INTRODUCTION
Orthodontic treatment involves improvement in patient's skeletal as well as dental and soft tissue structure. Therefore, careful analysis of craniofacial morphology is an inevitable step in diagnosis. Cephalometric radiograph gained popularity in orthodontics for craniofacial assessment since its invention in 1931. It became an usual practice to obtain and develop cephalometric standards in a population and compare it with the patient's measurements for diagnosis and treatment planning.

Most of the orthodontic problems arise from sagittal anterio posterior (AP) plane discrepancies. Therefore, analysis of jaws in AP plane is a major step in diagnosis. Since the advent of skeletal sagittal analysis by Wylie in 1947, numerous methods were developed to assess the jaws in AP plane. However, not a single analysis is without flaw. Angle ANB is altered with the change in the position of nasion and jaw rotations, whereas Wits appraisal is affected by occlusal plane orientation and erupting teeth. Beta-angle measurement is based on condyle or condylion, which is not a reproducible landmark. W-angle and Yen-angle have been introduced recently and also claimed to be more reliable because they utilize stable landmarks like Sella, G-point and M-points. Pakistani population has never been assessed for gender dimorphism using these newer measurements. Therefore, the aim of this study was to determine the gender dimorphism using few common sagittal analyses and newly introduced measurements, i.e. W-angle and Yen-angle.

METHODOLOGY
The data for this cross-sectional study conducted from August to October 2013, included 209 pre-treatment lateral cephalometric radiographs of patients selected randomly from the orthodontic department of Baqai Medical University, Karachi, Pakistan. Inclusion criteria were patients with any skeletal class (class I, II or III) having complete permanent dentition including second molars. Patients with craniofacial malformations, cleft lip, cleft palate, facial asymmetry, history of previous orthodontic treatment and inter-racial marriage in parents or grandparents were excluded from the study. Tracing was performed in a standard manner by single researcher for the measurements shown in Figure 1.
Landmarks/planes used in this research for analyses included: S: center of sella turcica, N: frontonasal suture at its most superior point i.e. Nasion, point A: deepest point at the concavity on maxillary alveolar bone, point B: deepest point at the concavity on mandibular alveolar bone, functional occlusal plane: line passing through the occlusion of molars and premolars, M: midpoint of premaxilla, C: center of the condyle, and G: center of mandibular symphysis. Angles determined in this research included angle ANB: difference between SNA and SNB, Wits-appraisal: horizontal distance in mm between point A and B on functional occlusal plane, Beta-angle: the angle between A-B line and a perpendicular line drawn from C-B line to point A, W-angle: angle between M-G line and a perpendicular line drawn from S-G line to point M, and Yen-angle: angle between S-M line and M-G line.

Patients were classified into 3 skeletal classes i.e. class I, II and III on the basis of cephalometric measurements, incisor relationship derived from models and profile derived from patients’ photographs in their files. Class I requirements were class I incisor relationship, straight or slight convex but esthetically pleasing profile, ANB angle between 2° - 4°, Wits-appraisal -3 – +3 mm, Beta-angle 27° - 35°, Yen-angle 117° - 123°, W-angle 51° - 56°. Class II criteria were class II incisor relationship, convex profile, ANB > 4°, Wits-appraisal > +3 mm, Beta-angle < 27°, Yen-angle < 117°, W-angle < 51°. Class III included class III incisor relationship, concave profile, ANB < 2°, Wits-appraisal < -3 mm, Beta-angle > 35°, Yen-angle > 123°, W-angle > 56°. Patients who matched 5 out of 7 criteria were classified, accordingly.

Dalhberg’s formula was applied to control the tracing errors: STROBE (strengthening the reporting of observational studies in epidemiology) was followed to design this study and STROBE checklist was applied to prepare this manuscript.

Statistical Package for the Social Sciences (SPSS) version 20 was used to analyze the data with confidence level set at 5% (p < 0.05). Kolmogorov-Smirnov test of normality was used for checking the distribution of data. Mann-Whitney U-test was applied to assess the difference in measured values for males and females.

RESULTS

Sample comprised of 117 females and 92 males, with the average age of 17.83 years.

