 11 years and 4 months and for the boys' group was 9 years and 6 months. Most of them, 31 in absolute numbers, in percentage 70,45% were between 9 and 13 years old, which is the average age for adolescence (7). The group that was mostly represented was that of the 12 years old, 15 in absolute numbers, percentage 29,55%.

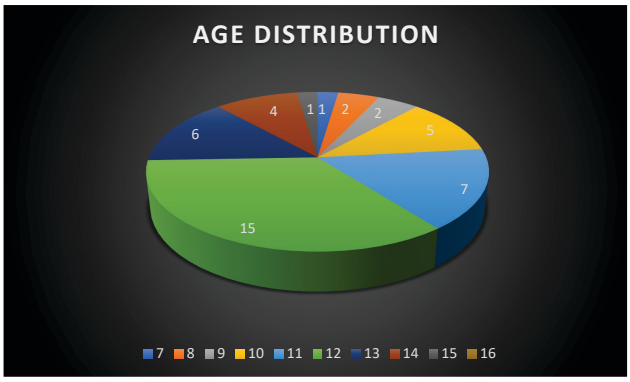


Figure 1: Group age distribution.

Out of the 44 children in the group 31 were girls, 13 boys, setting our findings in the limits of the current literature (8). The most representative ages for the girls were 11 and 12, and for the boys 10 and 12, as follows in Figure 2.

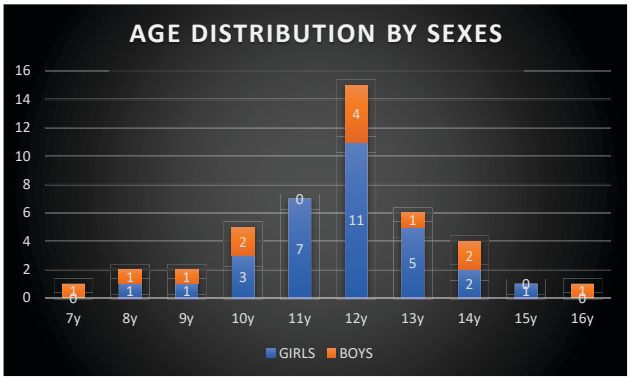


Figure 2: Age distribution by sexes

Therefore, we also evaluated the height distribution in our group, with the following findings: height ranging from 119 to 172 cm, with an average of 154,29 cm for the whole group, an average of 154,41 cm for the girls' group and an average of 152,30 cm for the boys group. As seen in Figure 3, the biggest growth spurt in girls was between the ages of 10 to 12, and for boys between the ages of 10 to 13.

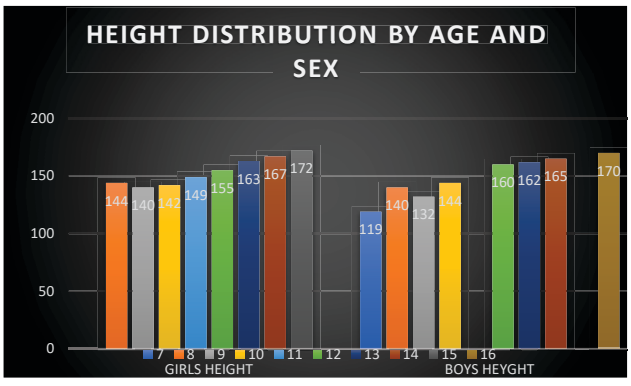


Figure 3: Height distribution by age and sex

Out of the 44 children evaluated in the given time frame, the distribution of visual impairment was 15 cases with myopic changes, 4 cases of hypermetropic changes, and 25 cases with no visual impairment. The distribution by sex and type of visual impairment is as follows in Figure 4. Some of the results in our group might be related to the fact that data was evaluated after the COVID pandemic, which forced all the schooling activities in on-line, thus increasing the exposure for screen time, which is a reason for the myopic changes. In favour of this affirmation stands the fact that 70% of the children had their glasses prescribed the year prior to our evaluation.

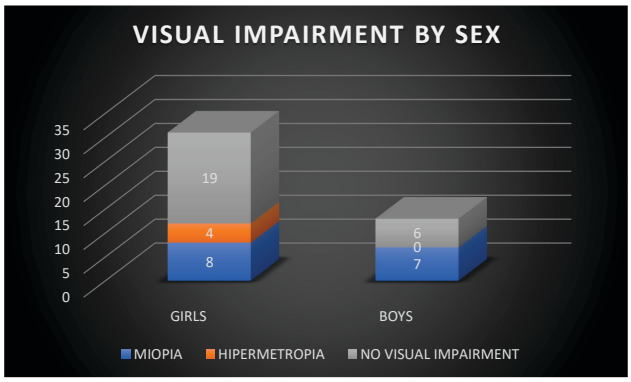


Figure 4: Visual impairment distribution by sexes

Out of the group that was examined the percentage from the total that had a positive Fukuda Stepping Test was 50%. The distribution by sexes is shown in Figure 5, showing a stronger positivity of the test for the girls than for the boys.

