Analysis of Neck Length and its Incidence for Cervical Spondylosis in Young Adults

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Abstract

Background: To analyze neck length and its incidence for cervical spondylosis in young adults

Methods: In this comparative study, the incidence of cervical spondylosis in patients with short neck length in adults aged 18 to 36 years with cervical spondylosis (n=192), was compared with controls (n=192). The cervical spine curvature was measured on the X rays using special software. The length was determined by drawing a line from the external occipital protuberance to spine of the C7 vertebra. The distance was measured by taking the perpendicular distance between the external occipital protuberance to the C7 spine with the angle of the mandible. The physical cervical length and postural variation was measured using inch scale by selecting a point from external occipital protuberance to C7 spinous process with the help of Dewalt DW085K Self Leveling Plumb, Level and Square 5 Beam Laser Pointer.

Results: Neck pain, limited neck movement, headaches and inability to fully bend the neck were presenting complaint in 90.1 % . The severe cases(7.9%) showed additional symptoms like weakness in the arm and loss of grip, and weakness of the arms in association with the general symptoms making about 1.5 % of total cases. The average physical neck length in males was 110.31±12.71 and in females was 109.25±13.97. The average lordotic curvature in males was 1016.37±121.66 and the average curvature in females was 1020.22±118.05. Hyperlordosis (69.79%), hypolordosis(26.56%) and straight curves were (3.65%). The curvature of spine of patients was more than controls and the neck length of patients was less than that of controls.

Conclusions: Curvature of cervical spine in patients with cervical spondylosis is more than that of controls. Also neck length in cervical spondylasis is less compared to controls.

Key Words: Cervical spondylosis, lordosis, neck length.

Introduction

Cervical spondylosis is the deterioration of the vertebrae and discs in neck region leading to neck pain. In severe conditions it may cause pressure on nerve roots with sensory and/or motor disturbances. Cervical spondylosis also known as cervical osteoarthritis and degenerative osteoarthritis, refers to the deterioration of the vertebrae and discs of the joints between the centre of the spinal vertebrae and/or neural foraminae. The edges of the vertebrae often develop small, rough areas of bone called osteophytes. Progressively the discs get thinner, increasing the risk of symptoms. It can lead to bouts of stiffness and neck pain. If the condition becomes severe, it may cause pressure on nerve roots with subsequent sensory and/or motor disturbances, such as pain, paresthesia, or muscle weakness in the limbs. The factors that can make a person more likely to develop spondylosis are overweight, lack of exercise, job requiring heavy lifting or a lot of bending and twisting, past neck injury (often several years before), and faulty spine posture. Posture is the position in which a person holds the body upright against gravity while standing, sitting or lying down. Good posture involves training the body to stand, walk, sit and lie in positions where the least
strain is placed on supporting muscles and ligaments during movement or weight-bearing activities. Proper posture or "neutral spine," is the proper alignment of the body between postural extremes. Correct posture minimizes stress on muscles, bones, and joints while incorrect posture places abnormal stress on these structures. The more posture deviates from the correct position, the greater the stress placed on the structures that work to maintain it. Incorrect posture usually develops with gradual changes in muscle, tendon, or fascial support. By the time an individual becomes a teenager or young adult, abnormal postural habits are entrenched. Poor posture becomes more exaggerated as people age and develop progressively greater tightness and weakness in already shortened or lengthened soft tissue structures, resulting in changes in bone alignment and stress distribution.4

In posture analysis, the spine is compared to a plumb line to detect the aforementioned abnormalities. A plumb line, is a straight line that suspends a weight or “Bob” on its end. When the weight is made of lead (plumbum in Latin), it is referred to as a lead weight or Plumb Bob. A plumb line is used for many reasons during a postural analysis, as it will ensure the posture chart is hanging straight, guarantee the client is viewed from a 90-degree angle and supplies a visual reference of the mid sagittal and coronal planes. This shows subjects where their body is being held in space by the muscles, why the muscles hurt, and where is the actual problem.

