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The Relationship between Balance and Spinal Deformities in Young Adult Female

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Abstract:

Background: Spinal deformities have been considered to affect balance. This study's purpose is to further investigate the relationship of spinal curves alignment as a whole and its effects on balance on young adult Saudi female. Such study can provide vital information for therapeutic approach in treatment of these patients. We hypothesize that there is a relationship between balance and spinal deformities in young adult Saudi female population. Methodology: A cross sectional randomized control trial of 60 young adult females aged from 18 to 25 years old who will subjected to spinal assessment by (DIERS Formetric III 4D) and balance assessment by (BIODEX Balance System). Data will be analyzed by using descriptive statistics and inferential statistics including t.test with a significant level of 0.05.

Results :The results of this study showed that there was a statistically significant reduction in postural stability normal group compared to lordosis group in open eye stability test which was significant. Conclusion: there is an effect of spinal deformities on balance in young adult female Specially lordotic deformities .

Key words: spinal deformities ,balance ,posture

Introduction:

The spinal column is an essential part of the human body providing posture and allows movement and flexibility while protecting the spinal cord(1). Misalignment of the spine or abnormality in the spinal curvature is the definition of spinal deformities . they can be genetic or developmental(2). These deformities include changes in the spinal curve in a sagittal plane either posterior (Kyphosis) or anterior (Lordosis) . also changes in the frontal plane (Scoliosis)(3).It is also possible to have more than one deformity at a time. Everyone is vulnerable and prone to have one of these abnormalities at any point of their life time as poor static and dynamic posture have a great effect in developing them (4).

Posture is the position assumed by the body and limbs in relation to each other to maintain stability with minimum strain and effort (5). posture is closely related to balance which can be defined as the ability to maintain the body segments in relation to the body's center of gravity (COG)(6). Good posture is one in which all the body segments work together to create an equal distribution of stresses on all the body protecting it from injuries or deformities(4). Vestibular, visual and somatosensory systems work together to maintain balance. Thus, any impairments or alterations to these systems can cause alteration in balance(6). A persons inability to maintain balance or restoring it indicates a problem in postural control, which in turn can be easily affected by cognitive , skeletal or motor deficits(7).

Changes in the body like physical injuries , impairments or deformities have been proven to have effects on balance. As proven in cases of ankle injuries (8), this also applies in cases of spinal deformities . There have been research evidence of such relation but mostly were focused on one type of deformity either scoliosis(9) , thoracic kyphosis , lumbar kyphosis or lumbar lordosis(10). Some other researches that did study the entire alignment of the spine only chose older group of people for their studies in ages ranging from 50-95 years suffering from diseases like osteoporosis(11).However, despite the differences in research criteria of the previous studies all arrived to the same conclusion, which is that spinal deformities lead to an increase in spinal inclination leading to a shift in COG causing postural imbalance which increases risk of falls and injuries(12).

The DIERS formetric 4D analysis system permits rapid static and dynamic (functional) optical measurement of the human back and spine. The procedure is radiation-free and operates without contact. Numerous clinical parameters for objective analysis of body statics, posture, scoliosis, and all forms of spinal deformities can be shown. The new 4D technology leads into functional clinical measurement technology, to increase measurement precision (4D averaging) and to avoid postural variances. Although studies relating spinal deformities to balance have been made before using various inclusion criteria. Yet remains a need for a better understanding of the influence of spinal curvature as a whole on balance of young adult females, as little is known about its impact at that age. Therefore, the aim of this study was to find the relation between spinal deformities and balance in young adult Saudi female population.

Significance of study : The results of this study would pay attention on balance defects when managing postural deformities in such subjects.

Results:

All data was statistically analyzed by SPSS software and descriptively analyzed by calculating the mean and standard deviation of overall stability for all groups and inferential statistics including t.test with a significant level of 0.05.The results of this study revealed reduction of stability in subjects suffered from spinal deformities .there was a significant effect on stability in lordotic subjects while this effect did not approved statistically in kyphosis and scoliotic subjects when compared with normal subjects

Methodology:

Study design : a cross sectional randomized controlled trial study .

Subjects :60 young Adult females (aged between 18 and 25 year) from Dammam university and signed on a consent form .

