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Skeletal and dental features of class II malocclusion among Palestinian population: a retrospective cephalometric study

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ABSTRACT

Aim. This study aims to assess the dentofacial characteristics for a sample of palestinian population with skeletal Class II malocclusion.

Methods. A total of 170 lateral cephalograms for non-growing patients (age ranged between 19 and 32 years) with skeletal Class II malocclusion were retrieved. The lateral cephalograms were analyzed using virtual cephalometric analysis software - WeDoCeph® (Audax®, Ljubljana, Slovenia) to assess sagittal and vertical Skeletal parameters including SNA, SNB, ANB, SN/Mandibular Plane angle SN/Go-Gn, FMA and the Y axis angle were measured. Moreover, the upper and lower dental angular parameters (Maxillary incisor long axis with Sella - Nasion line (U1-SN), Maxillary incisor long axis with Nasion - point A angular (U1-A Point), Mandibular incisor long axis with mandibular plane (L1-MP), Mandibular incisor with nasion-point B (L1- NB) angular were also measured. The mean and standard deviation for each measurement were calculated using the Statistical Package for Social Sciences (Minitab) for Windows. Gender differences were analyzed using the independent t-test.

Results. One-hundred and seventy lateral cephalometric radiographs were retrieved and analyzed. The Class II skeletal value (ANB value of 6.7 degrees) was mainly due to retrognathic mandible (SNB 75.5 degrees) rather than prognathic maxilla (SNA 82.2 degrees). In the vertical dimension, the Y axis angle, SN/Go-Gn angle, and FMA were generally increased. Regarding the dental parameters, the upper incisors were mostly retroclined, while the lower incisors were mostly proclined. There was a significant gender difference in two parameters (SN/Go-Gn and the L1-MP), where females showed more vertical growth and more lower incisors proclination.

Conclusions. Skeletal class II malocclusion in the studied sample was characterized by retrognathic mandible, increased vertical growth, and compensated upper and lower incisors. Compared with male subjects, females significantly had more vertical growth and more lower incisor proclination.

Keywords: palestinian, antero-posterior, vertical, dental, skeletal class II malocclusion

INTRODUCTION

Edward Angle defined Class II malocclusion as a distal relation of the lower to the upper permanent first molar to the extent of more than one-half the width of one cusp and the maxillary incisors being protrusive. In 1983, the British Standard Institute classified dental malocclusion according to the relationship between the maxillary and mandibular incisors: In Class II Division 1 the mandibular incisors lie posterior to the cingulum plateau of the proclined/upright maxillary incisors, while Class II Division 2 refers to cases where the the mandibular

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incisors lie posterior to the cingulum plateau of the retroclined upper central incisors [2].. The convex lateral facial profiles of skeletal Class II patients could be caused by a prognathic maxilla, hypoplastic or retrognathic mandible, or a combination of both. When such a deformity is confined to the dentoalveolar region, it is classified as dental. However, when the jaws are involved, the malocclusion is classified as skeletal Class II [1,3]. In most cases, a combination of skeletal and dental components are present [1,3]. The most common malocclusion reported in multiple studies [1,4,5] was Class II Division 1 malocclusion, which is caused by mainly by a retrognathic mandible . Skeletal Class II malocclusion is highly prevalent around the world [6-8] with less prevalence in permanent dentition compared with mixed dentition (19.56 ± 13.76% and 23.11 ± 14.94%, respectively) [9]. The highest prevalence of Class II (22.9%) was reported among caucasians [9], with Class II Division 1 being more prevalent than Class II Division 2 [9].

Low socio-economic level, caries history, premature loss of primary teeth, history of long-term sucking behaviours and resting tongue habits are all postnatal risk factors that may increase the susceptibility to or exacerbate existing Class II malocclusion and impair treatment efficacy [10-11]. Multiple studies [10,12,13] have linked prolonged sucking behaviours and Class II dental relationships with increased overjet. Moreover, morphometric analyses of Class II samples have revealed significant differences in mandible size and shape between Class II patients and control groups [14,16].

This study aims to assess certain cephalometric characteristics of skeletal Class II malocclusions in a sample of Palestinian population. This is the first study investigating this type of malocclusion among Palestinians.

