Pattern of Malocclusion in a Sample of Orthodontic Patients from a Hospital in the Kingdom of Saudi Arabia

Azzam Al-Jundi\textsuperscript{1*}, and Hicham Riba\textsuperscript{2}

\textsuperscript{1}Assistant Professor, Department of Orthodontics, College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.

\textsuperscript{2}Assistant Professor, Department of Pedodontics, College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.

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**Background:** Malocclusion can present itself in numerous ways. It is present in every society, but the norms and pattern vary. In order to correct occlusal disharmony, it is imperative to identify its pattern in the population so that proper resources can be directed toward its diagnosis and treatment planning. The aim of this study was to determine of skeletal and dental malocclusion in a sample of Saudi orthodontic patients. **Material and Methods:** To achieve this, dentofacial characteristics of 510 patients from September 2013 to May 2015 were analyzed and tabulated. Both male and female were included in this study. Different cephalometric values were used to evaluate the type of malocclusion. Casts were analyzed to record the patient's dental classification. **Results:** Molar Class II malocclusion was the most frequent, whereas class III subdivision the least frequent. Statistically significant difference was observed in normal overjet, overbite, crossbite, slight midline deviation, ANB, NL/ML, NSL/ML, according to gender and between the hypodivergent and hyperdivergent groups, and between ANB, AOBO in the skeletal class I and class II group. **Conclusion:** the results give a detailed pattern of malocclusion in orthodontic patients and may provide a baseline data for planning orthodontic service. Class II Saudi patients have a higher motivation for orthodontic therapy. Statistically significant difference was found between vertical and sagittal angles.

**Keywords:** Malocclusion, Dentofacial characteristics, Orthodontic patients.

**INTRODUCTION**

Malocclusion, defined as an improper relationship between teeth in the opposite jaws, has been a prevalent disorder in recent decades\textsuperscript{1}. The prevalence of malocclusion varies in different parts of the world among different populations. Knowledge about the distribution of different malocclusions may help orthodontic practitioners in a better understanding of the extent of malocclusion problem in a geographic location and help them in the proper orientation and management of treatment possibilities\textsuperscript{2}. There have been several studies investigating the prevalence of various dento-facial characteristics, but only a few have been conducted on an orthodontic population \textsuperscript{3,4}. In Saudi Arabia, a few studies have evaluated the prevalence and distribution of skeletal and dental malocclusion \textsuperscript{7,8}. Only a limited number of these studies have reported the distribution of the different malocclusion features in Saudi patients attending orthodontic treatment. The subject of distinguishing clearly between skeletal and dental malocclusions was hardly studied\textsuperscript{3}. The literature review concerning the prevalence of malocclusion had shown that several factors could be considered to have roles in the patterns of malocclusion in different populations. These contributing factors include: the time of the study, geographic and topographic areas, and the age and gender of the population studied\textsuperscript{10}. Methods of recording and measuring malocclusion could be broadly divided into two types: qualitative (Angle classification), and quantitative (overjet and overbite). Among the qualitative methods of recording malocclusion, Angle’s method of classifying malocclusion, with or without modifications, was probably the most widely used\textsuperscript{3,4}. ANB angle described by Downs\textsuperscript{11}, and Wits analysis described by Jacobson\textsuperscript{12} have been proposed in the assessment of an antero-posterior jaw base relationship.

*Corresponding Author: Azzam Al-Jundi: Assistant Professor of Orthodontics, King Saud Bin Abdul Aziz University for Health Sciences, Riyadh, Kingdom of Saudi Arabia. E-mail: azjundi@hotmail.com Tel : +966549933916*
However, each of the methods described exhibits its own inherent weakness based on the variability of factors other than the jaw relationship itself.  

