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Beyond Cobb angles: The role of Coxofemoral axis based positional parameters in Sagittal Spine alignment

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Abstract

Background

Conventional sagittal alignment assessment is largely based on angular morphological parameters and sagittal vertical axis (SVA). However, individuals with similar Cobb angles may demonstrate different sagittal profiles depending on the location of the apices of the thoracic and lumbar curves. Coxofemoral-axis-based positional parameters may therefore provide complementary information regarding global sagittal balance. The purpose of this study is to evaluate the relationships between conventional morphological parameters, global sagittal parameters, and coxofemoral-axis-based positional parameters in a healthy adults, and to identify positional measurements that may be useful in characterizing the sagittal alignment

Methods

This study is a Cross sectional Observational study. Standing whole-spine radiographs of 75 healthy individuals were evaluated. Morphological parameters included cervical lordosis, T1 slope, thoracic kyphosis, lumbar lordosis, sacral slope, pelvic tilt, and pelvic incidence. Positional and global sagittal parameters included SVA, thoracic apex-femoral axis distance (TF), lumbar apex-femoral axis distance (LF), S1F, overhang, thoracolumbar width (TL width), T1 pelvic angle (T1PA), T4 pelvic angle (T4PA), L1 pelvic angle (L1PA), and T1 sacropelvic inclination (T1SPI). Correlation, partial correlation, and linear regression analyses were performed to assess relationships among parameters.

Results

Strong correlations were observed between S1F and LF ($r = 0.91$), pelvic tilt and S1F ($r = 0.75$), overhang and S1F ($r = 0.74$), TF and TL width ($r = 0.71$), and T1SPI with both TF and TL width ($r = 0.77$). SVA demonstrated a strong inverse correlation with TL width ($r=-0.76$). Linear regression demonstrated significant relationships between S1F and LF/PT ($R^2 = 0.878$), overhang and PT/LF ($R^2 = 0.868$), SVA and TL width ($R^2 = 0.684$), and T1SPI with TF/TL width (approximately $R^2 = 0.69$; $p < 0.01$). Among the positional parameters, S1F demonstrated the strongest overall associations with established spinopelvic parameters, while TL width showed a particularly strong relationship with SVA.

Conclusion

Sagittal spine alignment is influenced by both spinal morphology and the spatial position of spinal curves. Coxofemoral-axis-based measurements provide complementary information regarding the spatial configuration of the sagittal profile. S1F appears to be a particularly useful positional descriptor of spinopelvic relationships, while TL width may serve as a simple marker of global sagittal alignment

because of its strong association with SVA. Larger pathological cohorts are required to determine their clinical and prognostic relevance.

Background

Sagittal alignment parameters are important radiographic measurements for assessing the alignment and balance of an individual's spine and pelvis. Several radiographic measures have been proposed for the establishment of sagittal alignment. Conventionally used Sagittal alignment parameters include Sagittal Vertical Axis (SVA) and the Cobb angle. The sagittal vertical axis is frequently used to evaluate global sagittal alignment and has an acceptable range of 0.5 ± 2.5cm [1, 2]. The Cobb angles assess cervical lordosis (CL), thoracic kyphosis (TK), and Lumbar lordosis (LL). The pelvic parameters, including Sacral slope (SS), Pelvic tilt (PT), and pelvic incidence (PI), also help in assessing the degenerative changes and compensatory mechanisms. The majority of the older studies use the same three anatomical landmarks in the form of the centre of the femoral heads, the sacral end plate, and the C7 plumb line to describe overall spinopelvic balance [2, 3].

The Cobb angle obtained from the upper and lower end plates of spinal regional segments defines the current sagittal parameters, which include TK and LL. It is observed that individuals with the same TK and LL can have completely different sagittal alignment. Thus, the locations of the kyphotic and lordotic apices, as well as their inflection points, should receive more attention since they are crucial factors in determining the peculiar features of sagittal spinal alignment [4]. According to Wang et al., it is essential to understand that TK and LL are elliptical rather than circular.[5]. Schwab et al. demonstrated that the location of centre of gravity was constant relative to subject feet even after an increase in Thoracic kyphosis (TK) and anterior shift in SVA.[1]

Thus, recent studies and research point towards the use of the femoral head as a radiographic marker to approximate the gravity line. [1]Rather than the kyphotic and lordotic angles, the location of the thoracic and kyphotic apices plays a more vital role in assessing the sagittal spine alignment.[5] Understanding the weight and centre of weight supported by the sacrum and the coxofemoral joints is essential for studying spinal posture.[2] Also, Seebaly et al. reported a decrease in Proximal junctional kyphosis incidence from 41.4% to 13.5%by restoring the LL sagittal apex.[6] Thus, these studies suggest that the morphological parameters such as TK and LL should be related to the coxofemoral joint rather than SVA alone in assessing the biomechanical balance of an individual.

Therefore, our study aims to assess the correlation between all the available morphological parameters (CL, T1slope, TK, LL, SS, PT, PI) and positional parameters (SVA, SVA -F, TF, LF, S1F, Overhang, TL width, T1PA, T4PA, L1PA, T1SPI) and their contribution to the sagittal alignment. Our study also aims to assess which parameter is best for assessing the sagittal alignment of a normal individual.

Methods

Aim

To evaluate the relationships between conventional morphological parameters, global sagittal parameters, and coxofemoral-axis-based positional parameters in a healthy adults, and to identify positional measurements that may be useful in characterizing the sagittal alignment.