MATERIALS AND METHODS

This was a cross-sectional, retrospective cephalometric study. This study was commenced after obtaining ethical clearance from the Palestinian Health Research Council (PHRC/HC/1277/23). Lateral cephalometric radiographs of a total of 170 non-growing patients (age ranged between 19 and 32 years) with skeletal Class II malocclusion were retrieved. Lateral Cephalometric radiographs of patients who visited the medical centre at Arab American University (Ramallah, Palestine) for orthodontic treatment between May 2017 and April 2022 were retrieved. The inclusion criteria were: non- growing patients with Class II skeletal base (an ANB value of more than 4 degrees), no previous orthodontic treatment and no conditions affecting the size and architecture of the jaws and the other facial structures. Radiographs with low diagnostic quality were excluded. The age and gender of the patients were recorded.

The cephalometric radiographs were analysed using WeDoCeph® software (Audax®, Ljubljana, Slovenia). A full list of the measurements recorded is presented in Table 1 and the normal values were listed in Table 2.

TABLE 1. The measurements and landmarks assessed on the lateral cephalometric radiographs

Measurement category	Landmarks
Skeletal antero-posterior measurements	• SNA angle: to assess the relative antero-posterior position of the maxilla to the cranial base. • SNB angle: to assess the relative anteroposterior position of the mandible to the cranial base. • ANB angle: to evaluate the anteroposterior relationship between maxilla and mandible.
Skeletal Vertical measurements	• SN/MP angle (SN- (Go-Gn)): to assess the vertical relation • FMA (Frankfort-mandibular plane angle): to assess the vertical relation • y-axis: to assess the vertical relation
Dental measurements	• The angle U1/SN: the angle formed by the intersection of the long axis of the upper incisor and the SN line. • The angle UI/NA: the angle formed by the intersection of the long axis of the upper incisor and the NA line. • The angle LI/NB: the angle formed by the intersection of the long axis of the lower incisor and the NB line.

The mean and standard deviation for each measurement were calculated using the Statistical Package for Social Sciences (Minitab) for Windows. The variables in the two groups (males and females) were compared using the independent t-test ($p < 0.05$). Tested variables were considered statistically significant at a "p-value <0.05".

RESULTS

Following the analysis of the lateral cephalometric radiographs, the mean value for SNA angle for both genders was 82.171 degrees (82.15 degrees for female patients; 82.22 degrees for male patients), with no significant statistical difference (p-value 0.905). In this study, 42.94% of the subjects presented with normal sagittal maxillary position (orthognathic maxilla), 28.82% presented with prognathic maxilla, and the remaining 27.65% presented with retrognathic maxilla.

The mean SNB angle value was 75.5 degrees (75.46 degrees for female patients; 75.62 degrees for male patients), with no significant gender difference (p-value 0.815). Specifically, 72.94% of the subjects presented with retrognathic mandibles, 22.35% presented with normal antero-posterior mandibu-

TABLE 2. Normal angular readings (according to Steiner & Tweed analysis) and the mean values of the skeletal and dental parameters for males and females

Parameter	Normal value according to Steiner's /Tweed analysis (degrees)	Female (Mean) (degrees)	Male (Mean) (degrees)	p-value
SNA	82.0	82.15	82.22	0.905
SNB	80.0	75.46	75.62	0.815
ANB	2	6.69	6.60	0.725
SN/Go-Gn	32.0	37.91	35.47	0.032**
FMA	25±3	30.4	27.02	0.136
U1-NA	22.0	17.64	18.75	0.432
U1-SN	102.0 ±2.0	99.79	100.96	0.468
L1-NB	25.0	32.53	30.07	0.033**
L1-MAND PLAN	92.0 ±5.0	98.77	98.15	0.637
Y-AXIS	59.0±3.0	60.54	60.27	0.679

** Statistically significant (<0.05)

lar positions (orthognathic mandibles), and the remaining 4.71% had prognathic mandibles.

The mean ANB angle was 6.68 degrees for female subjects and 6.59 degrees for male subjects, with no significant differences between both genders Table 2.