**AIMS OF THE STUDY**

This study was done to describe malocclusion pattern among patients who presented for treatment at orthodontic clinics at King Abdul Aziz Medical City, National Guard Health Affairs, Riyadh, Kingdom of Saudi Arabia. This study attempted to achieve the following aims:

- To determine the pattern of skeletal and dental malocclusions using ANB angle, Wits analysis, and angle classification in a sample of Saudi orthodontic patients.
- To compare the results of this study with that of other data reported in different populations.

**MATERIAL AND METHODS**

Pre-treatment dental casts and lateral cephalometric radiographs were obtained randomly after searching through 2400 files from the archive of orthodontic clinic at King Abdul Aziz Medical City, National Guard Health Affairs, Riyadh, Kingdom of Saudi Arabia. The selection criteria were based on the followings:

- All subjects shall be of Saudi descent in permanent dentition.
- Available pre-treatment dental casts (neatly trimmed with no broken teeth) and lateral cephalometric radiographs.
- Patients with syndromes, severe medical histories, and developmental anomalies such as ectodermal dysplasia, cleft lip and palate, Down syndrome, extractions of any permanent teeth, history of previous orthodontic treatment, prosthetic treatment, or trauma to any tooth before the commencement of orthodontic treatment were excluded.

Five hundred and ten (510) Saudi patients who fulfilled the inclusion criteria formed the sample of the present study. Data was obtained from study models and cephalometric analysis during the period of September 2013 to May 2015.

**Criteria of examination**

**Antero-posterior dimension**

**Angle classification: (study cast evaluation)**

One examiner assessed the molar relationship (antero-posterior dental arch relationship) on the basis of Angle’s definition. Molar class I was defined as occurring where the mesio-buccal cusp of the upper first molar occluded with the mesio-buccal groove of the lower first molar. Class I, class II Div. I, class II Div. 2, class II subdivision, class III and class III subdivision were also evaluated. Asymmetry was designated by the subdivision: class I on one side and class II on the other side, or class I on one side and class III on the other side. Patients with class II on one side and class III on the other side were excluded.

**Incisor relationship: (Measured by metal ruler)**

Overjet, the distance between the edge of upper central incisor and the labial surface of the lower central incisor, was measured in millimeters. The over jet between 0 and 4 mm were considered normal. Greater than 4 mm was considered increased. Over 8 mm was considered exaggerated. Anterior cross bite “negative over jet” < 0 mm was recorded when one or more upper incisor teeth were palatal to the lower incisor teeth.  

**Cephalometric variables**

The radiographic lateral cephalograms used were taken according to the conventional norm. All cephalograms were taken by the same radiographic apparatus:

Planmeca panorax 3Ds/3D Planmeca OY/A Sentajankatu 6/00800 Helsinki/Finland

Cephalometric landmarks were marked and digitized by one examiner to avoid inter-observer variability. Angular and linear variables were established and measured using Dolphin imaging 10.0 software (Dolphin imaging and management solutions, Chatsworth, California) by one examiner, and the following measurements were obtained:

**ANB angle**

A cephalometric angular measurement of the antero-posterior relationship of the maxilla with the mandible. The skeletal pattern was often determined cephalometrically by comparing the relationship of the maxilla and mandible with the cranial base by means of angles SNA and SNB. The difference between those two measurements was the ANB angle.

Subjects were classified into different skeletal malocclusion groups based on the following criteria:

**ANB angle**  
- Skeletal class I: 0° to 4°
- Skeletal class II: > 4°
- Skeletal class III: < 0°

**Wits appraisal: AoBo**

A cephalometric linear measurement compares the relationship of the maxilla and mandible with the occlusal plane. Since that all the cephalometric radiographs were taken from the same source, correction for the magnification factor was not considered during measurement of Wits appraisal. The following ranges of the skeletal classes were defined:

- Skeletal class I: -3 to +7 mm
- Skeletal class II: > +7 mm
- Skeletal class III: < -3 mm.

**Vertical dimension**

**Incisor relationship (overbite)**

Overbite is the perpendicular distance from the edge of the central lower incisor to the upper central incisor edge. Normal overbite 50% height: half or less than the lower central incisor is covered by the upper central incisor.

