Vertebral Column Morphology of High Level Fencing Players

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The purpose of the study is to investigate the vertebral column morphology in the thoracic, lumbar & sacral sections as well as identifying the incidence of scoliosis in high level fencing players. The sample was composed of 15 players from the National Egyptian Fencing Team and were chosen by the selective method. The Spinal Mouse device was used to evaluate the vertebra using descriptive methodology. Six tests in three positions (standing, flexion and extension) were done to simulate the physical performance of the sport. Statistical evaluations suitable for the study were used: mean, standard deviation, Spearman and Person correlation factors. The results showed a higher mean difference in the lumbar areas in the flexion position 48.73 degrees in comparison to the thoracic and sacral area. Meanwhile a higher mean difference for the thoracic and sacral area in the extension position 26.06 & 40.73 degrees consecutively confirmed by Spearman and Person correlation factors. There was no scoliosis in the sample. The researcher recommends focusing on strengthening exercises of the abdominal and lower back muscles ensuring the efficacy and stability of the vertebral column.

Keywords: scoliosis, kyphosis, spinal mouse, extension, sagittal position.

Introduction

Alricsson, M. and Werner, S. (2006) mentioned that the vertebral column is considered to be the main axis of the body .The rest of the skeletal system is attached to it and plays an important role in body movement .It is made of bones and cartilage and it gives the body its posture and strength. The structure of the bones suit their mechanical function whether static or dynamic. Bones are linked together by joints that act like levers and with the help of muscles, they complete the desired movement and maintain the body balance.

Ahmed Khater (1996) mentioned that the vertebrae grow by the same magnitude in height and width at the age of three. The vertebrae and spinal canal grow quickly till the age of 5 and the body growth continue till the end of high school. Most of the cervical, thoracic and lumbar vertebrae growth are completed by the age of 20, the sacrum vertebrae grow until 25 years and the coccyx vertebrae growth is completed by the age of 30.

Kurt et.al (2003) and Sean Hanrahan (2005) stated that if we look to the vertebral column in a sagittal position (front–back), we would find that the vertebral column is composed of 4 physiological curvatures 2of them heading forward (cervical and lumbar) and called lordosis. The other 2 heading backward (thoracic and sacrococcyx) and called kyphosis.

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These curvatures are strengthened due to the strength of the muscles, joints and cartilages. The cervical and thoracic curvatures are completed at the age of 7 and the lumbar curvatures are completed at the age of 12.The complete growth of the vertebral column happens at the age of 18 -20 and its main function is to maintain the body balance around an equal axis between the different curvatures.

Alricsson, M. and Werner, S. (2006) stated that the training skills for the different sports depend on a group of theoretical basics and scientific rules related to the human body's activities, which must be practically adopted to explain the body balance, and movement .This is done through the study of the skeletal-muscular system morphology, which will enable trainers to provide proper training.

A.Lopez- Minarro et.al (2011) mentioned that athletics have special features in the vertebral column curvatures depending on the type of sport practiced. Fencing is considered an acyclic non repetitive sport depending on one side movement .The trunk movements during performance varies between quick flexions and extensions from the sagittal spinal position. The high training loads with repetitive movements in the trunk lead to morphological changes of the vertebral column for example affecting the lumbar vertebrae, tension of the abdominal and lumbar muscles in addition to an increased risk of injury due to increased inner pressure on the vertebrae.

Grabara, M. and Hadzik, A. (2009); Caldwell, J.S, McNair, P.J. and Williams M. (2003); Young, J. L. (1996) have done many studies on the effect of the athlete's different positions during performance on the morphology of the vertebral column. Rowing, volleyball and water skiing involve quick repetitive flexion and extension of the trunk.

Jose M. Muyor, et.al (2011); Pedro A.Lopez - Minarro et.al 2011) concluded that cyclists during performance are forced into the flexion position which affects their trunk. Athletes in sports with frontal curvature positions e.g cyclists ,skiers ,and canoeists have been found to have kyphosis during standing position while canoeists have decreased thoracic and lumbar curvatures in sitting position.

These studies are only done by modern computerized devices to be able to give specific information .The Spinal Mouse device measures the angles between the vertebrae in the whole vertebral column except the cervical section. It discovers any deviation in the vertebral column and compares them to the normal measurements according to age, sex. It is an important device in the sports field, and all studies are performed on it. This research studies the vertebral column morphology for elite fencing player.