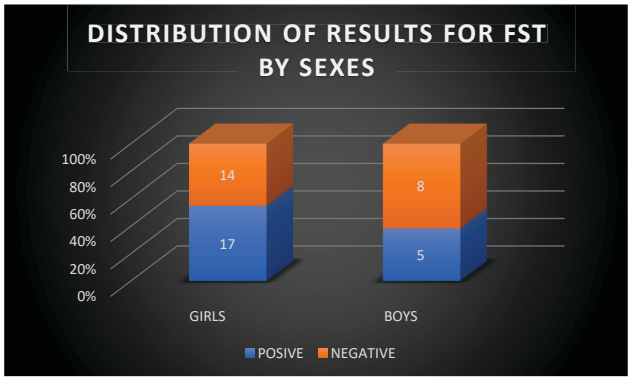


Figure 5: Results of Fukuda Stepping Test by sex distribution

The next idea was to see how many of the visual impaired children had a positive FST as well. This showed the fact the girls had equal percentage for positive FST for myopia and

hypermetropia, and that the boys had a very big difference between positive and negative FST for myopia: 14,28% positive.

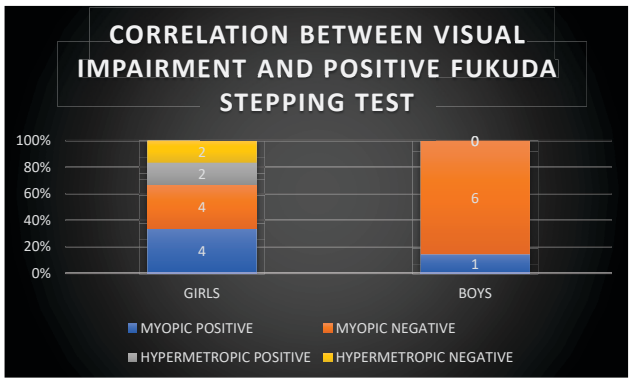


Figure 6: Correlation between visual impairment and positive FST

Of the 44 children evaluated, only 4 had no thoracic hump for the forward bending test at presentation. 28 out of 31 girls had a hump, 12 out of 13 boys had a hump. This was a reason that made us send these children to undergo a stitching radiograph of the spine to determine if any of them had structural scoliosis. In Figure 7, we can see the association between the positive FST and the presence of the hump. The biggest difference was found in the boys' lot, where only one person was found with a hump in the FST negative lot, compared to the same lot for the girls where 12 out of 14 cases had a hump. There was no difference with the hump presence if there was visual impairment or no, all the children with visual impairment had a hump as well.

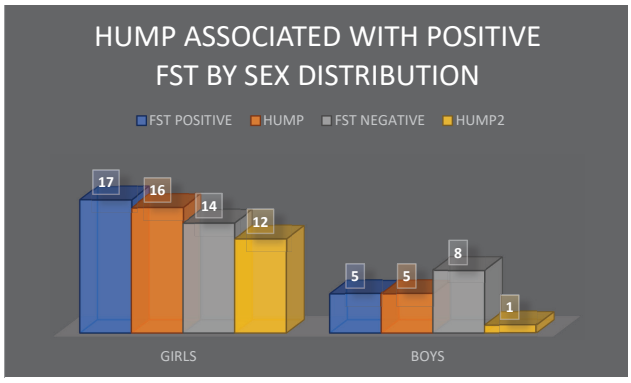


Figure 7: Hump association with a positive Fukuda Stepping Test by sex distribution

Out of the 44 children only 4 had no hump at the forward bending test and as such were not radiological evaluated. The rest, 39, were given standard stitching radiographs of the spine. The main factor that was measured was the Cobb angle, that in our group had a range from 3º to 24º. A real scoliosis is present from lateral bending angles higher than 10º, so that leaves us with a number of 29 cases of real scoliosis found, Cobb angles varying from 11º to 24º. Their distribution by sex is as follows in Figure 8.

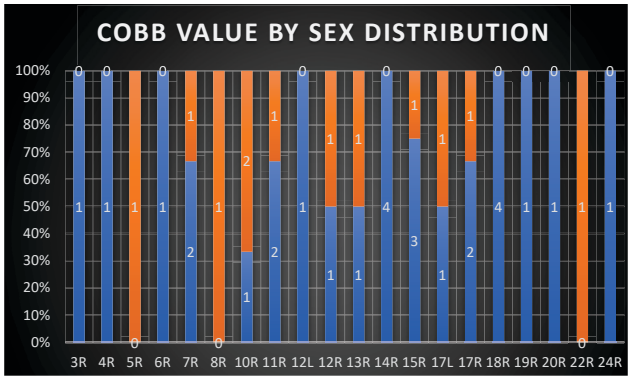


Figure 8: Cobb angle value and orientation by sex distribution

In the evaluated group, 7 out of 13 boys had a real scoliosis angle, and 20 out of 31 girls had a real scoliosis angle. This is showing us that our data can be aligned with the current literature as in girls are more prone to scoliosis than boys. Only 4 Cobb angles were oriented towards the left, while the rest were oriented towards the right.

