ABSTRACT

Background: The importance of sagittal plane alignment in adults involves both spinal and pelvic parameters. Most papers published in this field have studied white people and, to the best of our knowledge, there are only few studies on Asians and none in south Indian population.

Materials and methods: Prospective study of 120 healthy individuals done in Sri Ramachandra Medical College, Chennai, India, from August 2012 to June 2014. The study was conducted in the department of spinal surgery at our center with the approval of the ethical committee. Informed consent was obtained from all volunteers. Inclusion criteria were healthy individuals more than 18 years of age both male and female. Exclusion criteria were those who had any kind of spine or hip surgery, carriers of any type of musculoskeletal syndrome, or had a pelvic limb discrepancy (2 cm). The following items like age, sex, and lateral radiographs of the lumbosacral region with the individual standing, so as to obtain the pelvic parameters of PT, SS and PI were collected.

Results: The mean pelvic parameters in our study were pelvic tilt 14.20 ± 7.32, sacral slope 41.20 ± 11.01 and pelvic incidence 58.64 ± 12.59.

Conclusion: The pelvic parameters vary between different ethnicity was evident from our study. However, pelvic parameters of south Indian population have shown some similarity to the Mexican population.

Keywords: Pelvic tilt, Sacral slope, Pelvic incidence, Pelvic parameters.


Source of support: Nil
Conflict of interest: None

INTRODUCTION

Spinal deformity in adult presents as a complex clinical entity for the treating physician. Spinal deformity is a three-dimensional (sagittal, coronal and axial) pathology. The normal pelvis is horizontal, with symmetrical points at equal height. However, the geometry of the sagittal pelvic position is more complex. Characterization of the sagittal balance of the pelvis requires the definition of certain parameters based on notable biomechanical features involved in the transmission of constraints. The importance of sagittal plane alignment in adults involves both spinal and pelvic parameters. Since, the work published by Marney and Vidal on the pelvis and the concept of conus of economy presented by Dobousset, numerous studies have investigated the role of pelvis in the complexity of human standing sagittal spinal alignment. Most papers published in this field have studied white people and, to the best of our knowledge, there are only few studies on Asians and none in south Indian population.

MATERIALS AND METHODS

Prospective study of 120 healthy individuals done in Sri Ramachandra Medical College, Chennai, India, between August 2012 and June 2014. The study was conducted in the department of spinal surgery at our center with the approval of the ethical committee. Informed consent was obtained from all volunteers. Inclusion criteria were healthy individuals more than 18 years of age both male and female. Exclusion criteria were those who had any kind of spine or hip surgery, carriers of any type of musculoskeletal syndrome, or had a pelvic limb discrepancy (2 cm). The following items like age, sex, and lateral radiographs of the lumbosacral region with the individual standing, so as to obtain the pelvic parameters of pelvic tilt, sacral slope, pelvic incidence were collected. Each volunteer underwent a digital 30 × 90 cm lateral radiography of the lumbosacral region, with the individual standing, knees extended, and flexed arms in front. Care was taken to ensure that the radiography included both femoral heads. If the femoral heads did not overlap in the radiograph, the midpoint of the line connecting the iso-center of both femoral heads was taken as a reference point.

The mean age of the voluntaries was 30 years and their mean weight was 72.5 kg. The pelvic incidence, defined as the angle between the line perpendicular to the sacral plate at its midpoint and the line connecting this point to the axis of the femoral heads. It is an anatomical parameter,

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unique to each individual, independent of the spatial orientation of the pelvis. The anatomical components involved in the make-up of this parameter are the first three sacral vertebrae, the sacroiliac joints and the posterior segment of the iliac bone. This parameter could be considered as a constant because it is an anatomical one, independent of the position of the pelvis, the mobility of sacroiliac joint being considered negligible, and independent of the age once growth is completed. The sacral slope, defined as the angle between the superior plate of S1 and a horizontal line. A vertical sacrum is described by a low value, a horizontal sacrum by a high value. Pelvic tilting, defined as the angle between the line connecting the midpoint of the sacral plate to the femoral heads axis and the vertical

RESULTS

The results of measurement of pelvic parameters, like pelvic tilt, sacral slope and pelvic incidence of 120 normal south Indian, were tabulated in Table 1. Figures 2 and 3 were schematic examples of the measurement done in our study.