Study Design Cross sectional Observational Study

Patient selection:

All participants provided written consent for participation. In total, around 75 healthy individuals presenting to an Orthopedic outpatient department in a tertiary care centre between March 2026 and June 2026 with complaints of mechanical back pain or neck pain were included in the study. The participants were explained about the study objectives, methods, and potential risks and provided written informed consent. The inclusion criteria were (1) age between 20 and 60 years; (2) absence of symptoms that significantly affected work, daily activities and sleep;(3) Visual Analog Scale (VAS) < 2; Oswestry Disability score < 20. The exclusion criteria included (1) history of infection, spinal trauma, tumor, or deformity; (2) history of spine surgery; (3) Clinical LIST or palpable deformity on examination ; (4) associated conditions such as Ankylosing spondylitis, Rheumatoid arthritis, or congenital defects; (5) Apparent radiographic abnormalities including spondylolysis, facet hypertrophy;

Radiographic measurements

Each patient was made to stand upright, and hands were placed over the bilateral clavicle and shoulder to maintain the horizontal field of view with hips and knees in extension. A constant distance of 180 cm was maintained between the X-ray source and the film. PACS MD Vision software was used to measure the radiographic parameters. Two sets of parameters, radiological and morphological, were measured. The morphological parameters were measured based on Cobb's angle measurements according to various spinal segments such as Cervical Lordosis (CL), T1slope, TK, LL, Segmental LL, SS, PT, and PI.

The positional parameters were measured based on the location of these parameters with respect to the line passing through the centre of the coxofemoral heads (Coxofemoral line (CFL) as the origin. These include distance between thoracic apex from the femoral axis (TF), lumbar apex from femoral axis (LF), width of thoracic and lumbar apices (TL width), lumbar apex from the SVA (LS1), Femoral axis from the posterior superior corner of sacral end plate S1(S1F) and overhang, the distance between midpoint of sacral end plate and femoral axis. The other novel radiological parameters, T1PA, T4PA, L1PA (T1, T4, L4 Pelvic angles), were the angles made by the lines from T1, T4, and L1 to the centre of the femoral head and a line from the femoral head to the midpoint of the sacral end plate. T1SPI (T1 sacropelvic Incidence) is the angle between the line from the T1 vertebra to the centre of the femoral heads and the vertical. Sacral slope angle (SSA) is the angle made by the line from the centre of the C7 vertebral body to the posterior superior corner of S1 and the S1 end plate. All these parameters have been shown in Fig. 1. A, B, C. The measurements were done by two experienced spine surgeons for each parameter of interest.

Statistical analysis:

The measured radiographic parameters were measured using IBM SPSS Statistics for Windows ver.31.0. The normality of the data was checked using the Kolmogorov-Smirnov test. The parameters were divided into continuous and categorical variables. Correlation and partial correlation analysis were used to find the relationship among the parameters. Based on the correlation coefficient, the parameters were categorised into very strong(r = 0.80-1.00), strong (0.60–0.79), moderate(r = 0.40–0.59), and weak (r = 0.20–0.39). Principal factor analysis was used to segregate the radiographic parameters that had the most impact on other parameters and the overall sagittal alignment. Linear regression analysis was used for parameters with strong correlation at a level of significance of $p < 0.05$.

Results

Positional and Morphological Parameters:

A total of 75 patients who presented with mechanical back pain or neck pain were enrolled in the study, out of which radiographs that did not meet the inclusion criteria were excluded. The average age of the cohort was 46.48 +/- 10 years (rang – 28 to 70 yrs). The participants were predominantly females with sex distribution of 63% females and 37% males. All parameters showed a normal distribution curve except for T4PA and L1PA. The values of morphological parameters including CL, T1slope, TK, LL, s-LL, SS, PT and PI were 19.27 $\pm$ 8.08, 20.94 $\pm$ 7.43, 42.60 $\pm$ 10.27, 56.78 $\pm$ 12.08, 35.29 $\pm$ 7.79, 36.78 $\pm$ 5.73, 16.07 $\pm$ 5.40 and 52.5 $\pm$ 6.83 respectively. The positional parameters including SVA, TL Width and LS1 width were – 1.72 $\pm$ 3.69 cm, 119.69 $\pm$ 22.99, -47.71 $\pm$ 6.90 respectively. TF, LF and overhang values were 111.79 $\pm$ 28.80, -5.82 $\pm$ 18.23, and 32.48 $\pm$ 12.04 respectively. The values of other global sagittal parameters including T1PA, T4PA, L1PA, T1SPI and SSA are 12.33 $\pm$ 4.58, 8.28 $\pm$ 4.91, 7.24 $\pm$ 4.54, 6.81 $\pm$ 3.07, 130.99 $\pm$ 11.08.

Figure 1. A illustrates the measurement of Morphological parameters, CL- angle between lower end plate of C2 and upper end plate of T1; T1Slope angle between superior end plate of T1 and the horizontal; TK- cobbs angle between upper end plate of T1 and lower end plate of T12; LL- Lower end plate of L1 and the sacral end plate; SS- angle made by upper end plate of S1 and the horizontal; PI- angle between the perpendicula line to the sacral end plate and the line connecting mid point of sacral end plate to the centre of femoral head; PT- angle between line joining centre of sacral end plate and the vertical;

Figure 1.B illustrates measure ment of the postional parameters, vertical lines a- line through the posterior vertebral body of the thoracic apex vertebra(T), b- line from posterosuperior corner of S1 end plateA(S1), c- line through the anteriro vertebral body of lumbar apical vertebra(L), d- Line through the centre of bilateral femoral head(F). S1F, TF, LF, TL Width,Ls1 are the distance between the above mentioned lines respectively. Overhang- Distance between midpoint of sacral end plate and line b.

Figure 1.C illustartes the measurement of global sagittal alignment T1PA, T4PA and L1PA are the angle between the lines from T1,T4 and L1 vertebral body to centre of femoral heads and centre of emoral heads to the mid point of sacral end plate; T1SPI is the angle between centre of T1 vertebral body to the centre of fem oral head and the vertical; SSA- Angle made by the sacral end plate and the line from posterosuperior corner and the centre of C7 vertebral body.

Correlation and partial correlation analysis:

The correlation and partial correlation analysis revealed a varying degree of correlation among the parameters. There was a strong corelation between the adjacent morphological and positional parameters from cervical to lumbar segments. There was a strong correlation between S1F and LF($r = 0.91$), PT and S1F($r = 0.75$), PT and Overhang ($r = 0.69$, $p < 0.001$), Overhang and S1F($r = 0.74$), PT and LF ($r = 0.65$, $p < 0.001$), TF and TL width ($r = 0.71$, $p < 0.001$), and LF and Overhang ($r = 0.75$, $p < 0.001$), S1F and T1PA ($r = 0.60$,$p < 0.001$), S1F and T4PA ($r = 0.63$,$p < 0.001$), T1SPI and TF($r = 0.77$,$p < 0.001$) T1SPI and TL width($r = 0.77$, $p < 0.001$).

