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# Comparison of upper body alignment assessment in traditional and Aston paradigm

**Mohammad Kargar**
MSc Student of Corrective Exercise and sport injuries Faculty of P.E & Sport Sciences University of Guilan, Iran
Email: mohammadkargar8797@gmail.com

**Ali Shamsi Majelan**
Assistant professor, Department of Corrective exercise and sport injuries Faculty of P.E & Sport Sciences University of Guilan, Iran
Email: Alishamsim@yahoo.com

***Abstract*---**Introduction: From the past until now, many different methods have been tried to measure upper body abnormalities. The Aston evaluation model is one of these new methods of measurement. The purpose of this study is to compare the evaluation of upper body alignment in two traditional and Aston evaluation models. Materials and Methods: 60 students between 13 and 17 participated in this study. The craniovertebral method was used to evaluate forward head posture, the flexible ruler method was used to evaluate kyphosis and lordosis, and the Scoliometer was used to evaluate uneven shoulder and Scoliosis. A camera was also used to assess the upper direction of the trunk using the Aston model evaluation method. In this study, a non-parametric chi-square test was used to compare evaluations in the two methods. Results: The results of this study indicate that There is no significant difference between traditional and Aston measurements in assessing the alignment of the thoracic and lumbar spine in the sagittal and frontal plane. However, there is a significant difference between the two measurement methods in assessing the cervical spine and shoulder. Conclusion: According to the results of the present study, to evaluate the direction of the thoracic and lumbar spine, the Aston evaluation model can replace traditional methods. However, in assessing the direction of the cervical spine and shoulder, these two methods were significantly different from each other. Due to the novelty of the research and the lack of background on the Aston method, more studies are needed.

***Keywords*---**traditional assessment, Aston paradigm, musculoskeletal screening, upper body assessment*.***

## Introduction

Stature abnormalities prevalence is common among students due to various causes, including insufficient knowledge and information about adolescents (age of secondary and high school) [1]. In developed countries, people are screened at their school age to do the primary stages of diagnosis and assessment of abnormalities as soon as possible. On the other hand, physical status and stature structure are related to physical and mental health, and this connection may affect the individuals' self-confidence [2]. The first step to prevent structural abnormalities is epidemiology, identification, and evaluation of affected and susceptible individuals. Epidemiology of abnormalities aims to screen and identify height abnormalities and make a plan to prevent the development of these abnormalities [3]. Various methods have been introduced to evaluate posture owing to identified musculoskeletal abnormalities and injury risk factors. In general, as an essential health index, posture affects the activity of other organs and systems of the body [4].

Aston assessment paradigm is one of the modern noninvasive posture assessment methods providing the therapist with suitable information required for identifying client's abnormalities with few facilities and fast evaluation. Aston's paradigm was introduced in a book published in 2019. Judith Aston, a physical education graduate from the University of Los Angeles with 30 years of experience in this field, designed this paradigm. This paradigm emphasizes the visual assessment and skill of seeing the natural dimensions of the body dynamically in a 3D space as an integrated paradigm. Aston believes that, in terms of approach, traditional posture assessment considers the body a fixed structure and evaluates it based on a 2D context without considering how body organs are positioned relative to each other by assessing the soft tissue only on the alignment of the joints (regarding the vertical line). Hence, the traditional assessment must be changed, and the concept of seeing all body parts in a 3D context must be added to this approach considering its effect on the alignment, dimensions, and asymmetry. Aston's assessment skill is based on the use of mages, visual assessment ability, and a Ball body [5]. Various studies have compared the assessment methods. For instance, Rose and Hart compared the obtained results with Radiography to validate the flexible ruler, and Siedi et al. compared the validity and reliability of the flexible Iranian ruler in lumbar lordosis measurement with radiography. Moreover, Yousefi et al. compared the validity of the BLA* system with radiography, and Fadaee et al. compared the validity and reliability of spinal mouse with radiography [6-9].