Gender-based distribution of skeletal classes is shown in Figure 2. The sample in this study was dominated by female patients. Skeletal class II had the highest incidence, however, skeletal class III was the least prevalent type of malocclusion in this research.

Although the data obtained was parametric, but Kolgorov-Smirnov test showed that it was not normally distributed. Therefore, Mann-Whitney U-test was applied to obtain median values with interquartile ranges for ANB, Wits-appraisal, Beta-angle, W-angle and Yen-angle for all skeletal classes are shown in Table I. There was no significant difference found in all of the measured values among males and females except the Wits-appraisal and Beta-angle in class II cases (p < 0.05).

DISCUSSION

There are numerous methods introduced in cephalometrics for skeletal assessment in sagittal plane. However, all of them are associated with some flaws and limitations. Reliability of the analysis is affected by the reproducibility and instability of landmarks, inclination of reference lines or jaw rotations. Therefore, it becomes necessary to gather data and establish norms of every possible analysis for every population, so that the alternative analysis can be used for diagnosis. Thus, this study was designed to assess the craniofacial morphology of Pakistani males and females in sagittal plane, using commonly used measurements and newly introduced W-angle and Yen-angle.

The results of this study shows the highest prevalence of skeletal class II malocclusion (Figure 2), which is also supported by Waheedul-Hamid who evaluated a sample of 100 Pakistani patients for sagittal and vertical skeletal discrepancies and found skeletal class II to be the commonest malocclusion. The pattern of malocclusion in another study was also found to be class II in 70% of the research sample.

ANB angle is the most popular measurement to analyze the skeletal sagittal discrepancies, the mean values
for which were comparable to Caucasians but demonstrated higher limits.\textsuperscript{19} There was insignificant difference in ANB values for males and females. Previous study conducted by Jabbar reported even higher values for ANB angle, i.e. 4.14° in skeletal class I cases among Pakistani sample.\textsuperscript{20} In another study, angular measurements in an esthetically pleasing Pakistani sample were close to the Caucasian values.\textsuperscript{21}

Wits appraisal is the most popular alternative to ANB angle for skeletal sagittal analysis. In this study, the values for Wits appraisal for females were close to Caucasians. However, males showed tendency towards class II in skeletal class I patients.\textsuperscript{5} Thus, class II females showed higher values of Wits appraisal, which resulted in statistically significant difference between males and females. Jabbar also reported the Wits value of 2.46 mm in his class I population.\textsuperscript{21}

The measured value of Beta-angle in this study was not only close to the Caucasians norms\textsuperscript{7} but supported by other previous studies involving Pakistani patients which reported the mean values of 30.4\textsuperscript{22} and 29.28°.\textsuperscript{3} Although there was no sexual dimorphism found in the values of Beta-angle in class I patients but it showed significantly higher values in females in class II patients, which demonstrate comparatively more class II severity in males.

W-angle and Yen-angle are comparatively newer measurements, therefore, literature is scarcely available for comparison. Alam compared the mean values of W-angle and Yen-angle among Pakistani and Bangladeshi population and reported the values were close to the established standards.\textsuperscript{23} Similarly, in this study there was no significant difference found in the values of W-angle and Yen-angle between males and females and mean values were close to the original values.\textsuperscript{24}

The sample was dominated by females which explains their concern about dentofacial esthetics as also reported in previous studies.\textsuperscript{17,18} Beta-angle was the only measurement which showed significant sexual dimorphism in class II patients which can be explained by the difficulty in locating condylion on cephalogram, other than that the craniofacial morphologies of males and females were found to be similar. This finding was in agreement with other study involving Pakistani samples,\textsuperscript{18} which reported insignificant difference in cephalometric means among genders. Conversely, Shaikh found greater cranial base lengths and SNA angle in Pakistani males as compared to females.\textsuperscript{21}

\textbf{CONCLUSION}

Skeletal class II is the most prevalent type of malocclusion in Pakistani population. There were no significant difference observed in the craniofacial morphology of males and females, with the exception of Wits-appraisal and Beta-angle in class II cases.
REFERENCES