Inclusion Criteria: subject with normal BMI (between 18 – 25 kg/m2)

Exclusion Criteria: subject free from neurological ,musculoskeletal and vestibular disease , orthopedic operation and leg length discrepancy .

Instrumentations:

1-Biodex balance system (Figure 1)

It is used to measure dynamic balance. It consists of dynamic multiaxial platform, which can be set at variable degrees of instability. The system is interfaced with computer software and connected with Epson printer

to print the test results . Biodex balance system can evaluate the horizontal anteroposterior stability and mediolateralstability.(13)

Figure1: Biodex Balance System

2-DIERS Formetric III 4D (Figure 2)

it is a new tool used in spine and posture measurement. Body scan technique enables a contact free, radiation free, 3D analysis of the back under more functional conditions. (DIERS international is an exhibitor at the HOSPIMEDICA Bangkok).(14)

Figure 2: DIERS Formetric III 4D

3- Digital Scale (Figure 3)

It measures height and weight

Figure 3: Digital Scale

4-Tape measurement.

Procedure :

Each female subject will undergo these procedures :

- Wight and height will be measured for BMI
- After measurement of BMI we measure the leg length to check for discrepancies.
- Then the subjects matching our criteria, will undergo the test for spinal deformities using DIERS Formetric III 4D.
- The subject stands on marked point on the floor with her back exposed to the camera .
- Depending on the Formetric data results the subjects will be divided into two groups control (Normal, have no spinal deformities) and study group (have spinal deformities)

- After division each of the groups will undergo stability level evaluation using Biodex Balance System. In which the subject should center himself on the platform before starting the test. In this position the center of gravity of the body is centralized over the point of the vertical ground reaction force. Then the subject is instructed to achieve a centered position on the platform when it is released by shifting position of feet (foot) to keep cursor centered on the screen grid. The subjects keep this position while investigator identifies the subject's foot or feet position of platform grid through recording the heel coordinates and foot angle. Heel coordinates are measured from the center of the back of the heel while the foot angle is determined by finding a parallel line on the platform coincided to the center line of foot (third metatarsal). All these values of position are recorded on the balance system computer software to be used in each test to ensure the consistency of the tests to be performed in the same centered position.

The subjects assume test position which is Standing with both feet together with eyes open and close eyes.

- All tests are to be done with the Biodex Balance system at stability level eight (most stable level). The subjects will be instructed to maintain a level platform for a period of 20 seconds. The stability index will be obtained from each subject in both control and study groups from which the data will be collected for analysis.

Statistical analysis:

SPSS will use for all statistical analysis. data will descriptively analyzed by calculating the mean and standard deviation. and inferential statistics including t.test with a significant level of 0.05.

Results:

This study was done to investigate the relationship between spinal curvature deformities and balance in young Saudi females. The subjects included in our study 50% were normal , 33.3% lordotic and 17% were scoliotic as shown in figure 1 and table 1, with an average BMI of study group 21.873 and Standard deviation was 1.9696 and their mean age was 20.47 also for the control group the average BMI was 21.9 and Standard deviation was 1.4363 and their mean age was 20.93 as shown in table 2 . The data showed reduction of stability in subjects with spinal deformities. There was a significant effect on stability in lordotic subjects in open eye test ($p<.05$) while reduction in stability was significant in scoliotic and lordtic subjects in closed eyes subjects when compared to normal subjects as shown in Table3.

Figure 1: Sample size of normal , scoliolordotic groups

	Normal	Scoliosis	lordosis
Subjects number	33	12	15

Table 1 : Sample size of normal , scoliolordotic groups

Mean (S.D) of control group	Mean (S.D) of study group	
20.93(.594)	20.47(1.125)	age
21.9(1.4363)	21.873(1.9696)	BMI

Table 2: Mean and Standard deviation of age and BMI of both groups

	Mean(S.D.)		
	Normal	Scoliosis	Lordosis
Balance with open eye	.727(.4301)	1(1.0392)	1.210(.5301)*
Balance with close eye	4.507(3.0980)	5.020(3.3447)	4.430(2.6209)

Table3: mean values and standard deviation of balance with open and close eye for normal, scoliotic and lordotic groups. The * denotes a statistically significant difference with $p < .05$

