Pattern of skeletal and dental malocclusions in Saudi orthodontic patients

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ABSTRACT

الأهداف: دراسة توزيع الإطباق السني والهيكلي لدى مجموعة من مرضى تقويم الأسنان السعوديين.

الطريقة: أُجريت هذه الدراسة الوصفية الاسترجاعية في عيادة تقويم الأسنان، كلية الأسنان، جامعة الملك سعود، الرياض، المملكة العربية السعودية وذلك خلال الفترة من يونيو إلى سبتمبر 2009م، وقد قمنا عشوائياً باسترجاع سجلات مرضى تقويم الأسنان قبل بدء العلاج والبالغ عددهم 602 مريض. بعدها قمنا بدراسة الإطباق الهيكلي من خلال تحليل قياسات الرأس عن طريق برنامج دولفين من أجل قياس زوايا النقاط أ، ونازيون، وب واختبار ويتز. كما تمّ تقييم تصنيف الزوايا من أجل تحديد العلاقة الرحوية باستخدام الأمثلة الجبسية قبل العلاجية.

النتائج: لقد أظهرت النتائج أن اختلال الإطباق السني الأكثر شيوعاً لدى هذه العينة كان من الصنف الأول لتصنيف الزوايا، يليه العلاقة غير المتناظرة للأرحاء. في حين أن اختلال الإطباق الهيكلي الأكثر شيوعاً باستخدام قياس زوايا النقاط أ، ونازيون، وب كان من الصنف الأول، بينما كان اختلال الإطباق الهيكلي الأكثر شيوعاً باستخدام اختبار ويتز هو من الصنف الثاني. لم تُشاهد فروق جنسية بين نسبة انتشار كل صنف من أصناف العلاقة الرحوية والعلاقة الهيكلية باستخدام زوايا النقاط أ، ونازيون، وب واختبار ويتز.

خاتمة: أظهرت هذه الدراسة مدى اختلاف أنماط الإطباق الهيكلي والسني لدى مرضى تقويم الأسنان السعوديين وذلك اعتماداً على تقييم علاقة قاعدة الفك الأمامي والخلفي.

Objectives: To determine the distribution of skeletal and dental malocclusions in a sample of Saudi orthodontic patients.

Methods: Six hundred and two randomly selected pretreatment orthodontic records were evaluated in this descriptive, retrospective study conducted between June to September 2009 at the Orthodontic Clinic of the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia. Cephalometric analysis using Dolphin software to measure the A point, Nasion, B point (ANB) angle and Wits appraisal was performed to determine the skeletal malocclusion. Angle's classification was evaluated to determine the molar relationship using study models.

Results: The most common dental malocclusion was Angle Class I followed by the asymmetric molar relationship. The most common skeletal malocclusion using ANB angle was Class I, while the most common skeletal malocclusion using Wits appraisal was Class II. No gender difference was seen in the distribution of the molar relationship and skeletal relationship using both ANB angle and Wits appraisal.

Conclusion: The pattern of skeletal and dental malocclusions in Saudi orthodontic patients differs, based on the variability of the methods used to assess the anteroposterior jaw-base relationship.

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The prevalence of malocclusion has increased in recent decades, and it is considered one of the most common dental problems together with dental caries, gingival disease, and dental fluorosis.[1,2] Malocclusion patterns vary in different populations due to the variations in the genetic and environmental influences.[3] Planning orthodontic treatment and allocation of resources in a certain geographic location require baseline data on the prevalence of different types of malocclusion in that

