TO STUDY LUMBAR LORDOSIS IN FLAMENCO DANCERS HAVING LOW BACK PAIN USING FLEXIBLE RULER

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ABSTRACT

BACKGROUND: Flamenco dance form comes from Southern Spain. The flamenco is a solo dance characterized by hand clapping, percussive foot work, and intricate hand and arm and body movements. The percussive footwork and vibration patterns created during this dance form impose unusual demands on the musculoskeletal system. Flamenco dancing involves strenuous activity of the ankle, back and the hip taking the maximum adaptation to accommodate with the demands of this dance style. These types of adaptations and the shoes or the footwear that the dancer’s practice with i.e. high heeled shoes can be responsible in several forms of dance related musculoskeletal injuries. A preliminary study was undertaken to study the prevalence of low back pain in flamenco dancers and the result found stated that more than 50% of the dancers have low back pain. There are evidences in literature that have concluded changes in lumbar lordosis angle that leads to low back pain but there is dearth literatures for flamenco dancers with low back pain.

METHODOLOGY: A total of 60 subjects were enrolled in this study, 30 dancers (experimental group) with low back pain and 30 non dancers (control group) without low back pain. The low back pain was assessed using Oswestry disability index questionnaire and the lumbar lordosis was assessed using flexible ruler. The theta (θ) angle measurement of the experimental and control group was taken to study the Lumbar lordosis curvature of the spine. Also correlation was obtained using Pearson’s coefficient of correlation, to find correlation between low back pain and changes in lumbar lordosis angle of the spine.

RESULTS: This study shows a significant (p=<0.001) increase in the lumbar lordosis angle of the spine for experimental group as compared to the control group. Also, there is a positive correlation (r=0.3855) between low back pain and lumbar lordosis angle.

CONCLUSION: The study concludes that the lumbar lordosis angle of the spine in flamenco dancers with low back pain is substantially increased as compared to age and gender matched subjects. The deviations in the lordotic curvature of the spine can be one of the contributing factors for low back pain in flamenco dancers as there is a positive correlation between the change in the curvature angle and low back pain.

INTRODUCTION

Dance involves the body, emotion and mind; it is both a physical activity and a means of expression and communication. Dance is a conscious effort to create visual designs in space and continuously moving the body through series of poses and training patterns. The movements must also be in symmetric and follow rhythm. Musculoskeletal injury is found to be an important health issue for dancers at all skill levels. Although the types and patterns of dance style are different, it has been evident that most reported injuries are back and lower extremities. (¹) One such dance form is flamenco.

Flamenco dance form comes from Southern Spain. Flamenco dance form is highly expressive, Spanish, cultural dance. The flamenco is a solo dance characterized by hand clapping, percussive foot work, and intricate hand and arm and body movements. The percussive footwork and vibration patterns created during this dance form impose unusual demands on the musculoskeletal system. The flamenco dancing imposes repetitive high impact stress on the performer; this stress is because of the unusual pattern of wearing of (Traditional) high.

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heeled shoes, unique footwork that is tapping of the foot (zapateado) and exposure to constant vibratory pattern of movements. Flamenco dancing involves strenuous activity of the ankle, back and the hip taking the maximum adaptation to accommodate with the demands of this dance style. These types of adaptations and the shoes or the footwear i.e. high heeled shoes that the dancer’s practice with can be responsible in several forms of dance related injuries. Wrong adaptation of the posture and foot wear can impose excessive stress on the spine, especially on to the lumbar spine and hence resulting in pain and disability.

Lumbar lordosis is the curvature assumed by the lumbar spine and it forms an anterior convexity. Angle of the curvature is different among different individuals. This curvature of the spine, if compromised due to loading or stress causes weak abdominal musculature and tightness of rectus femoris of the quadriceps, lumborum and weakness of the gluteus maximus musculature and tight thoraco-lumbar extensor muscle group i.e. extensor spinae, multifidus, quadratuslumborum and latissimusdorsi muscles along with tensor fasciae latae tightness causing pain and discomfort in the dance routine. The most affected group of muscles in this anteriorly tilted pelvic posture are the back extensors and core muscles or stabilizers.

