INSIGHTS INTO CHIROPRACTIC

Discerning the true nature of an alternative health care method

Is There Such A Thing As "Normal" Spinal Alignment? Part II: The Cervical Spine

INTRODUCTION

In the last issue of this newsletter series, normal values of the magnitude of lumbar lordosis were presented based upon studies from the scientific literature which studied the geometric configuration of the lumbar spine in the sagittal plane. In this issue, studies which discuss the normal alignment and geometric configuration of the cervical spine in the sagittal plane will be discussed. The clinical significance of normal cervical spine alignment in the sagittal plane will also be discussed.

MODELS OF NORMAL CERVICAL LORDOSIS

At least two approaches can be used to develop models which may be used to establish "normal" values in the health care sciences: the confirmatory and exploratory methods.

In the confirmatory method, one proposes the solution to a problem based upon logical assumptions from existing knowledge, in an attempt to arrive at a theoretically ideal answer to the problem at hand. This approach is often used by mathematicians and/or physicists who attempt to provide theoretical answers to complex questions where the collection of data is difficult or impossible, or when no reliable data exists. Later, when data collected from nature is available, the confirmatory model can be tested against such data to determine or "confirm" the model's validity or lack thereof.

In the exploratory method, data collected from nature is used to construct a model in the laboratory of the problem under study. This is the method most often used by clinicians in an attempt to study body systems. For example, an exploratory model of the normal range of blood pressures in humans could be proposed by measuring and recording the blood pressures of a large sample of subjects. The mean or average value could then be determined and a range of values (usually plus or minus a specified number of standard deviations from the mean) could serve as the model of the normal range of blood pressures in human beings.

Harrison et al.(1) have proposed a confirmatory model of the cervical lordosis based upon two major assumptions: 1. The cervical lordosis is a circular arc, and 2. The "ideal" height to length ratio of the spine is in the range of 0.94-0.96 with the exact value of "ideal normal" in the mid-range of those values, i.e. 0.95. These assumptions are based upon the fact that other researchers who model the spine use circular arcs to model the sagittal curves, and that only the Delmas index, described by Kapandjii(2), gives an exact range of normal values.

In reality, the Harrison et al.(1) mathematical cervical spine model is a series of equations which describe the anatomical make-up of the cervical spine. These equations can be reduced to the single equation of Sine q/ q =

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Heightspine/Lengthspine, where q is one half the arc angle (in radians) of a circular lordosis extending from C1 to T1. Harrison's mathematical equations predict a number of values that can be measured on radiographs using the method described by Jackson et al.(3) for a family of circular lordotic arcs having a height to length ratio in the range from 0.91 (deeply lordotic) to 0.99 (almost military). One of the arcs predicted by the Harrison et al.(1) mathematical equations would have the magnitude of 42.2 degrees measured from C2 to C7 (Ruth Jackson's Angle) when the height to length ratio of the cervical spine is 0.95. This value is the mid-point in the range of "normal values" proposed by Delmas(2) and represents the range that could be used as a confirmatory model of the cervical spine in the sagittal dimension.

The clinical values predicted by the Harrison et al. equations were then compared to the average values measured from the lateral cervical radiographs of 400 subjects. The data was then divided into a number of subsets. Two of these subsets were individuals whose cervical spine measurements fell in the Delmas normal range and another were those individuals who presented with no history of cervicocranial symptoms. The average lordosis measured between C2 and C7 in the total of 400 subjects was 34°, 44° in those subjects in the Delmas normal range, and 34° degrees in the asymptomatic subjects.

The Harrison et al. mathematical equations predicted the average values of the 400 subjects to an average error of about 4%, 5% for the subjects with clinical measurements in the Delmas normal range, and 3% for the asymptomatic subjects. The authors state that they believe that their data demonstrates that the normal circumstance is for the cervical spine to assume a circular lordosis in the sagittal plane.

The subsets of subjects in the Delmas normal range, as well as those without cervicocranial symptoms, represent individuals whose clinical measurements can be used as data to propose both an exploratory model (the asymptomatic subjects) of the cervical spine--and as data to "confirm" or refute the Delmas normal range (i.e. the confirmatory model).

Also, in a separate study of the geometric configuration of the cervical spine in an asymptomatic population of 200 subjects, authored by Gore et al.(4), the average magnitude of the cervical lordosis measured between C2 and C7 was 21°.

Combining Gore's exploratory data with that presented by Harrison et al. results in a normal average range of cervical lordosis of 21° - 44°.