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Overbite > 50% height: more than half of the lower central is covered by the upper central incisor but less than the total crown. Total overbite of incisors 100% height; mandibular incisors are in contact with palatal mucosa. Overbite was measured in millimeters and considered as normal between 0 and 4 mm. Greater than 4 mm was considered as deep bite. Less than 0 mm was considered as an open bite.

Cephalometric variable

- FMA (22°-28°): angle between FH plan and mandibular plan.
- NL/ML (25°-31°): angle between palatal plan and mandibular plan.
- NSL/ML (29°-35°): angle between SN plan and mandibular plan.

Transverse dimension

Posterior crossbite

Included teeth in an edge-to-edge position unilateral cross-bite when one or more lower posterior teeth distal to the lateral incisor were placed buccal to the upper posterior teeth at maximum inter-cuspation in one side, while bilateral cross-bite in both sides.

Non occlusion bite: (Scissor bite)

One or more lower posterior teeth in any quadrant distal to the lateral incisor were lingually placed with respect to upper posterior teeth at maximum inter-cuspation.

Midline deviation

Shifting of the midline of the upper or lower teeth from the facial

Midline at centric occlusion

-Slight: 0-2 mm
-Medium: >2 - 5 mm
-High: >5 mm.

Statistical Analysis

Data were evaluated using statistical package. Software system, version 13 (SPSS 13.0) and the following tests were used:
- Descriptive statistics for the distribution of occlusal traits of the total sample were presented using frequencies and percentages.
- Chi-Square test was used to evaluate an association between some variables (Angle classification, over jet, overbite, cross bite, midline deviation) and gender.
- Cephalometric variables in each sagittal (ANB and AoBo) and vertical dimension (FMA, NL/ML and NSL/ML) separately, were evaluated and assessed using Chi-Square test.
- Independent student t-test was used for comparing the distribution of cephalometric variables (SNA, SNB, ANB, AoBo, FMA, NL/ML and NSL/ML) between males and females.
- The alpha level was set at 0.05.

Method error (Intra-examiner reliability test results)

The error of the method was determined by repeating the evaluations and measurements of 20 lateral cephalometric radiographs and their 20 pairs of study casts that were randomly selected from the sample within two-week interval to ensure acceptable intra-examiner reliability. All investigations were made by the same examiner.

Paired t-test was used to determine intra-examiner measurement error between the first and second measurements of ANB and Wits appraisal. No statistical significance differences were observed between the first and second reading of ANB and Wits using paired t-test (P > 0.05).

Results

Two thousand and four hundred case records at the orthodontic clinic at King Abdul Aziz Medical City, National Guard Health Affairs, Riyadh were searched, and five hundred and ten 510 were selected according to the inclusion criteria previously specified. Of these, 312 were female and 198 were male.

Malocclusion types (Table 3)

Class I malocclusion was found in 119 patients, which represented 23.3% of the total sample. Class II malocclusion (division 1 and 2) was diagnosed in 244 which represented 47.84% of the total sample. Class III malocclusion group consisted of 38 individuals, which represented 7.45% of the total sample. Class II subdivision was found in 98 patients, which represented 19.22%, and class III subdivision was found in 11 patients, which represented 2.16%.

No significant difference in the distribution of malocclusion according to Angle classification between genders was found. Association of the molar classes across gender was studied using Chi-Square test, the results showed that there was no statistically significant association (P = 0.554) between the different classes of molar relationships and gender.

Occlusal relationship in the antero-posterior dimension

Distribution of overjet. (Table 4)

46.47% of the total sample had an over jet between 0 to 4 mm, which could be regarded as normal antero-posterior incisor relationship, and was the most prevalent. 5.69% had 0 mm over jet, 5.49 had reversed anterior over jet, 29.80% had a greater over jet between 5 and 8 mm, and 12.55% had an over jet greater than 8 mm. A significant difference in the over jet distribution between male and female was found in the normal group (0 - 4 mm); the female group was the most prevalent (29.41%).