Once the height of the cervical vertebra is known, the curvature can be measured by measuring the perpendicular distance from the line drawn from the external occipital protuberance to the C7 spinous process to the highest point of the cervical lordotic curve. Having the general knowledge of the anatomy of the cervical spine with support of the radiological images, determining the postural alignment using plumb line method, taking into consideration the measurement of the cervical lordosis, we can co-relate the incidence of cervical spondylosis in patients with short neck length in young adults.5

**Patients and Methods**

This comparative study comprised patients of cervical spondylosis with short neck and control. Study was conducted at Majmaah University, College of Medicine and Department of Orthopedics, King Khalid Hospital, Al’Majmaah, Riyadh Saudi Arabia. Study time period was one year. Patients visiting the Orthopedics Department were already diagnosed with cervical spondylosis between the age group of 18 – 36 years. Patients with cervical spine injuries, surgical correction of deformity, cervical laminectomy, cervical rib and cervical tumors were excluded.

Reliability of questionnaire was checked by Cronbach’s Alpha. X-Rays were taken in DICOM format(Fig. A), which needs special viewer software. Once you move the cursor over the image in this viewer the bottom of the page determines the position in ‘X’ & ‘Y’ quadrants. The position was determined by the values in that pixel structure. So the curvature of the cervical spine was determined by moving the cursor over the outer border of the each vertebrae and then taking the value of the pixel at that point in X & Y axis (X: 207, Y: 1532, Val: 1334, WL: 901, WW: 3154). This value of each pixel was taken from C1 vertebrae to C7 vertebrae along the curvature. Around 20 to 25 points were marked and its values had been taken to minimize the error in the measurement. These values were then calculated to achieve curvature using the formula for:

\[
P(x_1, y_1) and \quad Q(x_2, y_2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
\]

The pixel value in the DICOM image was according to the pixel structure. Three data elements which defined the Pixel structure were (i)Bits Allocated (0028,0100); (ii)Bits Stored (0028,0101) and (iii)High Bit (0028,0102)

Rows (0028,0010) and columns (0028,0011) defined the size of the image. Rows were the height (i.e., the Y) and Columns were the width (i.e., the X). In our example every frame was 1280 x 960 pixels. Samples per pixel (0028,0002) were defined the number of color channels. In grayscale images like CT and MR it is set to 1 for the single grayscale channel and for color images like in our case it was set to 3 for the three color channels Red, Green and Blue. The Length was determined by drawing a line from the external occipital protuberance (EOP) to the spine of the C7 vertebra. The distance was measured by taking the perpendicular distance between the EOP to the C7 spine with the angle of the mandible.6,9

The physical cervical length and postural variation was measured using inch scale by selecting a point from External occipital protuberance (EOP) to C7 spinous process with the help of Dewalt DW085K Self Levelling Plumb, Level & Square 5 Beam Laser Pointer, 16° Digital Angle Finder and Level, and Laser Laval Tape measure Pro. The cervical lordotic curve was measured to see the extent of the deviation from the normal curve.
Two independent sample t test was applied to compare quantitative variables between cases & controls and males & females. A p-value of <0.05 was considered as statistically significant.

Results
Average age of patients was 27.87±4.58 years. Among the patients the presenting complaints like neck pain, limited neck movement, headaches and inability to fully bend the neck were present in 90.1 %. The severe cases of cervical spondylosis (7.9%) showed additional symptoms like weakness in the arm and loss of grip. Three cases (1.5%) had weakness of arms in association with the general symptoms. The physical neck length, distance between a perpendicular line from the external occipital protuberance to cervical spine of C7 vertebra and lordotic curvature revealed insignificant difference between males and females (Table 1). The number of cases of hyperlordosis (Fig. B) was 134 (69.79%), hypolordosis (Fig. C) was 51 (26.56%) and straight curves (Fig. D) was 7 (3.65%) (Table 2).

Significant inverse correlation was observed between curvature of the cervical spine and its length (r= -0.285, p<0.001), showing that as curvature of the cervical spine is increasing then its length is decreasing and vice versa. Similarly, significant inverse correlation was also observed between length of the cervical spine and distance (r=-0.43, p=0.023) showing that as length of the cervical spine is increasing the distance is decreasing and vice versa. In addition, significant positive correlation was observed between curvature of the cervical spine and its distance (r=0.643, p=0.006) showing that as curvature of spine is increasing the distance is also increasing and vice versa.