area.[2-4] A large number of studies on the prevalence of malocclusion in different populations have been published. In Saudi Arabia, few studies have evaluated the prevalence and distribution of skeletal and dental malocclusion. Nashashibi et al[5] reported the presence of 80.2% Angle Class I in a sample of 1,000 schoolchildren in Riyadh. Al-Emran et al[6] studied the prevalence of malocclusion in 500 schoolchildren in Riyadh. The results showed that 81.6% of the children had Angle Class I, 16.4% were found with Angle Class II, and 3% were found with Angle Class III.[6] In orthodontic patients, Class I molar relationship was the most common type of malocclusion seen in 60.7-69.3% of the investigated Saudi individuals in 2 studies.[7-9] Skeletally, the Class I relationship was also the most common type, occurring in 46.4% of the studied patients attending the orthodontic clinic at Riyadh Armed Forces Hospital.[7] None of the previously published reports in regard to the distribution of the different malocclusal features in Saudi patients attending for orthodontic treatment have distinguished clearly between skeletal and dental malocclusion.[8,9] Malocclusion can be recorded and measured by many methods. Angle's classification of molar relationship is probably the most widely used.[10] The A point, Nasion, B point (ANB) angle described by Downs[11] and Wits analysis described by Jacobson,[12] have been proposed in the assessment of anteroposterior jaw-base relationship. However, each of the methods described exhibits its own inherent weakness based on the variability of factors other than the jaw relationship itself.[13] The aim of the present investigation was to evaluate the pattern of skeletal and dental malocclusions using ANB angle, Wits analysis, and Angle classification in Saudi patients attending for orthodontic treatment. The study also compares the findings with results from other populations.

Methods. The study sample consisted of records of 602 Saudi patients attending for orthodontic treatment at the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia. The College of Dentistry Research Center Sub-Committee on ethics has recognized and approved this research project. The inclusion criteria of the study group included Saudi patients, in permanent dentition, with complete orthodontic records, and with no syndromes, history of extraction, or trauma. Patients in the mixed dentition or with incomplete records, syndromes, severe medical histories, developmental anomalies, such as ectodermal dysplasia, cleft lip or palate, Down's Syndrome, extractions of any permanent teeth, history of a previous orthodontic treatment, prosthodontic treatment, or trauma to any tooth before the commencement of orthodontic treatment was excluded. Data was collected during the period of June-September 2009 from the pre-treatment study casts and lateral cephalometric radiographs as follows:

Study cast evaluation. The molar relationship (anteroposterior dental arch relationship) on the basis of Angle's definition was assessed. Molar Class I was defined as occurring where the mesiobuccal cusp of the upper first molar occluded with the mesiobuccal groove of the lower first molar, or within the range of less than half a cusp width anteriorly or posteriorly (**Figure 1**).

Cephalometric analysis. Cephalometric radiographs were digitized and analyzed using Dolphin Imaging 10.0 software (Dolphin Imaging and Management Solutions, Chatsworth, California, USA), and the following measurements were obtained: 1. ANB angle: a cephalometric angular measurement of the anterior-posterior relationship of the maxilla with the mandible (**Figure 2**). Subjects were classified into the following different malocclusion groups: Skeletal Class I: 0-4°, Skeletal Class II: >4°, Skeletal Class III: <0°.[14-16] 2. Wits appraisal: a cephalometric linear measurement that compares the relationship of the maxilla and mandible with the occlusal plane (**Figure 2**). Since all the cephalometric radiographs were taken from the same source, correction for the magnification factor was not considered during the measurement of Wits appraisal. The sample size, mean and standard deviation derived from Jacobson study[12] was used to pool the male and female measurements. Accordingly, the following ranges of the skeletal classes were defined such as, Skeletal Class I: -1.8 to 0.8 mm; Skeletal Class II: >0.8 mm; Skeletal Class III: <-1.8 mm.

Data were evaluated using Statistical Package Software System, version 13 (SPSS Inc, Chicago, IL, USA) at a predetermined significance level of $p<0.05$.