Distribution of skeletal malocclusion using ANB angle and AoBo measurement. (Table 5)

Table 5 shows the distribution of skeletal classes using ANB angle among the sample.
Table (1): Error of the mode for the first and second reading of ANB and Wits by paired t-test

<table>
<thead>
<tr>
<th>Variables</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANB and Wits</td>
<td>0.817</td>
<td>0.419</td>
</tr>
</tbody>
</table>

Table (2): The intra examiner error of 20 repeated measurements for angular and linear variables evaluated by coefficient of reliability and Pearson’s correlation

<table>
<thead>
<tr>
<th>Variables</th>
<th>coefficient of reliability</th>
<th>coefficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANB and Wits</td>
<td>0.970</td>
<td>0.942</td>
</tr>
</tbody>
</table>

Table (3): Distribution of malocclusion types according to Angle and gender

<table>
<thead>
<tr>
<th>Angle classification</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>48</td>
<td>71</td>
<td>119</td>
<td>23.33% 0.90 NS</td>
</tr>
<tr>
<td>Class II</td>
<td>96</td>
<td>148</td>
<td>244</td>
<td>47.84% 0.06 NS</td>
</tr>
<tr>
<td>Class II sub</td>
<td>33</td>
<td>65</td>
<td>98</td>
<td>19.22% 0.066 NS</td>
</tr>
<tr>
<td>Class III</td>
<td>18</td>
<td>20</td>
<td>38</td>
<td>7.45%</td>
</tr>
<tr>
<td>Class III sub</td>
<td>3</td>
<td>8</td>
<td>11</td>
<td>2.16%</td>
</tr>
</tbody>
</table>

Total 198 38 82% 312 61.18% 510 100%

Statistical comparison could not be done because of the small size of the sample
N.S. Non-significant group differences.

Table (4): Distribution of overjet according to gender

<table>
<thead>
<tr>
<th>Over jet (mm)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0 mm</td>
<td>15</td>
<td>13</td>
<td>28</td>
<td>5.49% +</td>
</tr>
<tr>
<td>0 mm</td>
<td>10</td>
<td>19</td>
<td>29</td>
<td>5.69% +</td>
</tr>
<tr>
<td>0 - 4 mm</td>
<td>87</td>
<td>150</td>
<td>237</td>
<td>46.47% 0.05</td>
</tr>
<tr>
<td>&gt;4 - 8 mm</td>
<td>60</td>
<td>92</td>
<td>152</td>
<td>29.80% 0.22 NS</td>
</tr>
<tr>
<td>&gt;8 mm</td>
<td>26</td>
<td>38</td>
<td>64</td>
<td>12.55% 0.92 NS</td>
</tr>
</tbody>
</table>

Total 198 38.82% 312 61.18% 510 100%

Statistical comparison could not be done because of the small size of the sample
*Significant group differences P < 0.05.
N.S. Non-significant group differences.

Table (5): Distribution of ANB and AoBo

| Skeletal Malocclusion | ANB | | | AoBo | | | Chi-Square |
|-----------------------|-----|| |     | | | P |
| Class III             | <0  | 45 | 8.82 | Class III | 61 | 11.96 | 0.79 NS |
| Class I               | 0-4 | 256 | 50.20 | Class I   | 423 | 82.94 | <0.005**** |
| Class II              | >4  | 209 | 40.98 | Class II  | 26 | 5.10 | 0.002*** |
| Total                 | 510 | 100 | | Total     | 510 | 100 | |

N.S. Non-significant group differences.
*Significant group differences P < 0.05

The majority 50.20% had class I skeletal class, 40.98% had class II skeletal class relation, and 8.82% had class III relationship.