There was a moderate relationship between the following parameters, T1PA and Overhang ($r = 0.59$, $p < 0.001$), L1PA and Overhang ($r = 0.47$, $p < 0.001$), LL and TL width ($r = 0.57$, $p < 0.001$), sLL and SSA ($r = 0.58$, $p < 0.001$). It is also noted that global sagittal parameters such as T1PA, T4PA and L1PA expressed moderate relationship with PT, PI and LF.

There was also a negative correlation observed between the following variables SS and LF ($r= -0.48$, $p < 0.001$), SVA and TF ($r= -0.51$, $p < 0.001$), SVA and TL width ($r= -0.76$, $p < 0.001$), and moderate negative corelation between SS and LF ($r=-0.48$, $p < 0.001$), SSA and T1PA($r=-0.45$,$p < 0.001$), SSA and T4PA($r=-0.42$, p0.001).

Linear Regression Analysis:

Linear Regression analysis has been done for variables with very strong and strong correlation. It revealed that there was a relationship between Overhang and PT ($R^2 = 0.868$, $p < 0.01$), Overhang and LF ($R^2 = 0.868$, $p < 0.01$), S1F with LF ($R^2 = 0.878$, $p < 0.01$) and PT($R^2 = 0.878$, $p < 0.01$), SVA with TL Width($R^2 = 0.684$, $p < 0.01$), T1SPI and TF($R^2 = 0.684$, $p < 0.01$), T1SPI with TF($R^2 = 0.688$, $p < 0.01$), and TL Width($R^2 = 0.688$, $p < 0.01$). There was also and additional relationship between TL Width with L1PA ($R^2 = 0.465$, $p < 0.01$), SSA ($R^2 = 0.465$, $p < 0.01$), and TK ($R^2 = 0.465$, $p < 0.01$).

Discussion

Sagittal spine alignment plays a major role in understanding the biomechanics of spinal diseases and is imperative for successfully treating them [7–9]. We have evaluated the radiographs of 75 healthy individuals for various morphological, positional, and global sagittal parameters and tried to elicit correlations between these parameters. We noticed a strong relationship between the adjacent

morphological parameters from the distal cervical to the lumbar and pelvic parameters (CL, T1 Slope, TK, LL, SS). A similarly strong relationship was observed between adjacent global

Figure 6. Scatter plot graphs of various morphological and positional parameters and their correlation; A- Overhang vs PT; B- Pelvic tilt and LF; C- S1F and LF; D- S1F and PT; E- SVA and TL width; F- T1SPI and TF.

sagittal parameters (T1PA, T4PA, and L1PA). All these sagittal parameters are linked to each other from proximal to distal, thus maintaining the global sagittal balance.

It is observed that individuals with the same identical TK and LL can have completely different sagittal alignment [4, 10]. Thus, the locations of the kyphotic and lordotic apices, as well as their inflection points, should receive more attention since they are crucial factors in determining the peculiar features of sagittal spinal alignment [4]. According to Wang et al., it is essential to understand that TK and LL are elliptical rather than circular.[5]. In our study, Linear regression analysis established a strong negative relationship between TF, TL width, and SVA, indicating that the sagittal alignment (SVA) is greatly affected by the position of the thoracic and lumbar apex and the distance between the locations of these apices. Individuals with identical Cobb angles can have different apex locations and therefore entirely different sagittal profiles [9, 10]. Positional parameters address these limitations by describing where the curve lies relative to a stable anatomical reference. The femoral heads are particularly relevant because sagittal compensation attempts to maintain the trunk and gravity line in an efficient relationship with the hip axis [11, 12]. Accordingly, the combination of morphology and position may provide a more complete radiographic description than either group of measurements alone.

Linear regression analysis demonstrated that there exists a strong relationship between PT, Overhang, and S1F, thus indicating a spatial relationship between the pelvis and the coxofemoral axis. Wang et al. similarly demonstrated a particularly strong association between PT and Overhang, emphasizing that pelvic rotation is accompanied by a predictable change in the horizontal relationship of the sacrum to the femoral heads[5]. There is also a close relationship between S1F and PT, LF. This suggests that S1F and overhang may act as a useful positional link between pelvic orientation and the location of the lumbar curve relative to the hip axis. Practically the angular pelvic compensation and horizontal pelvic displacements are complementary to each other in Global sagittal balancing.

The relationship between LF, S1F, and PT reinforces the importance of the location of the lumbar apex rather than the magnitude of lordotic curvature alone. This also indicates that the location of the lumbar apex is coupled to lumbar and sacral morphology, thus strongly supporting the fact that individuals with the same lumbar lordosis can have different sagittal profiles based on the location of the lumbar apex [13].

The association between TF and TL width and the inverse relation of TL width with SVA supports the concept that the thoracic apex, lumbar apex, and the horizontal distance separating them behave as an interconnected positional system. The horizontal distance between the thoracic and lumbar apex plays

an important role in predicting the position of SVA [3, 14]. This coordinated behaviour is required to maintain an upright posture with the trunk balanced in relation to the coxofemoral axis [11]. The inverse linear relationship between SVA and TL width must be considered in determining the position of the lumbar apex during restoration of sagittal balance, especially in spinal deformity corrective surgeries [15, 16]. On an average the thoracic apex is located at T7 and lumbar apex at L4 and TL inflection point at T12[4, 17]. The location of lumbar apex from the coxofemoral axis (LF) shows a strong linear relation with PT and an inverse relation with SS. Thus, L apex and its position play an important role in determining lumbar sagittal alignment [17]. Hence, restoring the L apex to the optimal position minimises the mechanical complications post adult spinal deformity surgeries [18].

