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STUDY ON STUDENT SPINAL DEFORMITY BY FORMETRIC SCANNING METHOD

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Abstract: The increasing trend of time and pressure of students in learning process with inadequate attention to health has made spinal abnormal symptoms more and more common in the world. In particular, spinal deformity is one of the causes affecting the normal development of adolescents, causing a number of circulatory and respiratory diseases and leading to psychological effects as well. Therefore, early detection of spinal deformities is very important in routine scoliosis screening at secondary school. The purpose of this study is to investigate the actual status of spinal deformity in students using DIERS formetric 4D device, as well as to find out some leading causes in order to propose recommendation to avoid them. Pilot experimental measurements were carried out on a group of 9 students composed of 4 male and 5 female. This is a new spine measurement method no using ionizing radiation, giving multiparameter results and suitable for routine scoliosis screening for all ages. The results showed that all 5/9 students have had abnormal signs such as lordosis, kyphosis, scoliosis. Three of 4 female students have showed large pelvic deviations. The above cases can be caused by the prolonged sitting time, the lack of physical exercise and wrong sitting posture. Abnormal cases in women have some common features of living habits. Mentioned results partly shows the risk factors consistent with common surveys that need the proper attention of government, education system and community about spine health monitoring.

Author keywords: DIERS formetric 4D, scoliosis, routine scoliosis screening.

Introduction: Adolescent idiopathic scoliosis is a common disease with an overall prevalence of 0.47–5.2 % in the current literature [1]. Many countries around the world have performed extensive spine screening for adolescents in the past 10 to 20 years, while in Vietnam it has only been carried out about 10 years ago and on a scale of only hundred students. With the rate of scoliosis much higher than other countries, so our country needs a spine screening program for students, thereby taking measures to protect the spine for the next generation future.

Scoliosis is a term used to describe curvature of the spine to the side of the body axis and curvature of the vertebral bodies along the axis of the transverse plane, as distinct from kyphosis or lordosis is the deformation of the spine along the anteroposterior axis. Scoliosis reduces or loses the ability to work and independent in daily life, is the cause of many medical conditions such as cardiovascular, respiratory, motor system disease if not detected early, treatment correct and timely. Therefore, early detection of scoliosis will help prevent dangerous complications later.

The diagnosis of scoliosis is mainly based on clinical signs such as the appearance of curves in the spine, shoulder and pelvic asymmetry, bipedal disparity or Cobb angle measured in radiographs, rotation of the spine. of the vertebral body measured with a Scoliometer. However, X-rays will be harmful to health, and measuring on Scoliometer will give results that are highly dependent on the measurer, reducing the accuracy of the assessment, leading to incorrect treatment. Therefore, it is possible to use another method, the shape optical method (performed on the DIERS FORMETRIC 4D device) to screen effectively and without harm to health. Before the data on the relatively high rate of scoliosis at school age and the advantages and disadvantages of each survey method, the topic of this group's choice is "STUDY ON STUDENT SPINAL DEFORMITY BY FORMETRIC SCANNING METHOD" and was carried out with the following objectives:

1. Survey the shape and assess the status of the spine of students.
2. Evaluation of the association between risk factors in school and grades of scoliosis.

Methodology: The study was carried out on 9 students aged 21-22 from University of and Technology (VietNam National University of Ho Chi Minh City) by DIERS FORMETRIC 4D device manufactured by DIERS INTERNATIONAL GMBH.

DIERS FORMETRIC - Symmetrical 4D analysis system for rapid dynamic and static (functional) optical measurements of the human back and spine - is an instrument for dorsal resurfacing and analysis. The procedure is radiation-free, works without exposure, and has high resolution to the back and spine. Provides a variety of clinical parameters for objective analysis of the body's static state, posture, scoliosis and all forms of spinal deformities can be displayed. A set of thin horizontal stripes is projected onto the back of the person. Using images taken with the camera then reconstructed with computer software, analyze the curvature of the lines and reproduce in 3D the curves as depicted in Figure 1.