Results. The error of the method was determined by repeating the evaluations of molar relation, angular and linear cephalometric measurements on 20 records within a two-week interval. All investigations were carried out by the same operator. Paired t-test showed no statistical significant differences between the first and the second readings of ANB and Wits ($p=0.419$). The coefficient of reliability (0.970) and the coefficient of correlation (0.942) for both ANB and Wits was significant. Kappa score of 1, indicating a perfect agreement between the first and the second evaluations, was observed reflecting a high reliability in determining the molar relation. Of the selected 602 orthodontic patient records, 289 were males, and 313 were females. The ANB angle mean value

was 3.34°, while the Wits mean value was -0.5 mm. The age range was 11-48 years with a mean of 16.01 years (**Table 1**). The distribution of the molar classifications is shown in **Figure 3**. **Figure 4** shows the distribution of skeletal classes using ANB and Wits among the sample. According to ANB classification, most had a Class I skeletal relationship (51.7%), 40.2% had Class II skeletal relation, and 6.8% had Class III relationship. Wits, on the other hand, showed that 37.2% had Class II skeletal relation, 35.6% had skeletal Class III, and 27.2% had skeletal Class I. A comparison of mean values of ANB and Wits between males and females was carried out using independent t-test. There was a statistically significant difference in the mean values of ANB between males and females, where the mean value of the females was significantly higher than the mean values of the males. No significant differences in the mean values of Wits were detected between males and females (**Table 2**). Association of molar classes across gender was studied using chi-square test. The results showed that there was no statistically significant association (p=0.71) between the different classes of molar relationships and gender. In addition, the results showed that there was no statistically significant association between the different ANB (p=0.065), or Wits skeletal classes (p=0.07) and gender using chi-square test.

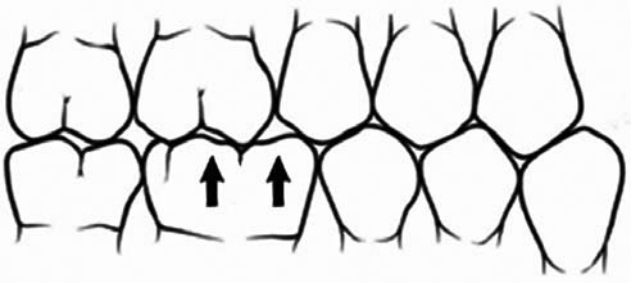

Figure 1 - Range of Angle Class I molar relationship: as the mesiobuccal cusp of the upper first molar occludes with the mesiobuccal groove of the lower first molar or within the range of less than half a cusp width anteriorly or posteriorly (arrows).

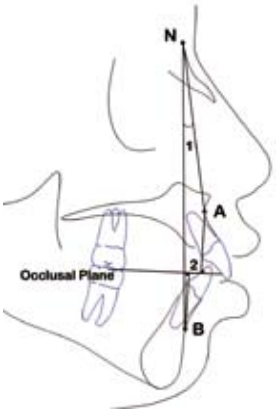

Figure 2 - Cephalometric measurements obtained from the digitized radiographs in the study: 1. ANB angle: formed by connecting points: N (Nasion) (the point in the midline at the nasofrontal suture), Point A (the deepest point in the anterior curvature of the maxilla), and Point B (the deepest point in the anterior curvature of the mandible). 2. Wits appraisal: the linear distance between the perpendiculars from points A and B onto the functional occlusal plane.

Table 1 - Mean and standard deviation of the A point, Nasion, B point (ANB), Wits and the age of the sample (n = 602) included in a study at the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia.

Variables	Minimum	Maximum	Mean ± SD
ANB,°	-11.2	10.6	3.34 ± 2.58
Wits, mm	-17.5	11.5	-0.52 ± 3.97
Age, years	11.0	48.0	16.01 ± 4.71