We also included other recently described few global sagittal parameters, including T1PA, T4PA, L4PA and T1SPI, which are pelvis-referenced angular measures of upper trunk inclination [19, 20]. T1PA, T4PA, and L1PA exhibit a moderate positive correlation with morphological pelvic parameters, including PT and PI, and a strong positive correlation with positional parameters such as LF and overhang. The T1SPI also had a strong relationship with TF and TL width, which suggests that a pelvis-referenced angular measure of the upper trunk may reflect the horizontal positioning of the thoracic and thoracolumbar regions [20]. This may be useful because it links upper-trunk inclination to the same coxofemoral reference system used for the positional distance measurements.

Among the positional parameters evaluated, S1F demonstrated the strongest overall associations with established spinopelvic parameters, while TL Width showed a particularly strong relationship with SVA, highlighting its potential relevance as a simple positional descriptor of global sagittal alignment.

The strength of the study includes the simultaneous evaluation of established morphological measurements and multiple coxofemoral-axis-based positional parameters. This permits assessment of sagittal alignment as an integrated geometric system rather than as a collection of isolated angles. Correlation, partial-correlation, and regression approach further allows exploration of both simple associations and relationships that persist after accounting for interconnected variables. The limitations of our study include a relatively small sample size, also the radiographic measurements represent static standing alignment and do not directly measure the gravity line, muscle activity, or dynamic compensations. Finally, the study was performed in a healthy cohort; the clinical thresholds and prognostic significance of these parameters have to be applied to a patient cohort with degenerative spinal pathology and have to be validated across multicentric trials.

Conclusion

Sagittal spine alignment represents an integrated interaction between morphological and positional parameters rather than a relationship defined by isolated angular measurements alone. The strong associations observed between coxofemoral axis-based positional parameters and established morphological and global sagittal parameters highlight the importance of incorporating the spatial location of spinal curves into the assessment of sagittal balance. In particular, relationships of TL width

and the thoracic and lumbar apex position with SVA and pelvis-referenced parameters suggest that these measurements provide complementary information regarding global sagittal alignment. Further studies in larger pathological cohorts are required to assess their clinical and prognostic relevance.

List of abbreviations

CFL: Coxofemoral line; CL: Cervical lordosis; IEC: Institutional Ethics Committee; L1PA: L1 pelvic angle; LF: Lumbar apex–femoral axis distance; LL: Lumbar lordosis; LS1: Lumbar apex from the sagittal vertical axis / LS1 width; PACS: Picture Archiving and Communication System; PI: Pelvic incidence; PT: Pelvic tilt; S1F: Distance/width between the posterosuperior corner of the S1 end plate and the coxofemoral line/femoral axis; sLL: Segmental lumbar lordosis; SPSS: Statistical Package for the Social Sciences; SS: Sacral slope; SSA: Sacral slope angle; SVA: Sagittal vertical axis; T1PA: T1 pelvic angle; T1SPI: T1 sacropelvic inclination; T4PA: T4 pelvic angle; TF: Thoracic apex–femoral axis distance; TK: Thoracic kyphosis; TL width: Thoracolumbar width / distance between the thoracic and lumbar apices; VAS: Visual Analog Scale.

Declarations

Ethics approval and consent to participate

This retrospective study was approved by the Institutional Ethics Committee of St. John's Medical College and Hospital, Bengaluru, India [IEC approval number: IEC/1/805/2025] and (IEC ref number. TH-179/2025). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent to participate in the study was obtained from all participants prior to their inclusion in the study.

Consent for publication

Not applicable. The manuscript does not contain any identifiable individual patient data or images.

Clinical trial number

Not applicable.

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Author Contribution

Dr VS has prepared the manuscript and Dr VS and Dr AM has done the radiological measurements done in this study, Dr ANV has contributed novel ideaS , various radiological parameters , reviewing the manuscript and constant support towards the study, Dr MS and AMK also reviewed the study and helped in sample collection

Acknowledgement

I acknowlege Dr K Seetharaman in contributing to the statistical analysis of this study

Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

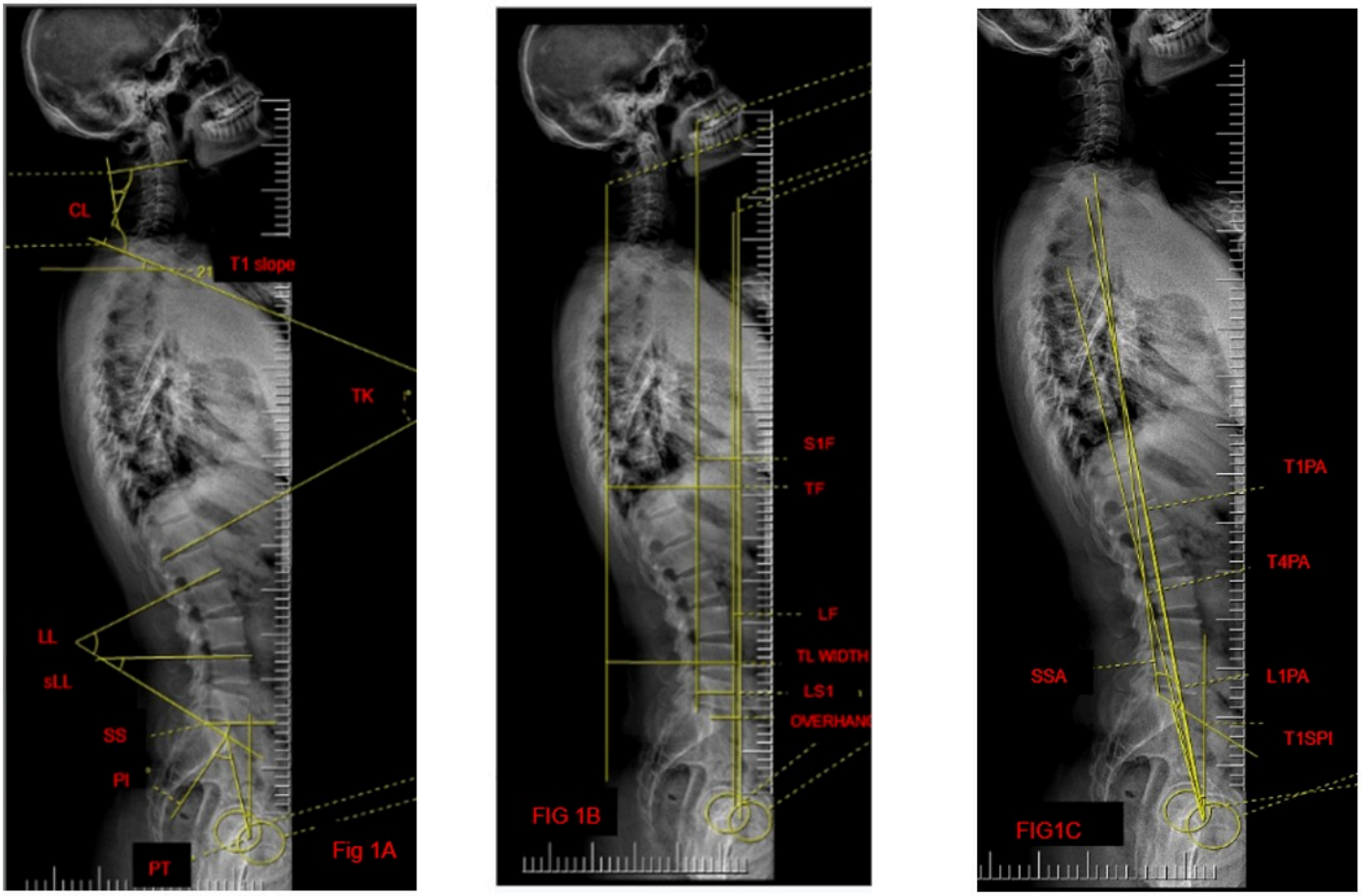


Figure 1

A illustrates the measurement of Morphological parameters, CL- angle between lower end plate of C2 and upper end plate of T1; T1Slope angle between superior end plate of T1 and the horizontal; TK- cobbs angle between upper end plate of T1 and lower end plate of T12; LL- Lower end plate of L1 and the sacral end plate; SS- angle made by upper end plate of S1 and the horizontal; PI- angle between the perpendicula line to the sacral end plate and the line connecting mid point of sacral end plate to the centre of femoral head; PT- angle between line joining centre of sacral end plate and the vertical;

Fig 1.B illustrates measure ment of the postional parameters, vertical lines a- line through the posterior vertebral body of the thoracic apex vertebra(T) , b- line from posterosuperior corner of S1 end plateA(S1) , c- line through the anteriro vertebral body of lumbar apical vertebra(L), d- Line through the centre of bilateral femoral head(F). S1F, TF, LF, TL Width,Ls1 are the distance between the above mentioned lines respectively. Overhang- Distance between midpoint of sacral end plate and line b.

Fig 1.C illustartes the measurement of global sagittal alignment T1PA , T4PA and L1PA are the angle between the lines from T1,T4 and L1 vertebral body to centre of femoral heads and centre of emoral heads to the mid point of sacral end plate; T1SPI is the angle between centre of T1 vertebral body to

the centre of fem oral head and the vertical; SSA- Angle made by the sacral end plate and the line from posterosuperior corner and the centre of C7 vertebral body.