CLINICAL VALIDITY OF SAGITTAL CERVICAL SPINE ALIGNMENT

Predictive validity is defined as, " . . . the degree to which a measurement successfully predicts an outcome of interest(5)." In terms of the case for a "normal" spinal alignment position the outcome of interest could be the relationship of pain and/or articular degeneration associated with individuals who do not possess the "normal" lordotic configuration described above.

Two studies have investigated the relationship of lordotic curve configuration to the presence of chronic headache pain. Vernon et al.(6) studied various aspects of headache pain in a prospective consecutive sample of forty-seven subjects with muscle contraction/tension-type headache and common migraine. Lordosis was assessed radiographically using the method described by Plaugher et al.(7) Using 25° as the lower limit of the "normal" magnitude of lordosis their findings indicated that, "For the total group, 77% of all subjects and 89% of females exhibited a marked reduction, absence or reversal of the normal cervical lordosis(6)."

Similarly, Nagasawa et al.(8) studied the lordotic configuration of the cervical spine from the radiographs of 372 patients with muscle contraction/tension-type headache. They calculated an index of lordotic curvature using

Ishihara's method(9). In clinical terms, Ishihara's index of cervical curvature describes the amount of cervical lordosis, the smaller the index, the straighter the configuration of the cervical lordosis. Ishihara's index for the 372 headache sufferers was 14.6%. This index was then compared to 225 normal control subjects. The normal control subjects index of curvature was 19.4% indicating a greater magnitude of overall cervical lordosis.

The relationship of cervical curvature to pain (or absence of pain) and pathology is perhaps best reflected when looking at another study which described the morphology of the static sagittal cervical spine conducted by Gore et al.(4) Gore et al. studied the cervical curve configuration of 200 asymptomatic subjects. Comparing the lordotic angle formed by the intersection of Ruth Jackson's(10) cervical stress lines at C2 and C7, Gore et al. found an average of 21.3° of lordosis as the typical cervical curve configuration. They found only a small minority of their asymptomatic subjects (9%) to have kyphotic deformities in their cervical spines.

Gore et al. further divided their sample into a number of subgroups. The data was separated into values for men and women in five separate age categories from 20-65 years. The mean value for lordosis was then reported in each age category. As the categories increased in age, the mean values for lordosis increased as well, from 16° for men age 20-25 years and 15° for women at 20-25 years of age up to 22° and 25° of lordosis for men and women age 60-65 years, respectively.

Since the inclusion criteria for the Gore et al. study required subjects having no history of neck pain, this finding may suggest that a deep lordosis may play a role in keeping the cervical spine free of pain. That is to say, it is possible that as individuals with kyphotic deformities or diminished lordosis advance in age, they may be more likely to experience neck pain and would thereby have been excluded from the Gore et al. study. But, because older asymptomatic subjects tended to have greater magnitudes of lordosis compared to younger asymptomatic subjects, this implies a deeper lordosis may immunize a patient against neck pain.

In terms of degenerative articular changes, Gore et al. found a statistically significant increased incidence of end plate sclerosis and anterior osteophytes in their older subjects with lesser degrees of lordosis. They state, " . . . when data of the subjects in the two oldest age groups were analyzed separately, the average cervical lordosis for subjects with moderate or severe intervertebral narrowing averaged 17° compared with 27° for those with lesser or no intervertebral narrowing(4)." This finding seems to suggest that cervical lordosis is an important factor in maintaining the structural health of the cervical spine. The altered gravitational stresses of diminished lordosis or kyphotic deformities may result in strains in the spinal tissues which could initiate tissue degradation or degeneration.

Finally, Harrison et al.(11) have published a review of the literature which describes more fully how reduced or reversed cervical lordosis results in abnormal gravitational loading which could adversely affect spinal tissues such as bone, ligament, disc, and nervous tissue. For an expanded summary, the interested reader is directed to this review.

CONCLUSION

The chiropractic belief that alterations in spinal alignment, commonly termed vertebral subluxations, is beginning to be evaluated in a systematic scientific manner. Studies performed by a variety of authors indicates that a normal sagittal cervical spine configuration exists in healthy pain-free subjects, and that this configuration is a circular shape with a normal average range of values of 21° - 44° between C2 and C7. Multiple studies now exist that demonstrate that, indeed alteration in spinal alignment, vertebral subluxation, may be a significant factor in spinal dysfunction syndromes.

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