INTRODUCTION

For proper alignment and good interdigitation at the end of orthodontic treatment, the tooth size should be in harmony in both dental arches to achieve normal overjet and overbite. Bolton’s analysis should be taken into consideration when diagnosing, treatment planning and predicting prognosis in clinical orthodontics. Many other methods have been devised to estimate tooth size discrepancy but Bolton’s analysis is still widely used in clinical practice. A sample of 90 patients with age ranging from 13 to 30 years were included in the study. The greatest mesiodistal width of each tooth in maxillary and mandibular arches (except for second and third molar) was measured using manual vernier caliper. Each tooth was measured twice from right first permanent molar to left fist permanent molar in each arch. The readings were then used to compute the anterior and overall Bolton’s ratios for each patient. The mean age was 20.75±2.9. Female to male ratio was 1.17:1. No statistical significant differences were present among different malocclusion groups with P-value of 0.38 for anterior ratio and for 0.122 overall ratio. There were no significant difference among males and females with P-value of 0.361 for anterior ratio and 0.592 for overall ratio.

Key Words: Orthodontic treatment, overjet, overbite, Bolton’s analysis.

ABSTRACT

For proper alignment and good interdigitation at the end of orthodontic treatment, the tooth size should be in harmony in both dental arches to achieve normal overjet and overbite. Bolton’s analysis should be taken into consideration when diagnosing, treatment planning and predicting prognosis in clinical orthodontics. Many other methods have been devised to estimate tooth size discrepancy but Bolton’s analysis is still widely used in clinical practice. A sample of 90 patients with age ranging from 13 to 30 years were included in the study. The greatest mesiodistal width of each tooth in maxillary and mandibular arches (except for second and third molar) was measured using manual vernier caliper. Each tooth was measured twice from right first permanent molar to left fist permanent molar in each arch. The readings were then used to compute the anterior and overall Bolton’s ratios for each patient. The mean age was 20.75±2.9. Female to male ratio was 1.17:1. No statistical significant differences were present among different malocclusion groups with P-value of 0.38 for anterior ratio and for 0.122 overall ratio. There were no significant difference among males and females with P-value of 0.361 for anterior ratio and 0.592 for overall ratio.

Key Words: Orthodontic treatment, overjet, overbite, Bolton’s analysis.
objective of this study was to determine the Bolton’s discrepancy among different groups of malocclusion.

**RESULTS**

The mean age was 20.75±2.9. Female to male ratio was 1.17:1. No statistical significant differences were present among different malocclusion groups. Table 1 shows the means, standard deviations, standard errors, minimum, maximum, F-value and p-value of overall and anterior ratios observed among the different malocclusion groups. (P-value 0.380 and 0.122 for anterior and overall ratios respectively).

There were no significant difference among males and females. Student t-test was performed to determine sexual dimorphism. Table 2 summarizes the means, standard deviations, and standard errors, minimum, maximum, F-value and p-value of overall and anterior ratios observed between male and female genders.

**DISCUSSION**

An ideal functional occlusion with adequate overjet and overbite requires among other factors, an adequate size ratio between upper and lower teeth. The importance of tooth size discrepancies in orthodontic diagnosis and treatment planning has been the subject of various discussions in orthodontic literature and accepted by orthodontic community because the

**METHODOLOGY**

In this cross-sectional study, a sample size of 90 patients, age ranged from 13 to 30 years were analyzed prior to orthodontic treatment. Subjects were selected randomly from patients reported at Orthodontic department of Khyber College of Dentistry, Peshawar. The inclusion criterion was; (1) Study cast casts which are of good quality. (2) All the permanent teeth to be fully erupted except for the third molars. (3) No mesiodistal and occlusal abrasions. (4) No proximal caries or proximal fillings. (5) No crown and bridge restorations. (6) No supernumerary teeth or dental malformations. (7) No history of previous orthodontic treatment.

The sample was divided into three groups: Group 1 with angle class I malocclusion (n=30), Group 2 with angle class II malocclusion (n=30) and Group 3 with angle class III malocclusion (n=30).

A thorough examination of all the study casts was done. The greatest mesiodistal width of each tooth in maxillary and mandibular arches (except for second and third molar) was measured using manual vernier caliper. Each tooth was measured twice from right first permanent molar to left first permanent molar in each arch. An average of 10 casts were measured per day to prevent visual fatigue. The readings were then used to compute the anterior and overall Bolton’s ratio using the following formulas; According to Bolton, the overall ratio is calculated by the following formula:

\[
\text{Overall Ratio} = \frac{\text{Sum of 12 lower teeth}}{\text{Sum of 12 upper teeth}} \times 100
\]

while, the anterior ratio is calculated by:

\[
\text{Anterior ratio} = \frac{\text{Sum of 6 lower teeth}}{\text{Sum of 6 upper teeth}} \times 100
\]

The data were analyzed by SPSS version 16.0. Kolmogrov-smirnov test was applied to see whether the sample was normally distributed or not. The test indicated that the data are normally distributed. Therefore, parametric tests were used. To statistically compare the anterior and overall ratios among the different malocclusion groups, analysis of variance (ANOVA) was applied. Statistical difference was found at p<0.05 and 95% confident interval. For gender differences independent student t-test was performed.