Figure 2: mean of balance with open and close eye for Lordotic, Scoliotic and normal groups

Figure 3: Standard deviation of balance with open and close eye for Lordotic, Scoliotic and normal groups

Discussion :

Based on the results, subjects with lordosis demonstrated a positive correlation with postural stability in both open eyes and closed eyes but in case of scoliosis the results were statistically significant in closed eyes only . Which meant there was an indication of the presence of a relationship between spinal deformities and balance. The results are parallel with Y. Ishikawa et al.(2009) although their studies of the effects of balance were on osteoprotic male and female aged between (50-96 years) discovered that lumbar curvature is an important factor in postural balance and incidence of falls.(1) Thus any changes in the alignment of lumbar curve it would affect balance. Also Georgios A. Styliandes et al. (2013) who

studied Idiopathic Scoliosis aged 12.9 -/+1.6 showed a distorted balance in the subjects of their study. (9)

Conclusion:

It was concluded that there was a relationship between spinal deformities and balance in adult Saudi females which provide vital insights on risks of falls and treatment plans to improve balance when treating spinal deformities in such cases.

References:

1. Hawes MC, O'Brien J P. The transformation of spinal curvature into spinal deformity: pathological processes and implications for treatment. Scoliosis. 1(1):3. 2006;

2. Dalleau G, Damavandi M, Leroyer P, Verkindt C, Rivard CH, Allard P: " Horizontal body and trunk center of mass offset and standing balance in scoliotic girls". Eur Spine J. 20(1):123-8. 2011

3. S.Negrini LA, C.Ferraro , P.Fraschini , S.Masiero , P.Siomnazzi , C.Tedeschi , A.Venturin Italian guidelines on rehabilitation treatment of adolescent scoliosis. Eur Medicophys;41-46, 2005

4. Bunnell WP. Selective screening for scoliosis. Clinical orthopaedics and related research. (434):40-5. 2005

5. Gerard J. Tortora SRG, Bonnie Roesch , Gerald J. Tortora. Principles of anatomy and physiology. 2nd edtion pp:345:356, 2003.

6. Dalleau G, Allard MS, Beaulieu M, Rivard CH, Allard P: " Free moment contribution to quiet standing in able-bodied and scoliotic girls". Eur Spine J.; 16(10) Oct; 1593-9. 2007

7 Pollock AS, Durward BR, Rowe PJ, Paul JP. What is balance? Clinical rehabilitation.;14(4):402-6. 2000

8. Refshauge KM, Raymond J, Kilbreath SL, Pengel L, Heijnen I. The effect of ankle taping on detection of inversion-eversion movements in participants with recurrent ankle sprain. The American journal of sports medicine.;37(2):371-5. 2009

9. Stylianides GA, Dalleau G, Begon M, Rivard CH, Allard P. Pelvic morphology, body posture and standing balance characteristics of adolescent able-bodied and idiopathic scoliosis girls. PloS one. ;8(7), 2013

10. Wang HJ, Giambini H, Zhang WJ, Ye GH, Zhao C, An KN, et al. A modified sagittal spine postural classification and its relationship to deformities and spinal mobility in a chinese osteoporotic population. PloS one. ;7(6), 2012

11. Ishikawa Y, Miyakoshi N, Kasukawa Y, Hongo M, Shimada Y. Spinal curvature and postural balance in patients with osteoporosis. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA.;20(12):2049-53. 2009

12. Kasukawa Y, Miyakoshi N, Hongo M, Ishikawa Y, Noguchi H, Kamo K, et al. Relationships between falls, spinal curvature, spinal mobility and back extensor strength in elderly people. Journal of bone and mineral metabolism.;28(1):82-7. 2010

13. Ibrahim AI, Muaidi QI, Abdelsalam MS, Hawamdeh ZM, Alhusaini AA. Association of postural balance and isometric muscle strength in early- and

middle-school-age boys. Journal of manipulative and physiological therapeutics.;36(9):633-43. 2013

14. Rigo M, Quera-Salva G, Villagrasa M. Sagittal configuration of the spine in girls with idiopathic scoliosis: progressing rather than initiating factor. Studies in health technology and informatics.;123:90-4. 2006