Table 5 shows that 82.94% had class I skeletal relation using AoBo measurement, (Wits appraisal), 11.96% had skeletal class III and 5.10% had class II skeletal relationship. A significant difference was noted between the two cephalometric measurements, angle ANB and AoBo measurement representing the sagittal relation between upper and lower jaws among the normal class I, ANB (0-4 degree), AoBo (-3 to +7 mm) and skeletal class II distal group ANB> 4°, Ao Bo> +7 mm.

**Occlusal relation in the vertical dimension**

**Distribution of overbite (Table 6)**

Normal overbite (50% crown height) was displayed by 48.03% of patients followed by 37.84% representing the overbite group (>50% crown height). Overbite (0-0.5 mm) accounted for 5.30%, deep over-bite (100% crown height) represented for 4.32%. Open bite < 0 mm represented 4.51%. A significant difference in overbite distribution between male and female was found in the normal group. (50% crown height), female group had the higher percentage (31.96).
Table (6): Overbite distribution according to gender

<table>
<thead>
<tr>
<th>Overbite</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0 mm</td>
<td>11</td>
<td>2.16%</td>
<td>12</td>
<td>2.35%</td>
</tr>
<tr>
<td>0 mm</td>
<td>11</td>
<td>2.16%</td>
<td>16</td>
<td>3.14%</td>
</tr>
<tr>
<td>50% h</td>
<td>82</td>
<td>16.07%</td>
<td>163</td>
<td>31.96%</td>
</tr>
<tr>
<td>&gt;50% h</td>
<td>79</td>
<td>15.49%</td>
<td>114</td>
<td>22.35%</td>
</tr>
<tr>
<td>100% h</td>
<td>15</td>
<td>2.94%</td>
<td>7</td>
<td>1.38%</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>38.82%</td>
<td>312</td>
<td>61.18%</td>
</tr>
</tbody>
</table>

*Statistical comparison could not be done because of the small size of the sample.
*Significant group differences P < 0.05.
N.S. Non-significant group differences.

Table (7): Distribution of vertical angle FMA, NL/ML/NSL/ML

<table>
<thead>
<tr>
<th>Vertical Analysis</th>
<th>FMA</th>
<th>NL/ML</th>
<th>NSL/ML</th>
<th>Chi-Square P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Hypo divergent</td>
<td>158</td>
<td>30.98%</td>
<td>219</td>
<td>42.94%</td>
</tr>
<tr>
<td>Normal divergent</td>
<td>234</td>
<td>45.88%</td>
<td>203</td>
<td>39.80%</td>
</tr>
<tr>
<td>Hyper divergent</td>
<td>118</td>
<td>23.14%</td>
<td>88</td>
<td>17.26%</td>
</tr>
<tr>
<td>Total</td>
<td>510</td>
<td>100%</td>
<td>510</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Significant group differences P < 0.05.
N.S. Non-significant group differences.

Table (8): Cross bite distribution according to gender

<table>
<thead>
<tr>
<th>Crossbite</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No crossbite</td>
<td>150</td>
<td>29.41%</td>
<td>254</td>
<td>49.81%</td>
</tr>
<tr>
<td>Unilateral Crossbite</td>
<td>36</td>
<td>7.06%</td>
<td>48</td>
<td>9.41%</td>
</tr>
<tr>
<td>Bilateral Crossbite</td>
<td>12</td>
<td>2.35%</td>
<td>10</td>
<td>1.96%</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>38.82%</td>
<td>312</td>
<td>61.18%</td>
</tr>
</tbody>
</table>

Statistical comparison could not be done because of the small size of the sample.
*Significant group differences P < 0.05.
N.S. Non-significant group differences.

Table (9): Distribution of midline deviation according to gender

<table>
<thead>
<tr>
<th>Midline Deviation</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 mm</td>
<td>136</td>
<td>26.67%</td>
<td>234</td>
<td>45.89%</td>
</tr>
<tr>
<td>&gt;2-5 mm</td>
<td>55</td>
<td>10.78%</td>
<td>70</td>
<td>13.72%</td>
</tr>
<tr>
<td>&gt;5 mm</td>
<td>7</td>
<td>1.37%</td>
<td>8</td>
<td>1.57%</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>38.82%</td>
<td>312</td>
<td>61.18%</td>
</tr>
</tbody>
</table>

Statistical comparison could not be done because of the small size of the sample.
*Significant group differences P < 0.05.
N. S. Non-significant group differences.