None of the children that we analysed had a Nash-Moe rotation higher than 2 out of 4, the higher Cobb values (>17º) being 2/4, as expected from the literature, while the ones under 16º were ¼ Nash- Moe.

The value of Cobb angle and the presence of myopia or hypermetropia is as follows in Table 1.

As it can be seen in the table, the highest values for the Cobb angle belonged to girls and boys with myopia, and the highest number of real scoliosis cases belonged to myopic girls.

No children in the group had any significant variation of Cobb angle (<5º>) at 6 months after the first evaluation.

Table 1: Cobb angle distribution by sex and visual impairment.

	GIRLS			BOYS		
Cobb angle value and orientation (º)	M	H	NVI	M	H	NVI
11R	0	1	1	0	0	1
12R	1	0	0	1	0	0
12L	1	0	0	0	0	0
13R	0	0	1	1	0	0
14R	1	0	3	0	0	0
15R	2	0	1	1	0	0
17R	1	0	1	0	0	1
17L	0	0	1	0	0	1
18R	0	1	3	0	0	0
19R	1	0	0	0	0	0
20R	0	1	0	0	0	0
22R	0	0	0	1	0	0
24R	1	0	0	0	0	0
Total cases	8	3	11	4	0	3

Discussions and Conclusions

These findings are compatible with the general literature in terms of sex distribution for scoliotic changes in the spine (more girls than boys) at the adolescent age.

A postural aetiology of scoliosis in the visually and vestibular impaired population could be implied, since all the cases that could be defined as scoliosis and not as a scoliotic attitude (Cobb > 10º) were positive for the Fukuda Stepping Test and more than 60% of the patients that had a Cobb angle value higher than 15º had a type of visual impairment (myopia).

Myopia was far more present as a type of visual impairment in the group compared to hypermetropia (15 to 4 cases). No cases of hypermetropia were found in the boys' group (0/13). Myopic boys 7 out of 13, compared to myopic girls (8 out of 31) and even if there were less boys in the general group the number of cases in the boys' population is higher.

The Cobb angle had the highest value for a 15-year-old myopic girl.

No relevant correlation was possible between myopia, positive FST and the presence of scoliosis, maybe because our group was small.

More studies need to be done to prove that there is, or not a correlation between the visually and vestibular impaired and the onset of scoliosis. Maybe taking into consideration an instrumental evaluation of the vestibular impairment, that could gather more information about which side and which vestibular canal are involved in the vestibular syndrome.

References

1. Dunn J, Henrikson NB, Morrison CC, Nguyen M, Blasi PR, Lin JS. U.S. Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews. Screening for Adolescent Idiopathic Scoliosis: A Systematic Evidence Review for the US Preventive Services Task Force. Rockville (MD): Agency for Healthcare Research and Quality (US); 2018.
2. Catanzariti JF, Salomez E, Bruandet JM, Thevenon A. Visual deficiency and scoliosis. Spine (Phila Pa 1976). 2001 Jan 1;26(1):48-52.
3. Cohen HS. A review on screening tests for vestibular disorders. J Neurophysiol. 2019 Jul 1;122(1):81-92.
4. Arabi H, Adarmouch L. Symmetry of postural tone in right homogeneous functional laterality evaluated by Fukuda test. Acta Biomed. 2020 Nov 30;92(1):e2021057.
5. Ucan B, Kaynak Sahap S, Bako D, Tıras ST, Ceylaner S, Fitöz S. Horizontal Gaze Palsy with Progressive Scoliosis in an Infant Diagnosed Before Developing Scoliosis: MRI and DTI Findings. Klin Padiatr. 2022 Jan;234(1):52-5.
6. Dolar Bilge A. Horizontal Gaze Palsy with Progressive Scoliosis: A Case Report and Literature Review. Neuroophthalmology. 2019 Nov;43(5):334-6.
7. Sung S, Chae HW, Lee HS, Kim S, Kwon JW, Lee SB, et al. Incidence and Surgery Rate of Idiopathic Scoliosis: A Nationwide

Database Study. Int J Environ Res Public Health. 2021 Aug 1;18(15).
8. Ekşi M, Özcan-Ekşi EE, Huet SE, Dinç T, Özmen BB, Akçal MA. Prevalence of Thoracic Scoliosis in Adolescents in Turkey: Analysis of 1065 Chest Radiographs. World Neurosurg. 2020 Mar;135:e527-e40.