The researcher finds that fencing exerts morphological changes on the vertebral column especially for elite player's .The aim of this study is to know the effect of fencing on the vertebral column and the incidence of scoliosis occurring to elites.

The purpose of the study is to identify the vertebral column morphology of fencing players in the thoracic, lumbar and sacral sections as well as identifying the incidence of scoliosis occurring to fencing players.

Method

Participants

The sample has been chosen by the selective method and it is composed of 15 players from the National Egyptian fencing team. The following table 1 shows the characteristics of the sample.

Table 1 Descriptive Characteristics of the Sample (N=15)

Parameters	Mean	Standard deviation	Skewness
Age (years)	19.18	2.71	1.24
Height (cm)	180.7	6.54	0.12
Weight (kg)	71.87	9.33	0.42
Training (years)	10.62	2.18	1 .23

Measures

The Spinal Mouse device is a wireless unit used to measure the angles between the vertebrae of the whole vertebral column except the cervical section. It also discovers any deviations and compare it to the normal vertebra, which is calibrated in the computerized unit according to age, and sex, that is why it is considered one of the modern important devices in the sports field.

The Device is composed of 2 main units:

- The unit that moves along the vertebral column.
- The unit attached to the computer.

The unit attached to the computer transmits the signal to the computer program for data analysis and it's calibrated to the 3 testing positions. The players data is entered on the computer program and then the testing position is selected from the screen .Press the left button to start and slowly move down the vertebral column starting from the first vertebra in the thoracic spinal till the sacrum vertebra and then press the left button to finish the test .The figure of the vertebral column is then shown on the screen. The same steps are done for tests 2 and 3.At the end the results of the vertebral column is shown.

Procedure

The required Procedure were prepared to perform the test at the laboratory of the Physical Education College for boys in Helwan University on 12/2/2015 to evaluate the vertebral column of the research sample.

The device has different tests but the researcher chose 6 tests suitable for the nature of the research:

a) Testing vertebral column in upright standing position.
b) Testing vertebral column frontal curvature – flexion position.
c) Testing vertebral column backward curvature – extension position.
d) The previous tests investigate the research 's first objective with its 3criteria (Attachment 1).

The following tests investigate the second objective of the research (Attachment 2).

a) Testing vertebral column in upright standing position 2.

b) Testing vertebral column in upright standing position and bending towards the right (Upright – Right).
c) Testing vertebral column in upright standing position and bending towards the left (Upright – Left).

The following data were obtained for each position in the 6 tests:

- The measure of the angles between 2 adjacent vertebrae.
- The angles for the vertebral column curvatures.
- The length of each section of the vertebral column from the first thoracic till the sacrum.
- Total lumbar section (Lumbar/Spinal).
- Total thoracic section (Thoracic/Spinal).
- Total sacral section (Sacrum/hip).
- Vertebral column inclination (Incl).
- General vertebral column (length).

Rules for testing the vertebral column:

- The researcher used one of the laboratory's assistants to help in conducting the tests.
- Excluding any player who had previously complained or suffered from pain in the vertebral column.
- Identifying the standing position by making a mark on the floor.
- Maintaining the distance between the player and the device by 1 meter.
- Making marks on the vertebral column while conducting the test for precision in case the device gets off track, then an error will show on the computer screen, so the test will be repeated.
- Keeping the hands still next to the body during the testing.

Results

The following table 2 compares the average difference between the three positions.

Table 2 Mean Difference between the 3 Positions (Standing-Flexion-Extension) (N=15)

Parameters	Standing	Flexion	Extension
SAC\HIP	4.661	1.086	26.06
TH\SP	30.26	38.13	40.73
L\SP	41.33	48.73	44.80
INCL	5.299	6.123	5.111
LENGTH	5.299	5.299	5.299

Table 2 shows the mean difference between the 3 positions. It shows the curvature of the lumbar section in the flexion position and the curvature of the thoracic and sacrum section in the extension position.

The Following Table 3 Shows the Relation between the three Positions.