Table (10): Distribution of cephalometric variables according to gender

<table>
<thead>
<tr>
<th>Angles</th>
<th>Male Average</th>
<th>S.D.</th>
<th>Female Average</th>
<th>S.D.</th>
<th>Gender P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>80.5</td>
<td>3.67</td>
<td>80.45</td>
<td>3.58</td>
<td>0.8 NS</td>
</tr>
<tr>
<td>SNB</td>
<td>76.73</td>
<td>5.56</td>
<td>76.96</td>
<td>3.66</td>
<td>0.85 NS</td>
</tr>
<tr>
<td>ANB</td>
<td>3.36</td>
<td>3.83</td>
<td>3.83</td>
<td>3.75</td>
<td>0.0068 ***</td>
</tr>
<tr>
<td>AOBO</td>
<td>1.7</td>
<td>4.52</td>
<td>1.33</td>
<td>3.77</td>
<td>0.08 NS</td>
</tr>
<tr>
<td>FMA</td>
<td>24.02</td>
<td>6.08</td>
<td>24.5</td>
<td>5.86</td>
<td>0.054*</td>
</tr>
<tr>
<td>NL/ML</td>
<td>25.22</td>
<td>6.37</td>
<td>25.81</td>
<td>6.71</td>
<td>0.025 *</td>
</tr>
<tr>
<td>NSL/ML</td>
<td>33.82</td>
<td>6.63</td>
<td>34.97</td>
<td>6.71</td>
<td>0.000017*****</td>
</tr>
</tbody>
</table>

*Significant group differences P < 0.05.
N.S. Non-significant group differences.
The vertical dimension divided into three groups (hypo divergent, normo divergent and hyper divergent) was described by three main angles: FMA, NL/ML, and NSL/ML. FMA revealed the highest prevalence 45.88% for the normo-divergent group, NL/ML (42.94%) for the hypo divergent group, and NSL/ML (43.33%) for the hyper divergent group. A significant difference was found between these angles in the hypo and hyperdivergent groups, and no significant difference in the normo-divergent group.

Occlusal relationship in transverse dimension

Distribution of crossbite (Table 8)

Unilateral crossbite in 16.47% and bilateral crossbite in 4.31% were found in the total sample. The frequency of the normal group with no crossbite was the highest (79.22%). No statistically significant difference between male and female for the unilateral and bilateral crossbite group was noted except for the normal group, where female had the highest frequency 49.81%.

Distribution of midline deviation (Table 9)

The frequency of midline deviation was higher in the slight midline deviation (0-2 mm) group (72.56%), followed by (24.50%) for the (2-5 mm) group, and (2.94%) for the great (>5 mm) group. A statistical difference was found in the slight midline deviation (0-2 mm) group between male (26.67%) and female (45.89%).

Distribution of cephalometric variables according to gender (Table 10)

Among the angles of sagittal dimension (SNA, SNB, ANB, AoBo) only ANB angle revealed a statistical difference between male and female, (P = 0.0068), while the angles of vertical dimension as FMA is tangentially statistically significant (P = 0.054), NL/ML (P = 0.025) and NSL/ML (P = 0.000017) are highly statistically significant.

DISCUSSION

The results of the study will supplement existing orthodontic literature since it reports data about the prevalence of dental and skeletal malocclusion. It provides clinicians with an understanding of the most common types of malocclusion among Saudi orthodontic patients. Although many studies have been published and described the prevalence and type of malocclusion, there were some variability between their findings and ours due to the varying methods and indices used to assess and record occlusal relationships, age differences of the study populations, examiner subjectivity, specific objectives and different sample sizes.3,9,10,21,22

Our results showed that the most common type of malocclusion was Angle class II which represents (47.84%) of the sample. The frequency of class I was (23.33%), class III malocclusion was observed in (7.45%), class II subdivision (19.22%) and class III subdivision (2.16%).