Pain reduces the productivity of the body and also causes overall feeling of being unwell. Pain should also be treated in the right areas and normalized and also the cause of the pain must be studied. In flamenco dancers low back is prevalent which affects the hours of practice and also affects their postural hygiene. There are evidences for the flexible curve or flexible ruler to be most reliable and valid with a reliability of 0.82 to 0.9 in studying lumbar lordosis measurement, hence using flexible curve for measurement of lumbar lordosis will be an appropriate instrumentation. The Oswestry disability index (ODI) also known as Oswestry disability questionnaire is a widely used questionnaire for estimating low back pain and disability levels. This test is considered to be a ‘GOLD STANDARD’ functional outcome measure or tool. It mainly gives information about level of back pain affecting the ability to manage their day to day activity. ODI has proved to be the most reliable and validated outcome tool in terms of back pain with a reliability of 0.87 to 0.92 ; and is universally accepted outcome measure for low back pain and hence used in our study and classify the level of pain. Assessment and study of the cause of pain giving posture i.e. lumbar lordosis in flamenco dancers proves to be vital for good postural hygiene and routine and maintenance of healthy mechanical loading strategies of back extensors and abdominal musculature i.e. core muscles using flexible ruler as a pivotal assessment tool. Correlating back pain with the change in the lumbar curvature angle may also prove beneficial for further more analysis and study of pain related issues in flamenco dancers with back pain.Flamenco dancers are prevalent to low back pain according to the study done by Bejjani FJ, Halpern N, Pio A, VHet.al, because of their vibratory and tapping dance style with heels and sustained postural adaptations. According to studies done on assessment of lumbar lordosis and pelvic inclination angle there was a significant increase in the lordotic curvature of the spine and inclination in normal individuals with chronic low back pain. There are literatures available for assessment of the lumbar spine curvature done on similar dance forms to flamenco dancers like Bharatanatyam and jazz dancers who have similar dancing routine. Bharatanatyam and jazz dance styles involves excessive foot work and postural adaptation causing changes in the lumbar curvature of the spine and being one of the vital reason behind causing low back pain. There is lack of literature found in flamenco dancers for the same. Also there is lesser evidences which prove correlation between the lumbar lordotic curvature angle change and low back pain. By taking Oswestry disability index as a standard criterion for grading the pain here, will help to study pain at wider spectrum. The present study is undertaken to study and correlate lumbar lordosis in flamenco dancers with low back pain.

**Study Design**

1. **TYPE OF STUDY**: Correlational assessment study
2. **POPULATION**: Flamenco dancers with low back pain (experimental group) with age and gender matched non dancers (control group)
3. **DURATION OF STUDY**: 18 months

**Sample Design**

1. **TYPE OF SAMPLING**: Convenient sampling.
2. **SAMPLE SIZE**: 60
   - 30 dancers (experimental group) and 30 age and gender matched non dancers (control group)
3. **LOCATION**: metropolitan city

**Selection criteria**

**Inclusion criteria**

1. Flamenco dancers in age group of 20 to 30 years.
2. Age matched non-dancers without low back pain (control group)
3. Flamenco dancers willing to participate in the study.
4. Flamenco dancers with low back pain. (experimental group)
5. Flamenco dancers practicing the dance for 1 year or more.
6. Modified Oswestry disability index score (score of 30 i.e. Minimal Disability)

**Exclusion Criteria**

1. Flamenco dancers without low back pain.(experimental group)
2. Subjects with any other low back pain pathologies.
3. Subjects with any neurological or cardiovascular problems.
4. Subjects having any previous history of trauma, fracture to the spine.
5. Obese individuals with BMI more than 25.

**METHODOLOGY**

**Procedure**

Sixty subjects, 30 subjects with Low back pain (experimental group) and 30 subjects without Low back pain (control group) who are willing to participate were included in the study.
All the subjects were screened as per the inclusion and exclusion criteria. The purpose of the study and the procedure was explained to the subject prior to the study.

A written informed consent was taken from all the subjects prior to participation.

**Measurement Tools:** Universal flexible curve or ruler, Pen/pencil, Paper, Adhesive marker, Modified Oswestry disability index questionnaire, Weighing machine, Ruler Low back pain in the subjects i.e. flamenco dancers were assessed using Modified Oswestry disability index questionnaire to rate the pain and disability. The Modified Oswestry disability index questionnaire was explained and then administered to the dancers and they were asked to fill the same. The scoring on the questionnaire helped to understand the score or level of disability.