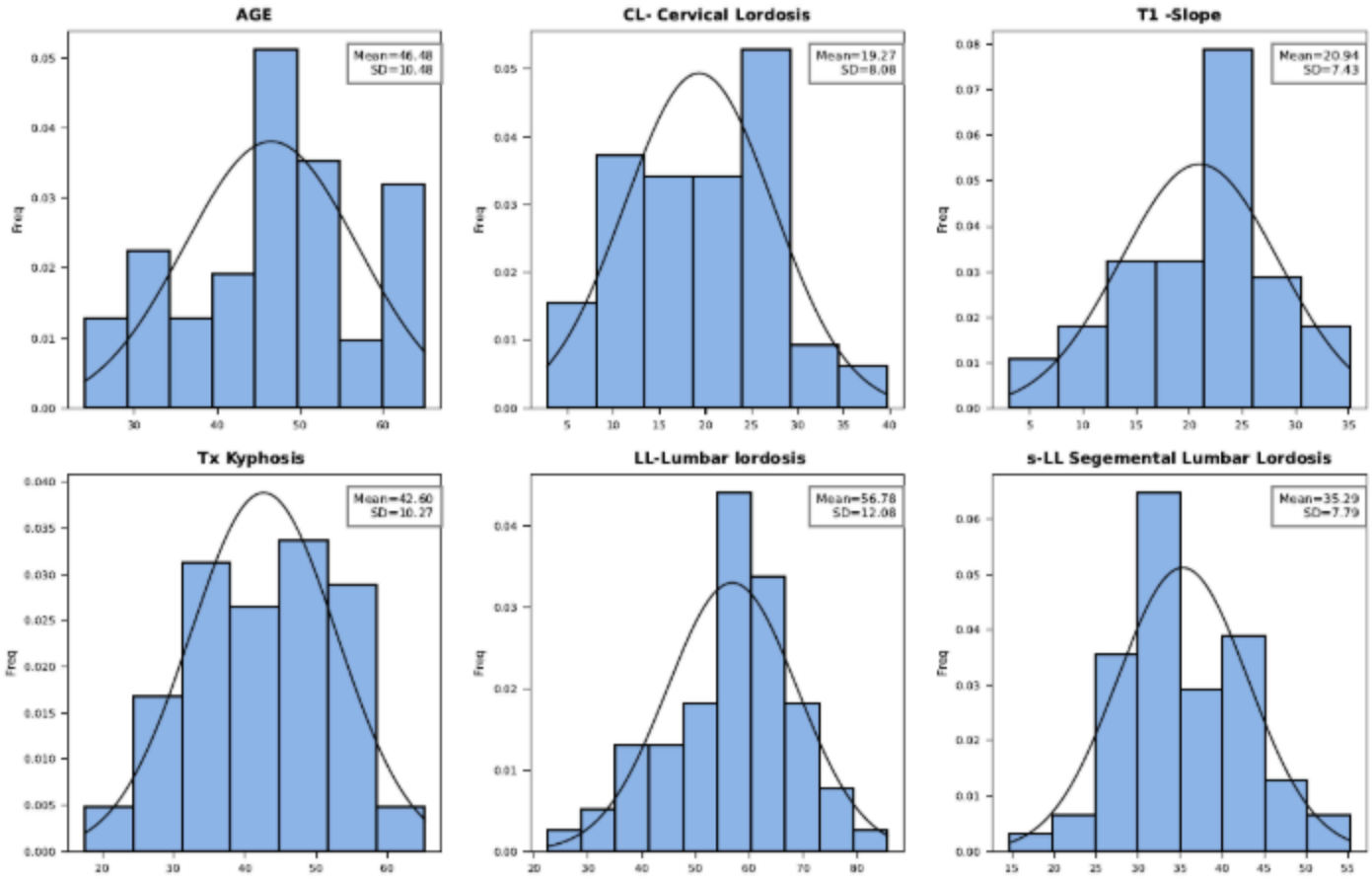


Figure 2

Histogram showing the normal distribution of measured sagittal parameters. CL- Cervical Lordosis; T1- T1 Slope; Tx -Thoracic Kyphosis; Ll- Lumbar Lordosis; sLL- segmental Lumbar Lordosis.

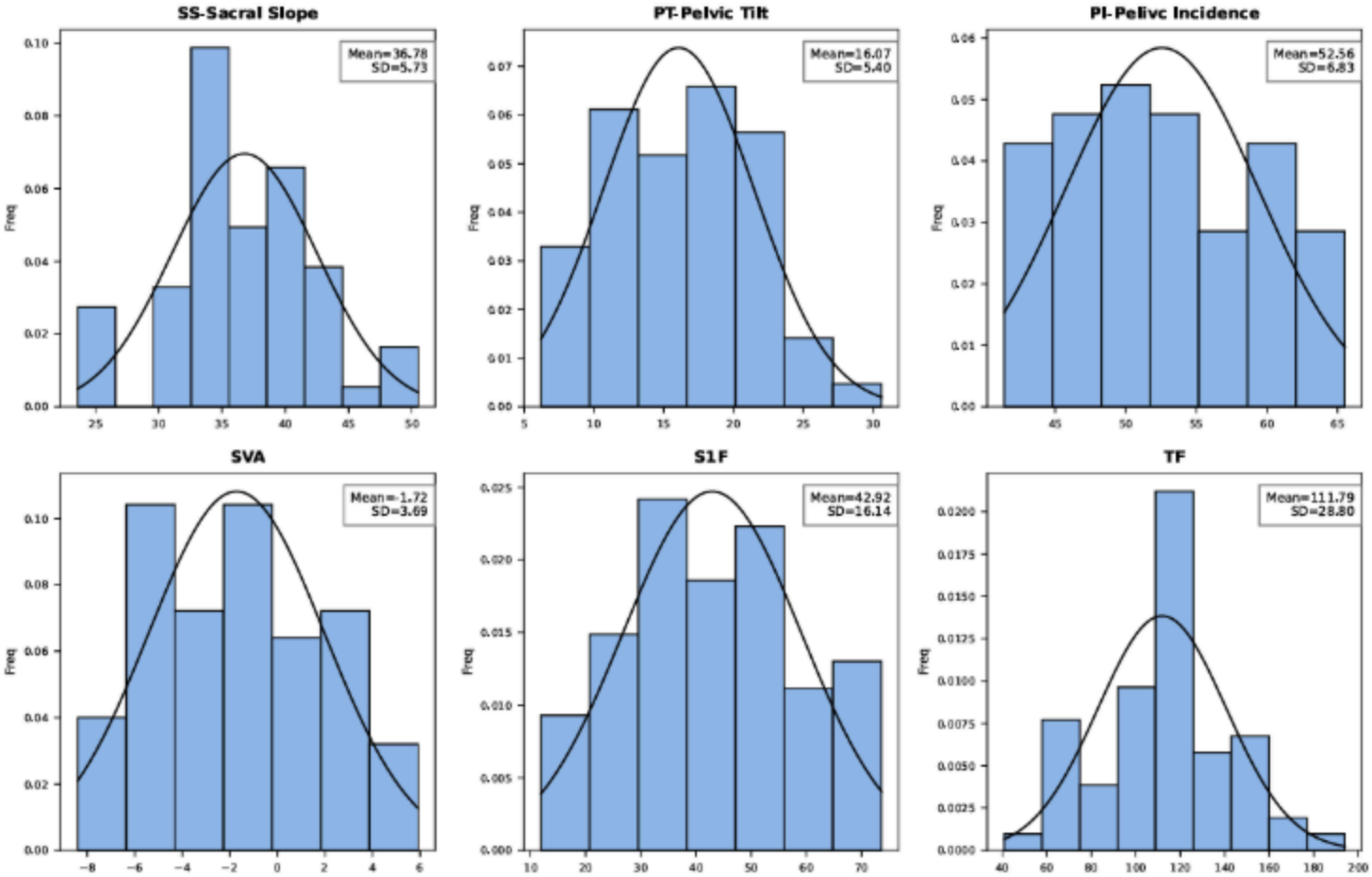


Figure 3

Histogram showing the normal distribution of measured sagittal parameters.; SS- Sacral slope; PT- Pelvic Tilt; PI- Pelvic incidence; SVA – Sagittal Vertical Axis; S1F width of posterosuperior corner of sacral end plate and CFL; TF.