The population of this study is similar to that found in other studies of orthodontic patients in terms of gender distribution and prevalence of molar relationship.14,23,24,25 However, in view of the biased nature of the sample, the data of this orthodontic population cannot be extrapolated to the whole of the Saudi population. This might be because our sample was selected from patients seeking orthodontic treatment and those individuals tend to present with class II and class III molar relation more than the general population.

Angle’s class II was the most frequent pattern of malocclusion found in our sample. Similar findings were observed by Geglor et al, Gul-e-Erumand Fida., Ijaz A, Hameed et al.14,23,24,25

On the contrary, the study of Aldress, Al-Balkhi and AlZahrani, AlKawari found different findings.9,10,22

International literature reported class II malocclusion as more frequent than class I and III malocclusions in Asian men.26

The type of malocclusion is an important factor that reflects patient’s motivation to seek orthodontic treatment. Wilmont et al reported that patients with severe sagittal class II malocclusion had a higher motivation for orthodontic treatment than class III patients.27

Jones investigated malocclusion and facial type in 132 Saudi Arabian patients referred for orthodontic treatment, and reported that 55.8% had class I, 28.8% had class II division 1, 4.5% had class II division 2, and 12.9% had class III malocclusion. However, these results don’t represent the prevalence of malocclusion in a referred Saudi Arabian population because of the insufficient sample size.28

Yang evaluated 3305 patients who visited the orthodontic department at Seoul National University Hospital from 1985 to 1989. He reported that the percentages of class I, class II division 1, class II division 2, and class III were 35.9%, 13.4%, 1.5% and 49.1% respectively. The higher reported frequency of class III malocclusion is noticeable and may be attributed to the ethnic differences.29

Several genetic and environmental interacting factors are known to be related to the etiology of malocclusion, soft tissue, mouth breathing, tongue thrusting, sleeping posture, sucking and other habits, as well as specific factors, such as skeletal growth disturbances, muscle dysfunction and disturbances in embryologic and dental development interact with heredity in the development of major types of malocclusion, as well as differences in racial and ethnic composition.30

The confusing meaning of subdivision has resulted in a disparity in the classification of a unilateral malocclusion. Angle says that a subdivision is the occurrence of a unilateral malocclusion whereby one side is normal and the other is abnormal, he neglects to specify whether the subdivision is the normal or the abnormal side.31 As a result, orthodontists in the United States cannot agree on the meaning of a class II Division 1, subdivision malocclusion and made a research project by surveying 34 chairpersons of the United States orthodontic departments to determine their view points and ascertain the criteria on which they base them.32

They naturally form a point of view based on an assessment of the replies. Subdivision would refer to the defective side in the Class I malocclusion. We have supported this opinion and found in this study % of Class II subdivision and % of Class III subdivision, this probably had reduced Class I from % to %.

- Angle’s classification has been the topic of many discussions in the literature. It is limited and does not incorporate vertical and transverse abnormalities. This method has been used in this study because it is a universally accepted and reliable system that is

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repeatable and minimizes the examiner's subjectivity.

- Analyzing incisor segments in both sagittal and vertical dimensions revealed the highest percentages in normal groups where overjet was between 0 and 4 mm 46.47% and 50% crown height was displayed in 48.03%.

- A statistically significant difference in the overjet, overbite and transverse distribution according to gender in the normal groups was found. The highest percentages characterized females. For overjet 29.41%, overbite 31.96% and transverse dimension without cross bite 49.81% and minor midline deviation 45.89%.