**Assessment of Lumbar Lordosis Using Flexible Ruler**

Lumbar lordosis is the curve assumed by the lumbar spine, where the lumbar spine forms an anterior convexity. The lumbar lordosis was measured here with a flexible ruler or a flexible curve. The subject were asked to stand in a relaxed position with the low back and upper buttocks exposed. The subject were asked to distribute weight evenly on both the lower extremity with feet 10 to 15 cm apart. The subject were made to stand with head facing forward and arms at their sides. Then the spinous process of L3 and S2 were palpated on the subject and points were marked with adhesive markers. The spinous process of L3 was located using the following method: The L4-L5 interspace is located on an imaginary line approximately midway between the superior aspects of the two iliac crests, then palpate 2 spinous processes up from this space to locate L3 spinous process’s. A marker was then placed over this process making sure the line on the marker is horizontal. Then the S2 spinous process was palpated which is assumed to be midway between the inferior aspects of the posterior superior iliac spine (PSIS). A marker was then placed over the center of S2 spinous process making sure the line on the marker is horizontal. The flexible ruler was then placed over the spinous processes marked on the low back and its contour was noted. The markings on the flexible ruler were noted and the ruler was carefully removed. The outline of the curve was traced on to the paper, the markings that correspond to L3 and S2 were named A and B respectively. The distance between the point A and B was measured (L). Another line perpendicular to (L) was drawn from midpoint of (I) and the curve will be then measured with a ruler. An angle theta is determined by using equation:

\[ \Theta = 4 \times [\arctan (2H/L)] \]

The theta represents the magnitude of lordotic curve of the spine. [1]

For the control group the low back pain and Oswestry disability index score was ruled out and they were assessed for lumbar curvature angle findings as they were assessed as healthy individual group (control group) for comparison with experimental group and to get standard \( \Theta \) angle measurements for the included age group.

**Statistical Analysis and Results**

Data was collected on a data sheet and encoded for computerized analysis using SPSS Version 7 for windows. Tables were made using Microsoft word and figures were plotted using Microsoft excel windows 10.

![Fig 1](image1.png) Demographic Data Describing the Age Mean Difference between the two groups

![Fig 2](image2.png) Observational Analysis For Lumbar Lordosis Between The Two Groups

<table>
<thead>
<tr>
<th>Lumbar lordosis angle</th>
<th>N</th>
<th>Lumbar lordosis angle Mean</th>
<th>Standard deviation</th>
<th>P value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental control</td>
<td>30</td>
<td>47.4</td>
<td>4.917</td>
<td>&lt;0.00</td>
<td>Highly significant</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>38.5</td>
<td>6.022</td>
<td>01</td>
<td>significant</td>
</tr>
</tbody>
</table>

![Fig 3](image3.png) Linear Correlation Between Lumbar Lordosis Curvature Angle And ODI Score According to Pearson’s Coefficient of Correlation
DISCUSSION

Low back represents a major social health problem in present times and since past few years. The lumbar spine consists of five vertebrae (L1–L5). The complex anatomy of the lumbar spine is a combination of these strong vertebrae, linked by joint capsules, ligaments, tendons, and muscles, with extensive innervations. The lumbar spine is governed by four functional groups of muscles, split into extensors, lateral flexors, and rotators. The lumbar vertebrae are vascularized by lumbar arteries that originate in the aorta. Spinal branches of the lumbar arteries enter the intervertebral foramen at each level, dividing themselves into smaller anterior and posterior branches the spine is designed to be strong, since it has to protect the spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes. The core muscles form the flexor group and the back muscles form the extensors group of muscles for the back. The intervertebral discs in the lumbar area are also wedge-shaped, at the L4-L5 and L5-S1 segments.[10]