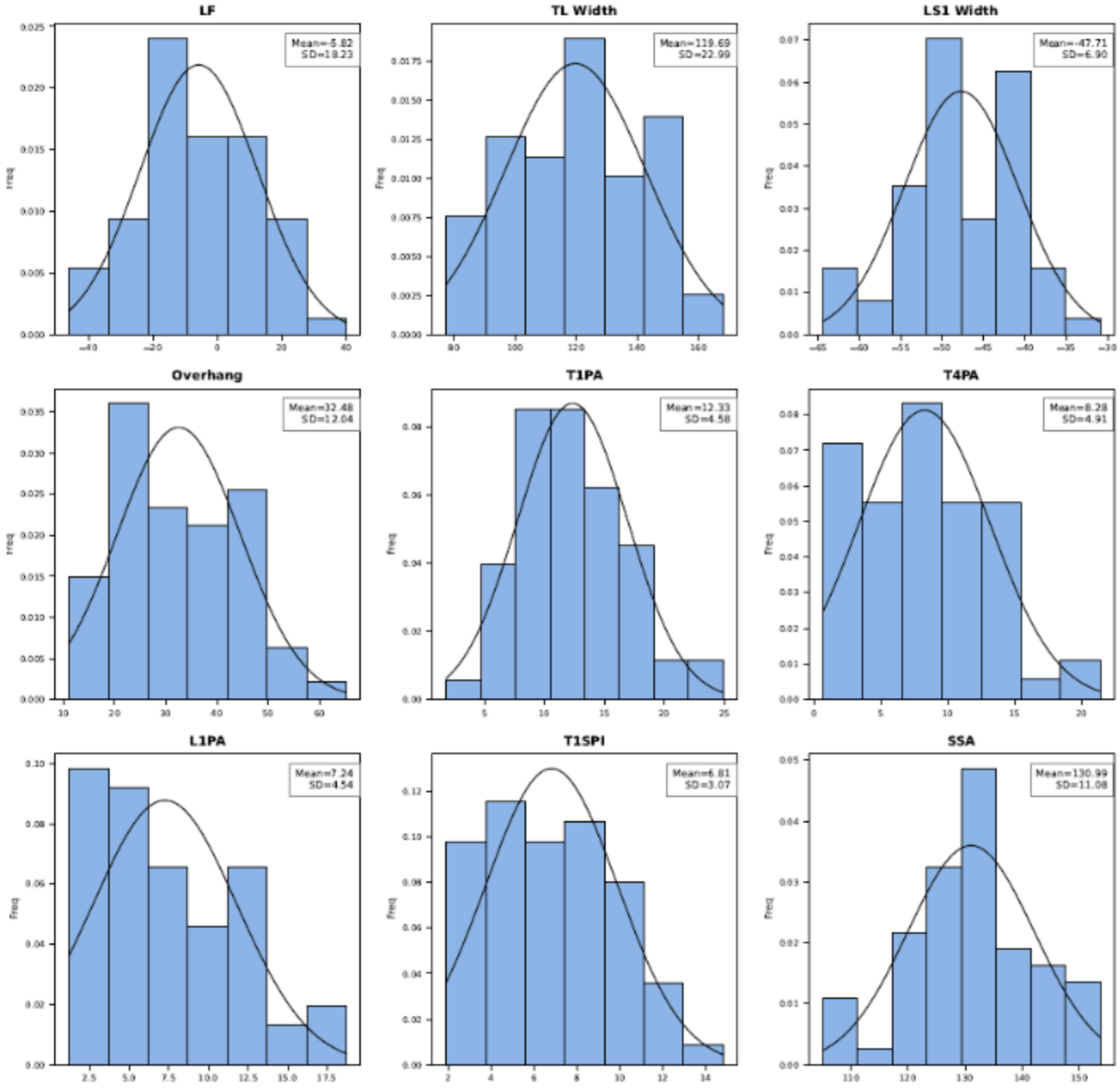


Figure 4

Histogram showing the normal distribution of measured sagittal parameters LF, lumbar width from CFL; TL Width -width of thoracic and lumbar apex; Overhang- width of midline of sacral endplate midpoint and CFL; T1pA, T4PA and L1PA Pelvic angles with respect to T1, T4 and L1 vertebral body, SSA- Sacral slope angle and T1SPI – Sacropelvic incidence with respect to T1 vertebral body