Table 3 The Relation between the Thoracic, Lumbar and Sacrum in the 3 Positions using Pearson Correlation Factor (N=15)

Correlation between the 3 positions(Pearson)	
Correlating Point	**Correlation**
(Lumbar/Spinal) Stand &Flex	.871
(Lumbar/Spinal) Stand &Exten	.728
(Lumbar/Spinal) Exten &Flex	.629
(Thoracic/Spinal) Stand &Flex	.843
(Thoracic/Spinal) Stand &Exten	.863
(Thoracic/Spinal) Exten &Flex	.373
(Sacrum/hip) Stand &Flex	.657
(Sacrum/hip) Stand &Exten	.098
(Sacrum/hip) Exten &Flex	.536

Table 3 shows Pearson correlation factor indicating there is a statistical significance between the sacrum extension and sacrum standing position equal to 0.98 which is a strong relation as it approaches 1.

To confirm the relation the researcher used Spearman correlation factor:

The following table 4 confirms the relation between the three positions.

Table 4 The Relation between the Thoracic, Lumbar and Sacrum in the 3 Positions using Spearman Correlation Factor (N=15)

Correlation between the 3 positions(Spearman)	
Correlating Point	**Correlation**
(Lumbar/Spinal) Stand &Flex	.888
(Lumbar/Spinal) Stand &Exten	.860
(Lumbar/Spinal) Exten &Flex	.629
(Thoracic/Spinal) Stand &Flex	.881
(Thoracic/Spinal) Stand &Exten	.869
(Thoracic/Spinal) Exten &Flex	.515
(Sacrum/hip) Stand &Flex	.434
(Sacrum/hip) Stand &Exten	.145
(Sacrum/hip) Exten &Flex	.680

Table 4 results matches with the results of Pearson correlation factor.

The following table No.5 shows the average difference in the inclined position.

Table 5 Mean Difference Results for the 3 Positions (Standing 2-Tilting to the left-tilting to the right) (N=15)

Parameter	Standing position 2	Tilting to the left	Tilting to the right
INCL	5.27	5.21	5.21
LENGTH	5.29	5.29	5.29

Table 5 shows the mean difference between the 3 positions indicating there is no difference between the curvatures of the vertebral column and the same length of the measured part of the vertebral column in both directions.

Discussion

The data analysis and presentation of the vertebral column testing's shown in table 2 (the mean difference of the 3 positions in the extension position) shows that there is a higher mean difference for the thoracic and sacrum section indicating that they were the parts affected during fencing performance. This data is also confirmed using Pearson and Spearman correlation factors (tables 3, 4).

Alirckson and Warner (2006) indicate a statistical increase in the thoracic kyphosis of skiers after 5 years. Ogrowska (2007) found a change in the sacrum section of rowers training from 8-20 year. Per A. (2002) indicates that high level players have stronger abdominal muscles than the lower back muscles which is the opposite for non-training people. Table (1) indicates that the training period of the sample reaches 12 years which agrees with Ahmed Khatar (1996).

The number of years performing with continuous high training loads is an important factor in determining the curvatures of the vertebral column .The yearly increase in loads is proportional to the increase in the thoracic curvature in different sports. This matches with what Smith (2008) mentioned that high training loads may lead to loss of the disc height which reduces the length of the anterior column of the spine. This will result in thoracic kyphosis leading to low back pain (sacrum section) as well as bringing the scapula in an anterior tilt and protracted position so restricting the shoulder range of motion.

The data analysis and presentation of the vertebral column testing's shown in table 2 (the mean difference of the 3 positions in the flexion position) shows there is a mean difference for the lumbar section curvature indicating that it is one of the affected areas during performance. This was also confirmed by Pearson & Spearman factors (table 3, 4).

Ahmed Wahid et.al (2007) agrees with the American Orthopedic Surgery Academy (1966) that in the flexion exercise in the thoracic section, the range of motion is less than in the lumbar section 30-40 degrees due to the presence of the thoracic cavity .The range of motion is greater in the lower section of the back because the lower ribs are longer and freely moving. While the lumbar vertebrae range of motion are relatively free 55 degrees, which is less than the sacrum vertebrae range of motion. The link between the lumbar and sacrum sections are responsible for the greater part of motion.