Moreover, many studies have assessed the upper body and concluded that early diagnosis of spinal and shoulder disorders, including scoliosis, kyphosis, lordosis, uneven shoulder, forward head, hip deviation, and shoulder deviations that are prevalent in adolescence could prevent their development and occurrence of new deformities [10]. Many studies have examined the prevalence of spinal and shoulder problems in normal people. For example, Daneshmandi et al. compared the spinal abnormalities between male and female students and found 79.75% and 81.66% spinal abnormalities among boys and girls, respectively. Moreover,

* Body Landmark Analyzer

they found 80.68% of abnormalities in the whole studied society [11]. Saneh studied the postural structure of female middle school students, and 34% of them had upper extremities abnormality [12]. Numerous studies have been done on traditional methods used to assess body alignment and musculoskeletal abnormalities. However, an evaluation method that does not require many tools and is the high cost is needed to have a simple method to screen students and people of a society in a broader range and higher speed rather than the traditional assessment model. Therefore, this study compares the upper body alignment assessment in two traditional and Aston assessment methods.

**Method**

This was a descriptive-comparative study in which data were collected through field study, and measurements were done quantitively and qualitatively. The statistical sample of the study comprised 60 active male students (in the age range of 13-17) in Rasht County (they had 3-5 exercise activities per week within permanent 60-minute workouts last year). Participants were selected using purposive and convenient sampling based on the inclusion and exclusion criteria [13]. Exclusion criteria included improper cooperation of respondents and unwillingness of participants or their parents to continue the test. Inclusion criteria consisted of the male gender of students, lack of any fracture, surgery, disease, and pain during the assessment, and having regular physical activity in the past year based on the WHO's definition.

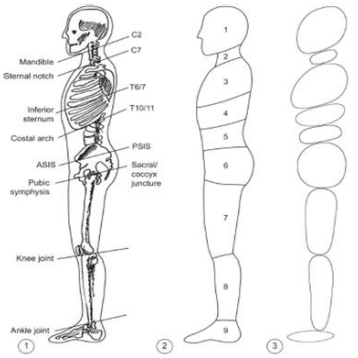
Moreover, the ethics code of study was received from the ethics workshop of the physical education research center (proposed ethic code: SSRI.REC-2112-1416 (R1)). Since the results are qualitative in the Aston measurement method, any deviation from normal status (even a mild deviation) in any traditional assessment is considered an abnormality. Different methods exist in traditional paradigms to evaluate kyphosis and lordosis and determine the angle; however, researchers used flexible rulers due to their high validity and reliability and repetitive application in studies. In this research, respondents were asked to wear clothes that allowed the convenient examiner measurement. Respondents stood in a line barefoot while there was a 10-15cm distance between respondents' feet. They remained in normal posture for 2 minutes until their body reached a normal and comfortable state. Examiner then marked points T2-T12 and s2-t12 for kyphosis and lordosis measurement, respectively [14]. In the next step, the examiner shaped the flexible ruler on the individual's spine and drew the resulting shape on the paper. Finally, the abnormality degree was calculated using the formula $\theta = 4 \text{ Arc tan } 2H/L$ [15, 16]. Scoliometer was used to measure Scoliosis. In this measurement, a person should stand with legs together and trunk flexion while knees are straight and hands are hanging. Examiner used Scoliometer to measure the deviation degree.

If the angle measured by a Scoliometer at any level of the spine varies between zero and seven degrees, the Scoliosis is mild, while the patient suffers from severe Scoliosis when the degree is greater than 7 [16, 17]. Forward head posture is a misalignment of the head to the trunk, and the craniovertebral method in the sagittal plane was used to measure this abnormality. This angle is measured based on the connection between the horizon line and the line crossed through

the c7 vertebra and the posterior part of the ear tragus. The intersection between these two lines shapes the craniovertebral angle, which is the angle on which the head is placed in forward head abnormality. An angle less than 49.9° is considered an abnormality [18, 19]. Scoliometer was used to measure uneven shoulders. In this case, the Acromion blade on both sides is marked, and arms are placed on the device to observe and record the upward and downward deviation of shoulders based on the degree [20].

To assess with the Aston method, respondents' photos were taken in the first step using a canon camera on a stand with a 1.5m distance from respondents to take front, back, right, and left views. Respondents had to wear suitable clothes when photos were taken from different views (so the ability was to see the structural shape of the body). Respondents were asked to stand in a convenient posture without any abnormal contraction and tension in the muscles looking at their opposite side. Photos of respondents were printed in the next step so the researcher could draw the ball body and conduct the musculoskeletal evaluation. In this paradigm, the examiner divided the body into nine parts to see all angles.