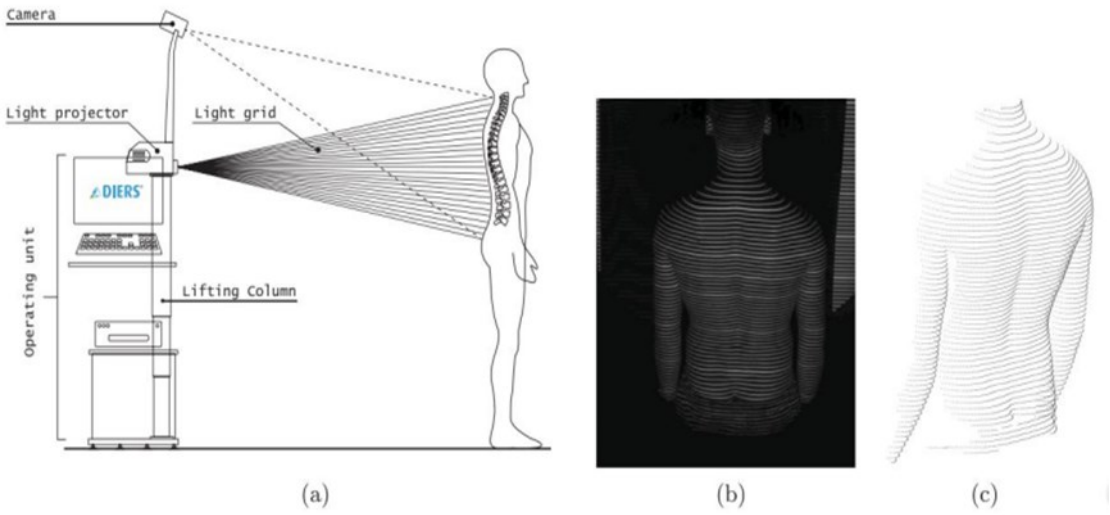


Figure 1: An example of data collected using the Diers Formetric system for one specific patient. (a) The Diers Formetric system. Reproduced from online published catalogue. (b)Image captured by system's camera. (c) Back surface 3D reconstruction.[2]

The system consists of an operating unit, a lifting column, a stripe projector and a camera that occupies a space of approximately 3 × 1.5 × 2.5 meters including the required distance

from the scanned object to the device. bag. The camera used has a maximum possible frame rate of 50 Hz, has a CMOS sensor with an image resolution of 1280 x 1024 pixels and a pixel size of 5.20 µm. Basic system components also include a background black velvet that is recommended to be placed in front of the subject to reduce reflections and enhance subject and background contrast. Diers Formetric helps detect anatomical landmarks, 3D computer model of the spine based on surface curvature estimation and dorsal reconstruction.

Measurement mode 4D Average: This is the default test type when capturing the desired patient's position. Test parameters: lasting 6s; number of recordings: 12; recording frequency: 2 fps. The obtained images will calculate the average values of the spine parameters, and then select the one with the parameters closest to the average parameters. A selected image will be displayed in the results section. The advantage is that it can eliminate distorting factors such as breathing, small body movements. The disadvantage is that the long recording time will affect the patient's standing still.

The data were processed by IBM SPSS statistics 20 software. SPSS Statistics 20 was used for all analyzes for the mean.

Characteristic parameters: VP (vertebra prominens), DL-DR (left lumbar dimple - right lumbar dimple), SP (sacrum point), SL(shoulder point left), SR (shoulder point right), DM (midpoint between lumbar dimples), CA(Cervical Apex), KA(Kyphotic Apex), LA(Lordotic Apex), ICT(inflection point cerviko-thoracic), ITL(inflection point thoraco-lumbar), ILS(inflectional point lumbo-sacral), Trunk Length VP-DM, Pelvic Inclination (Dimples), Kyphotic Angle ICT-ITL (max), Lordotic Angle ITL-ILS (max).

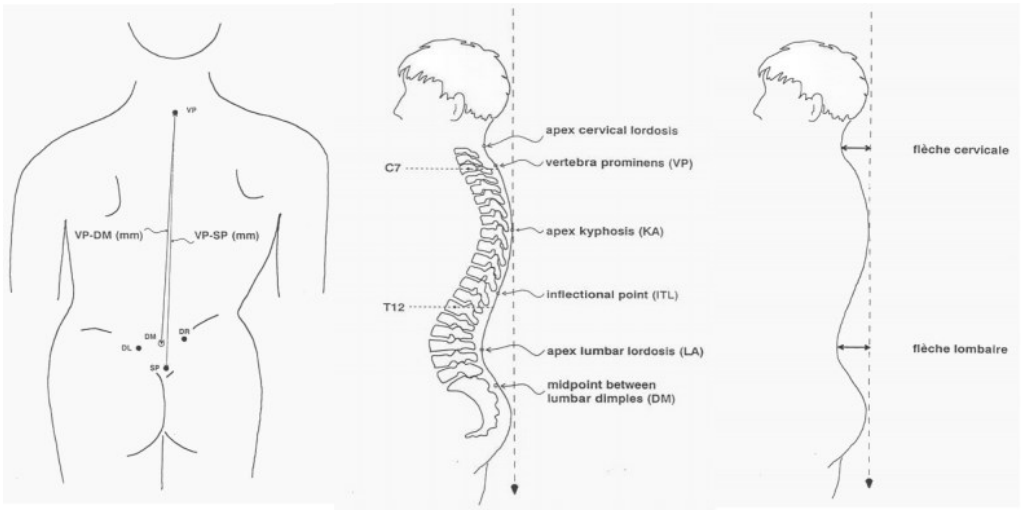


Figure 2: Anatomical landmarks and reference landmarks.