DISCUSSION

The concepts of sagittal malalignment was well described in literature, particularly in the context of iatrogenic flat back and post-traumatic kyphosis, regarding their clinical symptoms and treatment. A patient affected by sagittal malalignment will experience various compensatory mechanisms in an effect to preserve a rather vertical posture, when a subject pitches forward the pelvis rotates into retroversion in order to compensate for the positive sagittal balance. When pelvic rotation was not enough, there may be a need to flex the knees to compensate, leading to fatigue and pain, and seriously affecting quality of life.

The measure of pelvic incidence is a complementary approach of the standing posture, as in scoliosis, low back pain, spondylolisthesis, spine and hip surgery, obesity, and postural impairments. The pelvic incidence, with sacral slope and pelvic tilt, determines the conditions of the principle of biomechanical economy. If these ways of adaptation between the spine and hip are unbalanced, it can improve pathological patterns on a long- or short-term basis. The pelvic incidence is an understanding biomechanical tool around the hip. The anatomical parameter ‘pelvic incidence’ is a constant for each individual. It determines the variable parameters of ‘pelvic tilting’, ‘overhang of S1’ and the ‘sacral slope’. A geometric construction by complementary angles reveals that the anatomical parameter ‘incidence’ is the algebraic sum of the ‘sacral slope’ and the ‘pelvic tilting’: Incidence = sacral slope + pelvic tilting. The orientation of the pelvis determines the sagittal position of the sacral plate in relation to the femoral heads, adapted for each individual by the anatomical parameter ‘incidence’: the higher the value of the ‘pelvic incidence’, the higher the value of the adapted ‘overhang of S1’.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Measurement mean in (º)</th>
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<tbody>
<tr>
<td>Pelvic tilt</td>
<td>14.20 ± 7.32</td>
</tr>
<tr>
<td>Sacral slope</td>
<td>41.30 ± 11.01</td>
</tr>
<tr>
<td>Pelvic incidence</td>
<td>58.64 ± 12.59</td>
</tr>
</tbody>
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Table 1: Pelvic parameters in 120 South Indian individuals
Modifications of sagittal balance are associated with changes in pelvic orientation.\textsuperscript{7} Several studies have confirmed that the pelvic parameters determine the lumbar lordosis and sagittal balance of the spine in healthy individuals. In addition, they have a significant role in the development of some adult spine disorders, such as spondylolisthesis.\textsuperscript{5,9} Sagittal spinal morphology varies from one individual to another and is specific to each person. Classifications proposed in the literature are based on the measurements of curvatures, angulations or other parameters, chiefly for a normal population.\textsuperscript{10} They are purely descriptive rather than in any way analytic. Measurements of the pelvic parameters have been documented in Caucasians, Mexicans and Asian population of healthy volunteers by Zárate-Kalfópulos B et al.\textsuperscript{11} Differences in measurements of the pelvic parameters have been documented between black and white individuals with respect to adolescent idiopathic scoliosis. Ethnic differences are a significant factor not only when describing the anthropometric data but also when applying the findings to a different parameters, there is a need to describe the parameters differentially in relation to the ethnicity of the studied individual. Multiple differences in the physical constitution of interracial origin have been previously described. Given the importance of the spinopelvic parameters, there is a need to describe the parameters differentially in relation to the ethnicity of the studied individual. From Table 2, it is clear that there is a difference in the pelvic parameters between different ethnicity. The average weight of individuals in Lee CS et al study was 64 kg while average weight of individual in Zárate-Kalfópulos B\textsuperscript{11} study was 72 kg. While volunteers in our study had average of 72.5 kg. To attribute the observed differences to weight or body mass index would merely be speculation. However, pelvic parameters of South Indians were comparable to that of Mexicans. Other researchers have shown differences in sagittal parameters between different races. Hanson P et al\textsuperscript{12} found significantly greater lumbosacral curvature in blacks than in whites. Similarly, Lonner BS et al\textsuperscript{13} found significant differences between black and white patients with adult idiopathic scoliosis and showed that the pelvic incidence, pelvic tilt and lumbar lordosis values were higher in the black group. These authors concluded that race might influence the individual spino pelvic alignment. Our results suggest that race influences the individual when planning surgical reconstruction. Further, research is needed to explore other parameters, such as the total sagittal alignment of the entire spine, to identify ethnic differences.

**CONCLUSION**

The pelvic parameters vary between different ethnicity was evident from our study. However, pelvic parameters of South Indian population has shown some similarity to the Mexican population.

**REFERENCES**