The nine parts include: 1) head, 2) neck, 3) upper part of the chest, 4) lower part of the chest, 5) abdominal/lumbar part, 6) pelvis, 7) upper part of the leg, 8) lower part of the leg, 9) sole. This study aims to evaluate the upper body alignment; hence, five balls out of nine balls were needed: 1) head, 2) neck, 3) upper part of the chest, 4) lower part of the chest, and 5) abdominal/lumbar part. Assessment steps based on the Aston method by the examiner include the first step: converting the respondents' image to nine balls in four views 1) landmark reference, 2) outlined segments 3) ball body.




Shape 1- landmark reference outlined segment ball body

Second step: After the respondent's image was converted to nine balls of body, the symbols proposed by Aston were added to the body to identify musculoskeletal abnormalities. The symbols included 1) using the X symbol to determine the reference point, 2) drawing the plumb line, 3) determining the center of each segment and connecting the points, and 4) drawing horizontal arrows to find the location of anterior and posterior sections relative to the plumb line. However, it is worth noting that the length of arrows is drawn based on the displacement of each segment relative to the upper (when beginning from the bottom) or lower

(when beginning from the top) part. 5) drawing ⬆ to show the point that bears the heaviest weight, 6) drawing ↻ to show rotation in body extremities [5].

Shape 2. An example of assessing anterior and posterior views based on the Aston method

After the sample size was determined, data on personal profiles and medical records were collected through a researcher-made questionnaire. Some ethical principles were considered in the research process: informing and signing consent letters, disclosing information, and imposing no cost on families. In this research, the results of the non-parametric Chi-square test were reported using SPSS26 software. The significance level of the Fisher test was used because at least one of the categories of the table had an expected frequency of less than 5.

Table 1 reports the results of the demographic data of research samples (students)

Table 1
Personal profile of students

| Variable | Number | Average | Standard deviation |
|---|---|---|---|
| Age | 60 | 14.10 | 1.32 |
| Height | 60 | 163.33 | 13.3 |
| Weight | 60 | 51.93 | 11.88 |

The tables below report the results obtained from compared patterns in each variable (forward head, uneven shoulder, kyphosis, lordosis, and scoliosis). This study used a non-parametric chi-square test for data analysis because the data were nominal.

Table 2
Results of Chi-square test to compare cervical, thoracic, lumbar, and shoulder spine alignment in two traditional and Aston alignment

| Variable | Classes | Group | | The amount of chi-square | P |
|---|---|---|---|---|---|
| | | Traditional | Aston | | |
| Kyphosis | Has | 29 | 34 | 3.45 | 0.07 |
| | Does not have | 31 | 34 | | |
| Scoliosis | Has | 18 | 20 | 1.42 | 0.37 |
| | Does not have | 42 | 40 | | |
| Lordosis | Has | 46 | 44 | 0.76 | 0.492 |
| | Does not have | 14 | 16 | | |
| Forward head posture | Has | 18 | 24 | 31.79 | 0.00 |
| | Does not have | 42 | 36 | | |
| Uneven shoulder | Has | 42 | 53 | 11.71 | 0.002 |
| | Does not have | 18 | 7 | | |

**Discussion and Conclusion**

This study aims to compare the upper body alignment in two traditional and Aston assessment patterns to help experts identify musculoskeletal abnormalities with lower speed and cost. According to the results reported in Table 2, there was no significant difference between traditional and Aston assessment patterns in the sagittal plane's thoracic and lumbar spine segments. Hence, the Aston paradigm can be used in musculoskeletal screenings to evaluate abnormalities. However, a significant difference exists between traditional and Aston assessment patterns in evaluating cervical (forward head) and shoulder (uneven shoulder) spine alignment. Therefore, the Aston assessment paradigm cannot be used. Although it was tried that respondents become familiar with the assessment conditions, a cause led to a significant difference in assessing cervical and shoulder spine. This cause was that students were too young and could not hold their heads in normal posture when they stood in front of the camera (photos used in Aston assessment). Many studies have been conducted on different types of traditional methods. Radiography is the gold standard for assessing the spine. Sagittal plane radiography is used to evaluate forward head, Kyphosis, and Lordosis in the frontal plane for Scoliosis [21, 22]. However, some limitations, like risks caused by radiation for individuals and high cost, upper vertebrae of the thoracic spine in the sagittal plane are not observed clearly due to the scapula and arm bone. Moreover, radiography cannot be used in screening a high number of participants. In this line, there are studies on noninvasive methods to assess the cervical spine. In studies by Lau et al., Neiva et al., and Smith et al., examiners need a special0.