Table 1: Comparison of curvature, length and distance between males and females.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (Mean± S.D)</th>
<th>Female (Mean± S.D)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>295</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Curvature</td>
<td>1016.37±121.66</td>
<td>1020.22±118.05</td>
<td>0.794</td>
</tr>
<tr>
<td>Length</td>
<td>110.31±12.71</td>
<td>109.25±13.97</td>
<td>0.885</td>
</tr>
<tr>
<td>Distance</td>
<td>9.46±0.73</td>
<td>9.51±0.81</td>
<td>0.615</td>
</tr>
</tbody>
</table>

Table 2: Distribution of the cervical lordotic curve.

<table>
<thead>
<tr>
<th>Distribution of the cervical lordotic curve</th>
<th>No(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperlordosis</td>
<td>134(69.79%)</td>
</tr>
<tr>
<td>Hypolordosis</td>
<td>51(26.56)</td>
</tr>
<tr>
<td>Straight</td>
<td>7(3.65)</td>
</tr>
</tbody>
</table>

Table 3. Comparison between curvature of cervical spine, distance and neck length between control and patient.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Controls Mean + S.D</th>
<th>Patients Mean + S.D</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>192</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>Curvature of cervical spine</td>
<td>1006.75±12.34</td>
<td>1127.55±11.34</td>
<td>0.003*</td>
</tr>
<tr>
<td>Distance between perpendicular line from the OCP to cervical spine</td>
<td>9.51±2.33</td>
<td>13.45±1.34</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Length</td>
<td>98.51±3.22</td>
<td>112.36±2.19</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

* Indicate significant differences (p<0.05) between Controls and Patients

Significant difference was observed between the curvature of cervical spine of controls and patients (1006.75±12.34 Vs 1127.55±11.34, p=0.003) showing that the curvature of spine of patients was more than controls. Similarly, when distance was compared between patients and controls a significant difference was observed (13.45±1.34 Vs 9.51±2.33, p<0.001) showing that the distance in neck of patients was more

Fig. A: Showing the measurements
Fig. B: Hyperlordosis of the cervical spine
Fig. C: Hypolordosis (Kyphotic) cervical spine
Fig. D: Straightening of the cervical spine
than controls. Neck length of the patients also differed significantly when compared with controls (98.51±3.22 Vs 112.36±2.19, p=0.001) showing that the neck length of patients was less than that of controls (Table 3).

Discussion

The natural history of cervical spondylosis was associated with the aging process. Senescent and pathologic processes were thus morphologically indistinguishable. Clinical manifestations of cervical spondylosis may arise when morphologic changes are superimposed on a developmentally narrow spinal canal. Common clinical findings are neck pain, limited neck movement, headaches, inability to fully bend the neck, weakness in the arm and loss of grip.10-12

Paul et al did a series of lateral radiographs of the cervical spinal column in order to determine vertebral body dimensions. A two-dimensional analysis of vertebral body height (average distance between superior-inferior surfaces), depth (average distance between anterior-posterior surfaces), and area (average height X average depth) revealed minimal effects due to stature. In all subjects, average depth exceeded average height for vertebral bodies C3 through C7. Upon combining stature groups both sexes revealed maximum average values for these dimensions at the seventh cervical vertebral body. Minimum average height occurred at C5 whereas minimum average depth was found at C3.13 Mahajan et al. 1994 in their study attempted to create standards and percentile charts for Indian children and compute age independent correlations of neck length with linear measurements such as standing and sitting height. The subjects heights and weights conformed to ICMR standards were inducted. Neck length was measured by a modified two-point discriminator between two fixed bony points-inion and spinous process of C7 with the head held in neutral position. They concluded that age independent linear regression equations: Neck length = 10 + (0.035 x height) and Neck length = 9.65 + (0.07 x sitting height) were highly significant. Neck length relationships of 30 randomly selected normal children clustered around the regression lines and 16 with genetic syndromes fell below the regression lines.14 Hickey et al. 2000 discussed about the individuals with forward head posture (FHP) and related postural abnormalities are at increased risk for various musculoskeletal and/or neurovascular related cervical pathologies. This study compared reliability of RHP measurements using the CROM instrument with that of a plumb-line measurement. All subjects were screened for cranial, cervical, and/or upper thoracic dysfunction. Both testers performed two CROM and two plumb-line measurements. Thus they concluded that reliable measures of RHP can be obtained using either the CROM device or plumb-line technique.15

Conclusion

Curvature of cervical spine in patients with cervical spondylosis is more than that of controls. Also neck length in cervical spondylosis is less compared to controls.

References