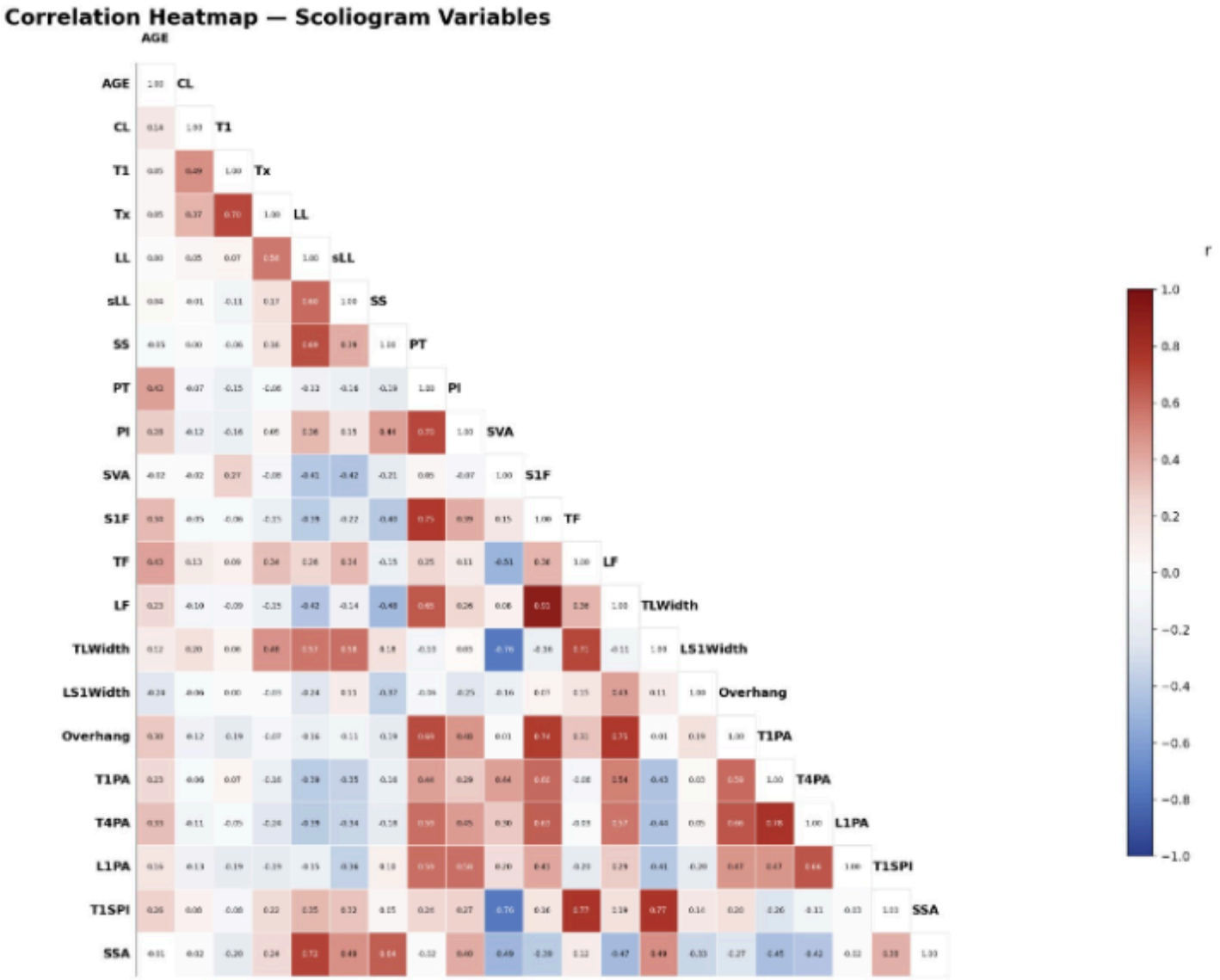


Figure 5

Illustrates the graphic depiction of correlation coefficients between various morphological and positional parameters. CL- Cervical Lordosis; T1- T1 Slope; Tx -Thoracic Kyphosis; Ll- Lumbar Lordosis; sLL- segmental Lumbar Lordosis; SS- Sacral slope; PT-Pelvic Tilt; PI- Pelvic incidence; SVA – Sagittal Vertical Axis; S1F width of posterosuperior corner of sacral end plate and CFL; TF and LF thoracic and lumbar width from CFL; TL Width -width of thoracic and lumbar apex; Overhang- width of midline of sacral endplate midpoint and CFL; T1pA, T4PA and L1PA Pelvic angles with respect to T1, T4 and L1 vertebral body, SSA- Sacral slope angle and T1SPI – Sacropelvic incidence with respect to T1 vertebral body.

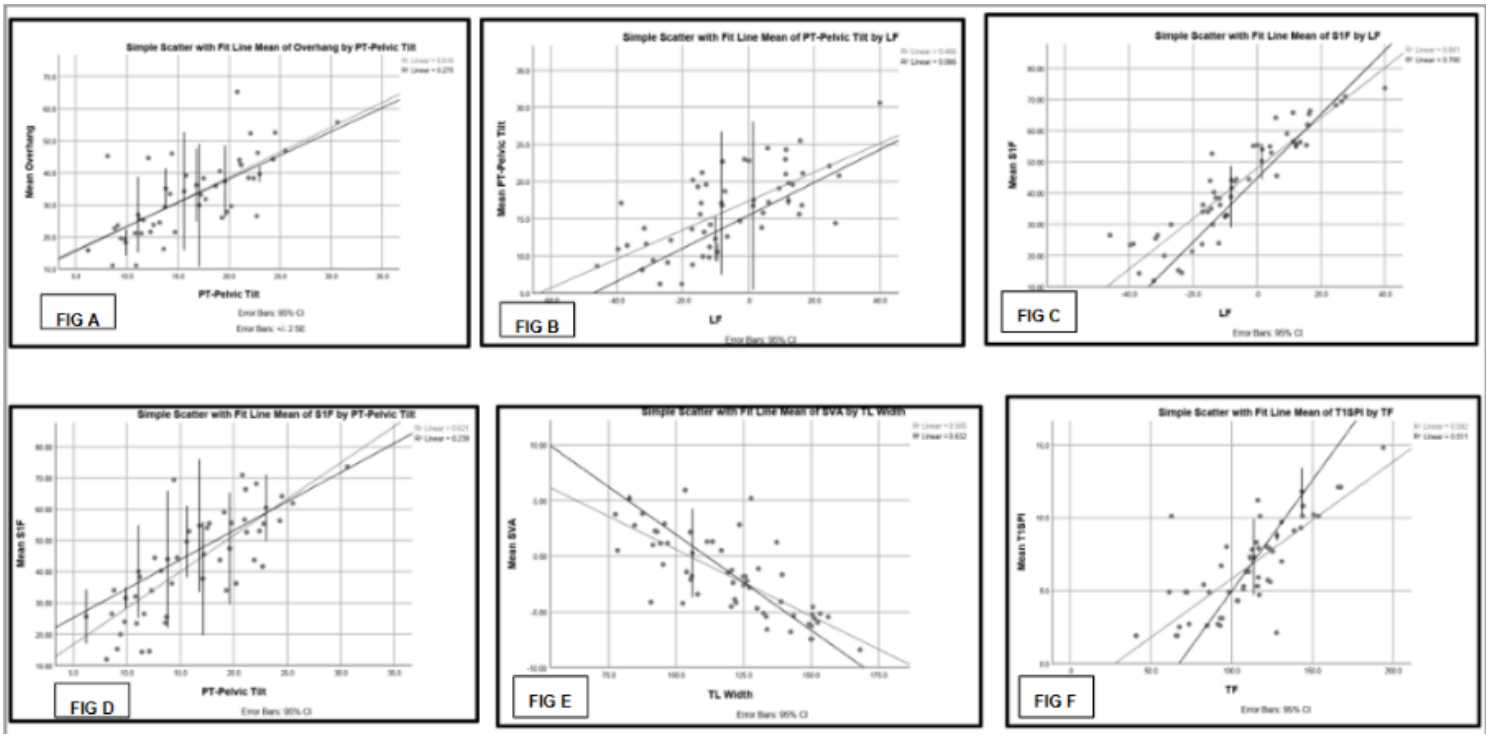


Figure 6

Scatter plot graphs of various morphological and positional parameters and their correlation; A- Overhang vs PT; B- Pelvic tilt and LF; C- S1F and LF; D- S1F and PT; E- SVA and TL width; F- T1SPI and TF.