<table>
<thead>
<tr>
<th>Class</th>
<th>Mean</th>
<th>Std.dev</th>
<th>Std.error</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Overall ratio</th>
<th>Anterior ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>79.24</td>
<td>4.00</td>
<td>0.74</td>
<td>69.0</td>
<td>87.70</td>
<td>91.63</td>
<td>81.0</td>
</tr>
<tr>
<td>Class II</td>
<td>78.9</td>
<td>5.39</td>
<td>0.96</td>
<td>71.40</td>
<td>90.90</td>
<td>91.76</td>
<td>78.0</td>
</tr>
<tr>
<td>Class III</td>
<td>79.24</td>
<td>4.00</td>
<td>0.74</td>
<td>69.0</td>
<td>87.70</td>
<td>91.63</td>
<td>81.0</td>
</tr>
</tbody>
</table>

P-value 0.380 0.122  0.979 2.153

Significant level= <0.05
relationship between upper and lower teeth is related to orthodontic finishing excellence.\textsuperscript{19,25} In this study, Bolton's anterior and overall ratio in three different classes of malocclusion were studied.

In present study, the statistical analysis of Bolton's anterior and overall ratio calculated in three different classes of malocclusion showed no significant differences. This finding is in agreement with earlier studies done by other researchers.\textsuperscript{26,27} No correlation between angle's classification of malocclusion and Bolton's discrepancy was shown by Crosby and Alexander. They studied 109 pretreatment casts of orthodontic patients of class I, class II Div. 1 and class II Div. 2 malocclusion.\textsuperscript{18}

Fahad et al\textsuperscript{9} analyzed sample size of 160 pretreatment casts of orthodontic patients and concluded that there is no statistically significant difference between these groups. Also Laino et al\textsuperscript{28} speculated after their study on different malocclusion groups that there is no evidence of any predisposition for tooth size discrepancy in any of malocclusion groups.

In conflict with the current results, Batool et al\textsuperscript{29} found significantly higher mean anterior ratio for class II group than class I and class III groups. They selected cross sectional data from study casts of 135 patients reported to Armed Forces Institute of Dentistry, Rawalpindi. All other ratios were within close range of Bolton's norms. Also Oeyemi et al\textsuperscript{30} collected data of 372 school children, aged between 12-16 years and reported that significant difference exist between Bolton's mean tooth size ratio and of different malocclusion groups.

This study demonstrated that there was no gender difference in both anterior and overall ratio Bolton's ratio, a finding which is in agreement with other studies.\textsuperscript{1,31} Arya et al\textsuperscript{32} speculated mean size of each tooth for different groups i.e., class I and class II boys and girls in their study. Difference for individual between different arches was not analysed. Basaran et al\textsuperscript{33} failed to show any gender dimorphism or statistically significant difference of Bolton's tooth size discrepancy among different malocclusion groups. The study was conducted in Turkish population. The sample size consisted of 60 normal occlusion group and 300 patients divided into various malocclusion groups. Another study carried out by Ivan Ricci et al\textsuperscript{34} consisting of 105 individuals of age range 13-17 years in Brazilian population showed no significant difference between genders for both anterior and overall ratio in different classes of malocclusion.

Bernabe et al\textsuperscript{24} demonstrated sexual dimorphism, which is in disagreement with the present study result. Overall ratio between male and female samples was significantly different, but anterior ratio between males and females was not different. Similarly a study in Nigerian population reported that overall ratio and anterior ratio were higher in females than males.\textsuperscript{29}

TABLE 2: STUDENT T-TEST OF ANTERIOR AND OVERALL BETWEEN GENDERS

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>F-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior ratio</td>
<td>Male</td>
<td>41</td>
<td>78.7902</td>
<td>3.94055</td>
<td>.61541</td>
<td>0.844</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>48</td>
<td>80.3896</td>
<td>4.69238</td>
<td>.67729</td>
<td>0.541</td>
</tr>
<tr>
<td>Overall ratio</td>
<td>Male</td>
<td>41</td>
<td>91.91</td>
<td>3.46</td>
<td>0.541</td>
<td>0.289</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>48</td>
<td>92.41</td>
<td>3.07</td>
<td>0.44</td>
<td>0.592</td>
</tr>
</tbody>
</table>

REFERENCES

Bolton discrepancies among different classes of malocclusion