Our results showed that the most common type of skeletal malocclusion determined by angular measurement (ANB) was skeletal Class I followed by Class II then Class III. These results were in agreement with Jones who found that the most common skeletal malocclusion among 132 Saudi orthodontic patients was Class I (46.4%) followed by Class II (27.5%) and Class III (26.1%)23.

Higher percentages of Class III cases reported by Jones might be the result of examining a small sample size that tends to be less representative.23. Our results followed the pattern reported by Farawana who found that Class I skeletal relationship was predominant in the Iraqi population (74.5%), while Class II consisted 15% and 16% were class III 24.

- Our results revealed that the most common type of skeletal malocclusion using Wits appraisal was Class I (82.94%) followed by Class III (11.96%) and Class II (5.10%).

-Bishara et al described changes in sagittal jaw relationship, comparing the ANB angle and Wits method that the interpretation of the results of the two forms of analysis is dependent on the geometrical errors inherent in the two methods, they also suggested that the vertical development of the face will alter the value of the ANB angle.25.

-Evaluation of the sagittal jaw relationship can be expressed either as an angle or as a linear measurement. While angular analysis will include variation due to facial height, jaw prognathism and jaw inclination, the Wits appraisal is very sensitive to changes in the inclination of occlusal plane.26,37.

Al-Jasser reported that Saudi male and female have longer lower anterior facial height and increased mandibular plan angle. When skeletal Class I and Class III determined by ANB and Wits were evaluated, 51.6% of the cases were Class I and 8.14% were Class III according to ANB, while 27.24% were Class I and 35.5% were Class III using Wits appraisal.28.

The downward and backward rotation of the mandible might explain why some of the cases which diagnosed as skeletal Class I with ANB measurement, they were actually Class III with rotated mandible that masked the true skeletal relationship. The same argument can be used to explain the classification of skeletal Class II relationship. The downward and backward rotation of the mandible made the diagnosis of some cases lean toward Class II according to ANB, however, Wits appraisal showed that these cases were Class I.

- When evaluating severity of antero-posterior jaw disharmony, the jaws must of necessity be related to each other and neither to cranial and extra cranial landmarks.

- Relation of jaws in the antero-posterior dimension described by two measurements ANB and Wits appraisal AoBo revealed a significant difference in the Class I normal ANB (0-4 degree), AoBo (-3 to +7 mm) group and Class II distal group ANB> 4 degree, AoBo> +7 mm.

- Our results revealed that the Wits appraisal provides a reliable indication of the extent or severity of antero-posterior skeletal disharmony of the jaw. This was also confirmed by Jacobson when ANB is 7 degree in each instance of Class II malocclusion and Class I normal occlusion, the Wits appraisal whereas the reading for the Class I normal occlusion is 0 mm. The relation of jaws in the vertical dimension referred to three angles FMA, NL/ML, and NSL/ML revealed no correlation between them, although a significant difference exists according to gender.29.

- Our results showed no gender differences in the distribution of the molar relationship, this was in agreement with most of the previous studies, but in disagreement with the findings of El-Mangoury and Moustafa who found that normal occlusion and Angle Class I relationship were more common in female. While Angle Class III was common in male.30. This might be due to racial and ethnic differences.

CONCLUSION

In this present retrospective study, the following conclusions can be drawn:

- The most common type of molar relation was Class II followed by Class I relation and the least was Class III malocclusion.

- Using the angular measurement (ANB) the most common type of skeletal malocclusion was skeletal Class I followed by Class II, then Class III

- The most common skeletal malocclusion determined by Wits appraisal was Class I, followed by class III, and the least was Class II.

- No correlation in vertical seemed between FMA, NL/ML and NSL/ML.

- In Saudi orthodontic patients, the pattern of dental and skeletal malocclusion differs based on the variability of the methods used to assess the antero-posterior jaw-based relationship.

The epidemiological data on the prevalence of malocclusion is an important determinant in planning appropriate levels of orthodontic services and further studies are required to provide accurate estimates of the orthodontic treatment need in Saudi population.

REFERENCES