Method and tools that are expensive and unavailable [23-25]. Checkerboard, plump line, and New York are other noninvasive methods that Griegel-Morris et al. and Kim et al. used [26, 27]. A previous study used the craniovertebral method to measure the forward head and showed a high-reliability correlation of 0.88-0.98 [28]. Different noninvasive methods, including spinal mouse, spinal pantograph, and kyphometer, exist to assess the spine in Kyphosis and Lordosis abnormalities [29, 30]. The flexible ruler is one of the validity of tools in measuring dorsal kyphosis and lumbar lordosis and has been reported equal to 0.87, 0.87, and 0.91 in many studies, such as Hart and Rose, Tilloston, and Seidi, respectively. According to previous reports and research, the flexible ruler was used in the present study because is a convenient and available tool [6, 31, 32]. The Cobb Measurement method is the main standard to measure scoliosis. As explained, this study used a noninvasive Scoliometer tool suitable reliability has been reported in different studies, including Amendt et al. who indicated proper reliability of the measurement tool. They suggested using this tool as a suitable screening device based on the positive analysis of data [33, 34]. Different methods such as checkerboard and different types of Scoliometer is used to measure uneven shoulder. This study used the Scoliometer measurement method [20, 35]. Unlike the traditional assessment paradigm that many studies have addressed, no study has examined the Aston technique. Aston paradigm has been used by individuals who have been trained by Judith Aston or those who have studied her books. Aston explains that visual sources are useful for therapists and clients. The advantages of this method for therapists include: 1) recording posture images from four views at the start point of therapy as the reference landmark, 2) comparing changes in clients during sessions, 3) therapy results can be documented at the end, 4) the next step determined the therapy and different segments of body desire caused by the therapy. The reason is that results may indicate a region we neglected before.

Aston assessment paradigm helps clients to see themselves from the side or back view (this is usually an experience that opens their eyes to different views of the body), providing the best posture by observing personal patterns before exercise (pretest), during the exercise, and changing pattern after the exercise. This method helps the therapist facilitate diagnosis by prioritizing and sequencing the therapy and provides a system to improve assessment skills by finding and compromising connections between one part of the body and other parts. Moreover, this paradigm contributes to using and creating coherence between abnormalities by learning different techniques. Another advantage of Aston's approach is its application for all individuals, from professional athletes to physical and nervous patients, increasing the ability to practice therapies for analysis and identification of client's body pattern, the collaboration of different patterns with misalignment symptoms for more effective intervention, and observing body view as a whole (each segment represents connections between body organs). The mentioned advantages help therapists to identify and plan patient therapy allowing them to find those regions with compression, excessive stretch, reduction in dimensions, hypermobility, or hypomobility. This paradigm helps therapists to show how body pattern works when facing fatigue, overuse syndrome, and pain. Moreover, Aston increases therapists' ability for visual assessment of different patterns of the body [5].

According to previous studies, the mentioned tools for traditional assessment were introduced as the most common and valid tools used to evaluate musculoskeletal abnormalities. Hence, this study used these tools to compare the Aston assessment pattern with the best traditional assessment method. Therefore, the results of the present study and previous studies indicate no difference between traditional and Aston assessment patterns in evaluating thoracic and lumbar spine alignment, so the Aston assessment paradigm can be used in screening high-number societies to accelerate measurement. Aston paradigm provides other benefits, such as easing the work because respondents do not have to be present in the test location for long, and any unique laboratory tool is not required. However, there was a significant difference between traditional and Aston assessment paradigms in evaluating cervical and shoulder spine alignment. In general, the Aston paradigm is novel, and there is no sufficient background for it, so further studies must be done in this context.

**Article Message**

According to high-speed measurement in the Aston method and results obtained in this study, it is recommended to use this paradigm in screening projects that aim to evaluate thoracic and lumbar spine alignment in the sagittal and frontal planes.

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