Young J.L (1996) and Ahmed Wahid et.al (2007), explained that the flexion in the standing position depends to a great extent on the earth's gravity. The extensor muscles of the vertebral column facilitates this movement as well as the increase of the pull on the posterior part of the annulus fibrosis, the longitudinal posterior ligament, and the ligament flav. Robert G. & Watkins M.D (1997), Ahmed Wahid et.al ,Burri C.& Ruter.A (2000) confirmed that practical measurements showed that the load on the intervertebral discs upon lifting is less than the calculated load by 30% at the intervertebral disc between the fifth lumbar and the first sacral and less by 50% in the lower thoracic section. This is because the abdominal muscles absorbs this difference due to the strong contraction during lifting.

This is also confirmed by Jose Muyor et.al (2013) indicating that the pelvic area is the base of the vertebral column and the frontal curvature of the pelvis increases the curvature of the lumbar section. While the backward curvature of the pelvis decrease the lumbar curvature.

Table (5) presenting the mean differences of the 3 positions (standing 2- tilting towards the right and left) states that the inclination and the length of the measured vertebrae are the equal for both sides (5.21) degrees indicating that there is no scoliosis in the sample .The researcher states that this is because the players focus on performing prophylactic exercises to avoid any tilting to the left and right side.

The researcher highlights the importance of applying training programs for all aspects of the vertebral column, not only for the right and left sides that receive most of the pressure during the training period. In addition strengthening the abdominal and lower back muscles will help in protecting the vertebral column from the encountered loads during training. Finally, all these programs would help in the protection of the vertebral column from any deviations or injuries that may result from practicing fencing.

Conclusion

a) The lumbar section is affected by the performance of fencing in the flexion position.

b) The thoracic and sacrum sections are affected by the performance of fencing in the extension position.

c) There is no change or deviation in the angles between the vertebrae whether towards the right or the left caused by the performance of fencing in the standing position.

Recommendations

a. Using vertebral column measurements and testing's in different positions as an indication for early detection of any abnormal inclinations.

b. Focusing on the strengthening exercises of the abdominal and lower back muscles to ensure the efficacy and the stability of the vertebral column.

c. Considering prophylactic programs to ensure avoiding any postural deformations that may occur due to playing the sport whether in sagittal or coronal plane of the vertebral column.

d. The importance of making the players and their parents aware of the postural changes that might happen from the sport and what will happen if they don't support the trainers in educating their children to follow proper postures.

e. Continuously identifying changes that happen to the vertebral column to be able of developing the training programs.

f. Testing other body joints for example knees and shoulders.

g. Conducting similar research studies on other sports especially young players.

h. Using advanced devices to evaluate the players every 6 months to assess their morphological state.

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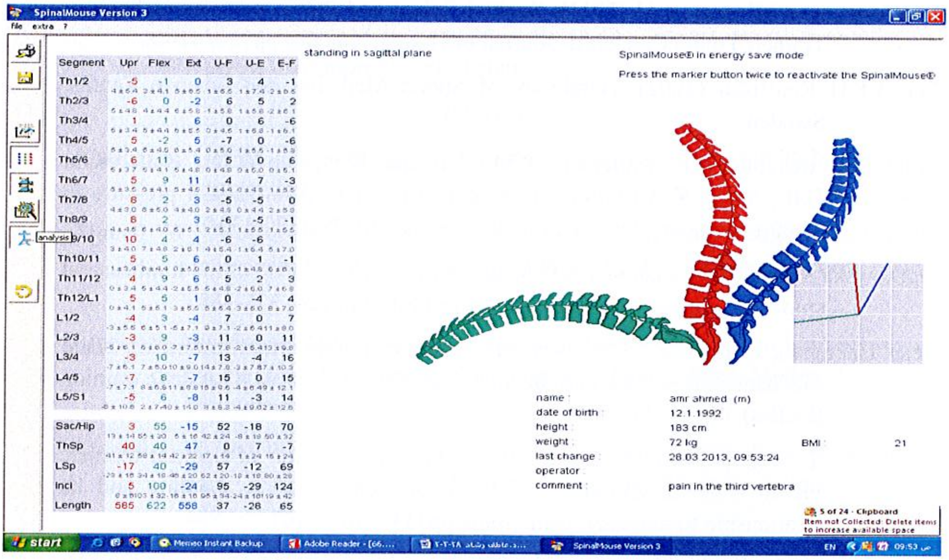
Attachments

Attachment 1: Picture of the results from the Spinal Mouse device to show the first 3 tests.



Attachment 2: Picture of the results from the Spinal Mouse device to show the tests from 4 to 6.