Discussion. This study reports data regarding the prevalence of dental malocclusion using Angle classification and skeletal malocclusion using both Wits appraisal and ANB angle measurement. It provides clinicians with an understanding of the most common types of malocclusion among Saudi orthodontic patients. Although many studies have been published that describe the prevalence and types of malocclusion, some variability between their findings existed 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 differing sample sizes. In a study by Silva and Kang,[17] more than 93% of the studied Latino adolescents living in the USA subjects demonstrated some form of malocclusion and 62.9% exhibited Angle Class I. Onyeaso[18] found that 50% of school students in Nigeria had Class I malocclusion. In North Jordanian schoolchildren, the prevalence of malocclusion was 92%.[19] Behbehani et al[20] reported that 86% of the studied adolescent Kuwaiti population had malocclusion, and 57.8% had Class I molar relationship. In Iran, the range of adolescents with normal occlusion was 4-22.9% in two studies, and those who had Class I Angle relationship were 41.8-51%.[3,21] Grando et al[22] and Martins Mda and Lima[23] found that 74.2-88.5% of the studied adolescents in Brazil had some type of malocclusion. Of those, 47.7-62.6% patients had a Class I malocclusion.[22,23] The prevalence of malocclusion among the orthodontic population varies as well. In Nigeria (76.5%) and Turkey (74%) a higher percentage of Angle Class I malocclusion was observed,

Table 2 - Comparison of the mean and standard deviation of A point, Nasion, B point (ANB) and Wits between males and females included in a study at the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia.

Variables	Mean ± SD	95% confidence interval		t-value	*P*-value
		Lower	Upper		
ANB,°		-0.841	0.0162	-2.04	0.042
Gender					
Male, n=289	3.12 ± 2.78				
Female, n=313	3.55 ± 2.36				
Wits, mm		0.0626	1.210	1.77	0.077
Gender					
Male, n=289	-0.23 ± 4.2				
Female, n=313	-0.8 ± 3.74				

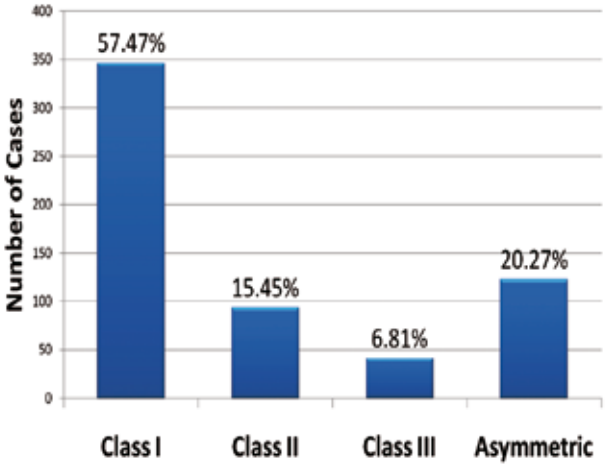

Figure 3 - Distribution of Angle molar classification among the sample between males and females included in a study at the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia.

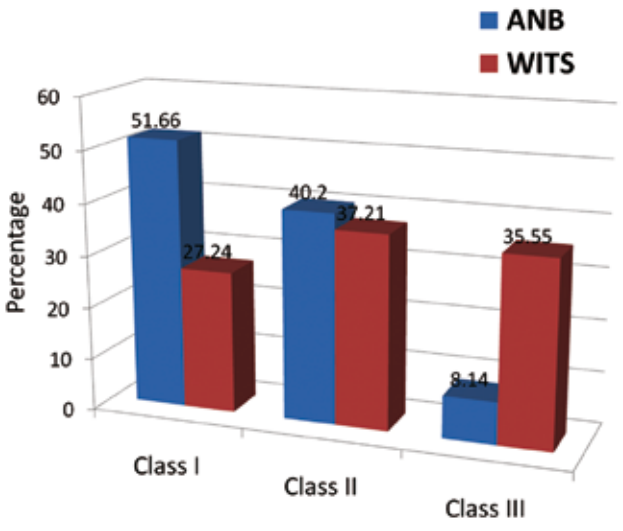

Figure 4 - Distribution of skeletal classes using angular measurement (A point, Nasion, B point [ANB]), and linear measurement (Wits) between males and females included in a study at the College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia.