According to Kendall and McCreary, in normal individuals (standard posture) the hip is in the neutral position and the pelvis is level with no anterior or posterior tilt. In a level pelvis position, lines connecting the symphysis pubis and the ASIS are vertical and the lines connecting the ASIS and PSIS are horizontal. In this optimal position, the LoG passes slightly posterior to the axis of the hip joint, through the greater trochanter. The degree of lumbar lordosis is variable among individuals and is the result of many factors, including the fact that the: L5 vertebra is wedge[1] in flamenco dance form due to high heeled shoes the posture abnormal and pelvis is anteriorly tilted always, the excessive anterior tilting of the pelvis due to high heeled shoes being worn during the dance causes the spine to go in to hyper lordosis causing abnormal loading on to the spine and wrong postural adaptation causing excessive load on the extensor muscle group of the spine i.e. extensor spinae, multifidus, quadratuslumborum and latissimusdorsi and making the flexor abdominal musculature i.e. rectus and oblique muscles weak i.e. the extensor muscles undergo lengthening and the abdominal muscles undergo shortening making it difficult to maintain the dance position for long and hence also cause pain during the dance sessions and affect there functional performance. The tapping and rigorous foot work along with prolonged abnormal posture causes hindrance in their postural hygiene causing the trunk extensor strength reduction and shortening and lengthening of the trunk flexor muscles and also causes imbalance in muscles surrounding the pelvic bone.[13] Lumbar hyper lordosis can be the result of sustained adaptation of posture during the dance form practice and this arched back posture causes pain and spasm due to excessive stress or loading.[10] This abnormal arching of the back may also cause anterior tilting of the pelvis.

Flamenco dancers have very vigorous dance routine with high heeled shoes and constant tapping movements cause the vibratory action and as a result the spine, hip, knees and ankle take the maximum load also wearing heeled shoes causes pelvis to anteriorly tilt and causes increased angle of the spine i.e. hyperlordosis. As this study shows substantial probability in increase in the angle of the spinal curvature than the normal angle i.e. normal 35 to 45-degree curvature angle which is normal in the age matched individuals (control group). The excessive anterior tilting pelvis due to high heeled shoes being worn during the dance causes the spine to go in to hyper lordosis causing abnormal loading on to the spine and wrong postural adaptation causing excessive load on the extensor muscle group of the spine i.e. extensor spinae, multifidus, quadratuslumborum and latissimusdorsi and making the flexor abdominal musculature i.e. rectus and oblique muscles weak i.e. the extensor muscles undergo lengthening and the abdominal muscles undergo shortening making it difficult to maintain the dance position for long and hence also cause pain during the dance sessions and affect there functional performance. The tapping and rigorous foot work along with prolonged abnormal posture causes hindrance in their postural hygiene causing the trunk extensor strength reduction and shortening and lengthening of the trunk flexor sand extensor and overall muscle weakness . Hence this repeated anterior pelvic tilt due to high heeled shoes and prolonged tapping dance type causes adaptation of a lordotic posture. This imbalance in the trunk flexors and extensors may in turn cause pain and is a probable reason for low back pain in flamenco dancers. The changes in spinal curvature angle were proving to be of utmost importance in this study, hence a Pearson’s correlation coefficient was measured for studying the correlation between lumbar lordosis angle changes i.e. the O angle and the LBP. The PCC in this study is 0.3855 which proves positive correlation between changes in lumbar lordosis angle O and low back pain. This correlation all the more proves the posture to be one of the significant reasons for LBP in flamenco dancers. Improving postural hygiene of these dancers is imperative for long term elimination of low back pain and also for postural awareness strengthening of the back and core musculature may also prove significant. Hence, further postural feedbacks and proper ergonomic advice is of great importance. The correction of the flexor extensor imbalance may also further improve equilibrium and body mechanics. Hence, good postural hygiene and awareness during dance routine and maintenance of healthy mechanical loading strategies of back extensors and abdominal musculature i.e. core muscles are of sheer importance.

CONCLUSION

The study concludes that the lumbar lordosis angle of the spine in flamenco dancers with low back pain is increased as
compared to age and gender matched subjects. The deviations in the lordotic curvature of the spine can be one of the contributing factors for low back pain in flamenco dancers as there is a positive correlation between the change in the curvature i.e. lumbar lordosis angle and low back pain.

**Clinical Implications**

The deviation in the lordotic curvature angle (ʘ) is a contributing factor for low back pain in flamenco dancers as they show a positive correlation with each other and hence it is of grave importance that lumbar spine postures should be assessed in not just for the flamenco dancers but for the entire dancing community as a physiotherapist when a patient of a dancer community approaches for low back pain. Flamenco dancers need to acknowledge their problems such as low back pain so that correction of their abnormal postures and the imbalance in the trunk flexors and extensor mechanism can be improved for a better postural hygiene.

As a physiotherapist we must focus on assessing the back and core muscle strength as there is a probability of them to be weak and also assess their lumbar lordosis curvature angle before beginning with the training program.

In training stabilizing the dancers (patient) for core musculature and back extensor mechanism Is imperative and also this approach will help strengthen the musculature as well as reduce the pain intensity.

Acknowledgement

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