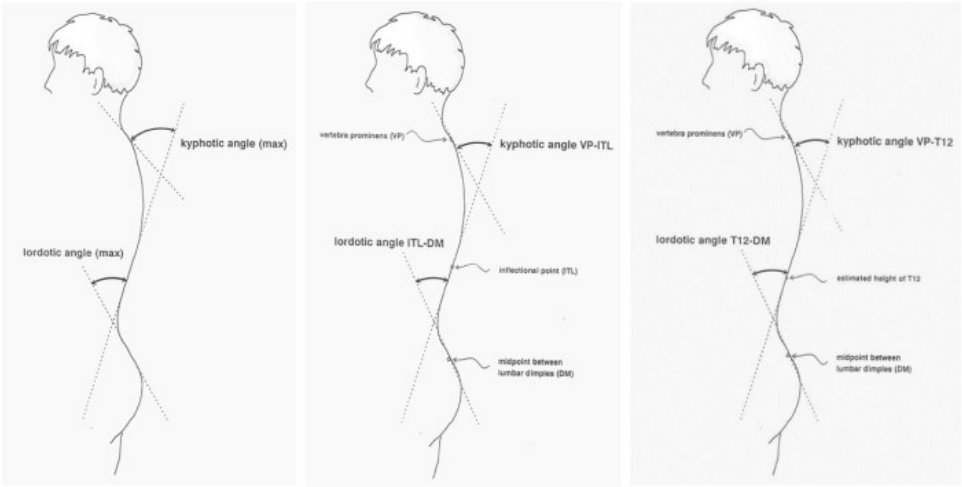


Figure 3: Other parameters.

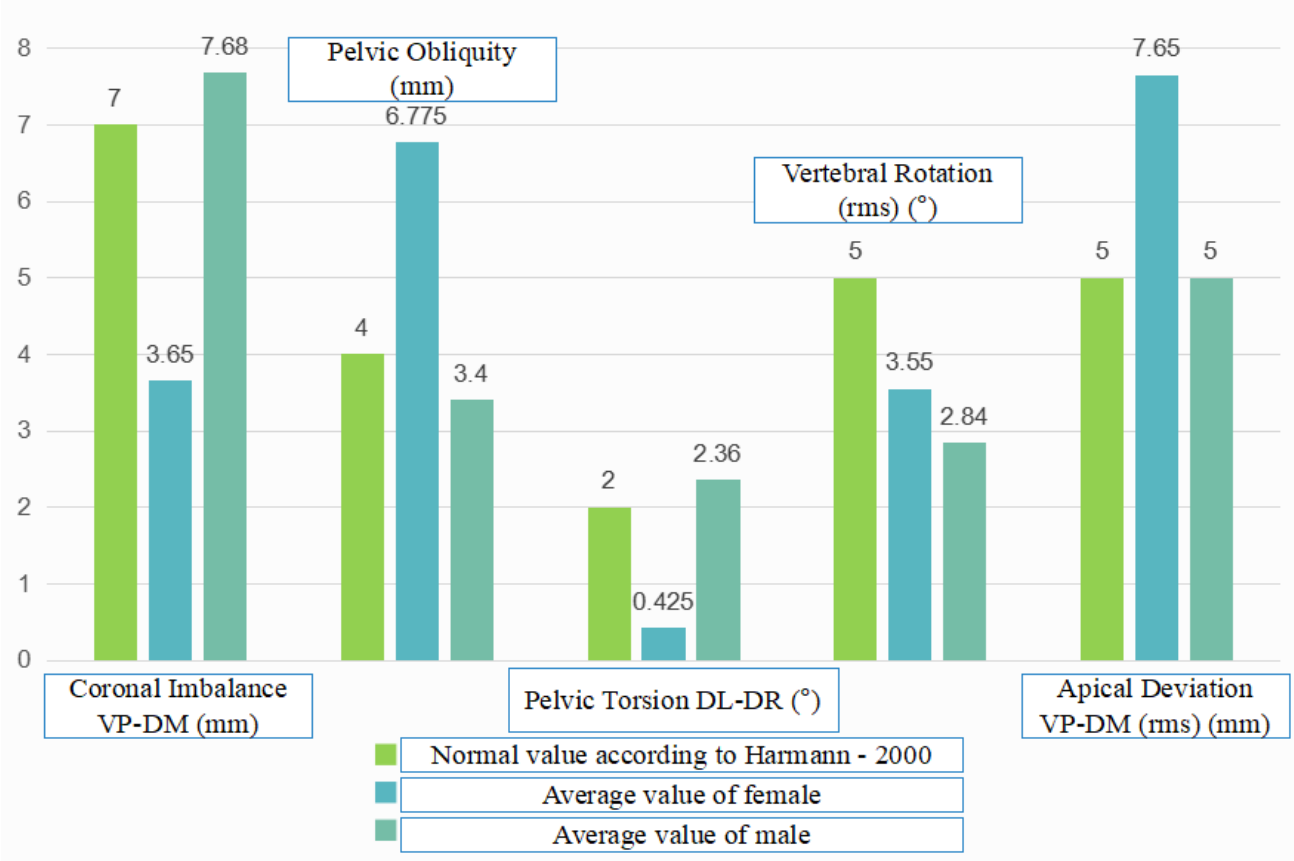
Results:

Table 1: Some information of two groups of male and female students

	Male		Female		Total	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Age (year old)	21.8	0.45	22	0	21.89	0.33
High (cm)	170	7.38	159	0.82	165.11	7.82
Weight (kg)	68	11.70	56.25	13.05	62.78	13.07
BMI (kg/m^2)	23.42	2.72	22.22	4.94	22.88	3.64
Length of spine (mm)	479.8	30.38	442	18.90	463	31.5

The group of female students has 4 cases where the value of pelvic deviation exceeds the normal threshold, and 3/4 cases are female with a very large degree of deviation (10mm, 10mm, 5.2mm), with the average value of this group of 3 female students is 8.4 ± 2.77 mm. In all these 3 cases, it was reported that they sat for more than 12 hours a day, did little exercise, wore a backpack with a weight of 3-7 kg, had pain in the neck/shoulder, and constriction. back. One of the three cases was accompanied by a very large (13.1mm) deviation on the frontal plane, which is a sign of scoliosis. This case has sitting time more than 12 hours a day, never doing sports, sitting and working on a chair without backrest and often having pain in the neck/shoulders, nape, waist.

For male students, all 5 students had signs of scoliosis, curvature or kyphosis. With spinal disequilibrium values, mean DL-DR pelvic torsion is larger than normal range, with mean lumbar flexion angle smaller than normal. There were 3 cases with signs of kyphosis with an average kyphosis angle of 56.03 ± 1.88°, 3 cases with signs of spondylolisthesis with an average curvature angle of 24.03 ± 1.18°. A special case has a hunchback angle in the lumbar region of 35°, a small flexion angle of 23.4° with spinal imbalance up to 14.5mm, this case has sitting time only from 6-8 hours a day, most of the time working is lying in a hammock or mattress, doing little sports and having pain in the neck/shoulders.



Figrue 4: Comparing some parameters with normal value according to Harmann (2000).

Discussion:

The purpose of this study is to build up a spine screening program for schoolchildren and students. Factors such as BMI, sitting time, sitting posture, type of backpack, frequency of exercise need to be proven as one of the causes of spinal deformity so that more effective

measures can be taken in protecting the spine of students. However, this study has not been able to prove that yet.

In general, most of the participating students showed signs of scoliosis, which are cases of idiopathic scoliosis. The causes leading to this type of scoliosis mostly arise due to the wrong posture in daily life, the intensity of work is not suitable for age, lack of sports activities, etc. From studies and surveys on scoliosis and its influencing factors [3], [4], [5], it shows the need to change the tables and chairs used in schools, desks and chairs. chairs should be appropriate for the height and weight of the student; lighting must be good, do not let children lower their heads when studying; Besides developing educational programs in schools that teach children to maintain correct body posture. Carrying a backpack that is too heavy is also a cause of great influence on children.

Therefore, it is necessary to take measures to reduce the weight that students have to carry when they go to school. Can reduce the number of school supplies of students. Allocate enough space for schools and the cost to build bookcases and shelves that are not always brought to school, and plan to control the books and supplies students bring to school each day. Creating conditions for children to be active in sports and physical training, besides that, nutrition is also an important factor for children's development, good physical condition is a condition for good health. .

Since then, it has been found that screening for spinal diseases early is very important in later treatment, avoiding dangerous complications. However, the limitation of this study is that the sample size is too small (n = 9) so it has not been able to produce statistical results. Participants were only about 21-22 years old from Polytechnic University. If further research can expand the audience to more age groups or subjects other than students, or it can involve students from many schools to get the most objective data representing the target audience, students in general.

Conclusion

Research shows that this method can reconstruct the spine and the entire dorsal surface, in addition to providing parameters of the spine, it also gives us relevant parameters that can evaluate the internal structure. This is really an effective and fast method to assess the condition of the spine without radiation harm. The reliability of the method has been verified through many studies [6], [7], it can be as widespread as X-ray today. In the future, it is necessary to disseminate and improve knowledge of scoliosis prevention and rehabilitation widely to all students, students and people around. Simultaneously with the development of computers in big data processing, the use of artificial intelligence (AI) in spine screening will be applied to help save time and increase the accuracy of measurements and scoliosis screening becomes easier.

Acknowledgment

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