while in Pakistan a higher percentage of Angle Class II malocclusion was found among the orthodontic patients (70.5%).[24-26] Subjects in this study were randomly selected and were in the permanent dentition stage. The gender distribution in this study was almost equal with a slight increase in female patients, which indicated that the level of awareness and interest in obtaining such treatment is similar in both genders. These results were in agreement with Al-Balkhi and Al-Zahrani[8] and Alkawari's study[9]. The results of the present study showed that the most common type of molar relation was Class I followed by asymmetric relation, Class II relation, and Class III malocclusion. These results were in agreement with previous Saudi studies that measured dental malocclusion in orthodontic patients.[8,9] The percentage of Class II molar relation patients in the sample was comparable to the results reported by Al-Balkhi and Al-Zahrani,[8] however, Alkawari[9] reported a higher percentage of Class II patients. This study revealed a higher percentage of asymmetric relation (20.3%) compared to the 2.1% reported by Alkawari[9]. These differences could be explained by the fact that the method by which the molar relationship was evaluated was not clearly described by Alkawari, and also due to differences in the sample size, or the age range since that Alkawari study included patients with primary and mixed dentition.[8,9]

Our results were also in agreement with studies that were performed in other countries that measured malocclusion in orthodontic patients like Nigeria and Turkey.[24,25] However, it disagreed with the findings of Gul-e-Erum and Fida[26] who found that Pakistani orthodontic patients have a higher percentage of Class II malocclusion. This might be due to the relatively small sample size used in their study, and the lack of consistency in determining the molar relationship. When our results were compared to studies conducted on non-orthodontic population in other countries, we found that studies in USA, Nigeria, Jordan,

Kuwait, Iran, Brazil, and Tanzania reported that the most common type of dental malocclusion was Class I, followed by Class II, then Class III and that was similar to our results.[3,17-23,27] However, a study by Gelgor et al[28] that examined teenagers in central Anatolia, Turkey, revealed that the most common type of malocclusion was Class II, division 1. Several genetic and environmental interacting factors are known to be related to the etiology of malocclusions. Soft diet, 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.[4]

The current study revealed that the most common type of skeletal malocclusion using Wits appraisal was Class II, a result that was in conflict with ANB angle findings. Bishara et al[29] described changes in the sagittal jaw relationship, comparing the ANB angle, and Wits method. They demonstrated that the interpretation of the results of the 2 forms of analyses is dependent on the geometrical errors inherent in the 2 methods. They also suggested that the vertical development of the face will alter the value of the ANB angle.[29] Evaluation of the sagittal jaw relationship can be expressed either as an angle, or as a linear measurement. While angular analysis will include variations due to facial height, jaw prognathism, and jaw inclination, the Wits appraisal is very sensitive to changes in the inclination of the occlusal plane. Al-Jasser[30] reported that Saudi males and females have long lower anterior facial height and increased mandibular plane angle. When skeletal Class I and Class III results 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. The downward and backward rotation of the mandible might explain why some of the cases which were diagnosed as skeletal Class I with ANB measurement, 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 towards Class II according to ANB, however, Wits appraisal showed that these cases were Class I. This study showed no gender differences in the distribution of the molar relationship and skeletal relationship using ANB angle and skeletal relationship using Wits appraisal, and this was in agreement with most of the previous studies.

This descriptive retrospective study which evaluated the records of Saudi patients referred for orthodontic treatment measured the amount of sagittal dental discrepancy as recorded by the static occlusion in the dental casts. Information regarding possible functional shift from the centric relation to the centric occlusion positions cannot be derived from the orthodontic trimmed models. The effect of the mesiopalatal rotation of the maxillary first permanent molars on the Angle's classification was not measured in this study. Further investigations are needed to study the prevalence of Centric Relation-Centric Occlusion (CR-CO) shifts in orthodontic patients and differences in the malocclusion patterns among the Saudi orthodontic patients in the various regions of the Kingdom.

In conclusion, in Saudi orthodontic patients the pattern of skeletal and dental malocclusions differs based on the variability of the methods used to assess the anteroposterior jaw-base relationship.

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