Tables 3 and 4 shows the sagittal position of the maxilla and mandible with percentages.

TABLE 3. The sagittal position of the maxilla with percentages

SNA	Count	%	CumPct
Retrognathic maxilla	47	27.65	27.65
Normal anterior-posterior position of maxilla	74	43.5	70.59
Prognathic maxilla	49	28.82	99.41
N=	170		

TABLE 4. The sagittal position of the mandible with percentages

SNB	Count	%	CumPct
Retrognathic mandible	124	72.94	72.94
Normal anterior-posterior position of mandible	38	22.35	95.29
Prognathic mandible	8	4.71	100.00
N=	170		

Regarding the vertical dimension, 48.82% of the patients showed values above the norm (High angle patients), and the remaining 51.18% had either average or low angle readings. There was a significant difference between the mean SN/Go-Gn values of male and female subjects (35.47 and 37.91, respectively), with higher SN/Go-Gn values presented in females.

Regarding the Frankfort mandibular plane angle (FMA), 54.12% of the studied sample had normal values (normal angle patients), while 38.82% of the patients had values above the norm (high angle patients), and only 7.06% of the studied patients showed values below the average (low angle patients). The mean FMA value was 29.4 degrees, with no significant differences between male and female patients (p-value 0.136).

With the y-axis measurements, 54% of the subjects had normal values, and 33.53% of the subjects had increased y-axis values. The remaining 11.76% of the patients possessed y-axis values less than the normal range. The mean value for the y-axis reading was 60.4 degrees, with no significant gender (60.27 and 60.54 degrees for male and female patients, respectively) difference.

Regarding the dental measures, the majority of the subjects (54.71%) had retroclined maxillary incisors when the maxillary incisor long axis to NA angular was measured. The mean value for both genders was 17.9 degrees with no significant gender difference (18.75 degrees & 17.64 degrees for males and females respectively) was detected. Similarly, the Upper incisor to Sella-Nasion line measurement showed that 47.06% of the subjects had retroclined maxillary incisors. The mean value for both genders was 100.1 degrees with no significant difference between males and females (100.96 degrees & 99.79 degrees respectively).

Regarding lower incisor inclination, the Lower incisor to Nasion-point B angular measurement revealed that most of the subjects (71.76%) had proclined lower incisors, while twenty two percent of the patients had normal lower incisors inclination, and the remaining 5.88% of the patients had retroclined mandibular incisors. The mean value for both genders was 31.7 degrees with a significant difference between genders (p-value 0.033) where the females showed more lower incisor proclination (30.07 degrees, 32.53 degrees for males and females

subjects respectively). The L1-Mandibular plane measurements showed 54.12% of the patients with proclined lower incisors. The mean value for both genders was (98.602) degrees, with no significant gender difference.

DISCUSSION

Various skeletal components can contribute to the skeletal class II malocclusion. Some studies have indicated that the maxillary protrusion is the cause of Class II division 1 malocclusion, while others found that the maxilla was in a normal position in relation to the cranial base with the mandible being retrusive. moreover, other studies found that both maxillary protrusion and mandibular retrognathia combine to produce skeletal class ii malocclusion [1,17-19]. For this reason, numerous cephalometric investigations were measured In this study to determine the features of skeletal class ii malocclusion.

Skeletal components

A. Antero-posterior (SNA, SNB and ANB) parameters

In this study, skeletal Class II cases were selected with an ANB angle of more than 4 degrees. Tables 3 and 4 clarified that the retrognathic mandible (mean SNB value of 75.5 degrees) being the main cause for the skeletal class II malocclusion. This was in agreement with what was found by Karlsen and Krogstad [19], Sayin and Turkkahraman [21] and other studies [1,17,22-24].

In the Arab world context, the findings of our study were in agreement with the findings of Al-Khateeb et al [25] and Al – Jundi & Riba [26]. Al – Jundi & Riba found smaller mandibular size and more posterior position among Saudi patients presented with class II division 1 malocclusion.

On the other hand, the findings of our study contradicts those found by Hassan et al [27] who found the prognathic maxilla being the main cause for Class II division 1 malocclusion in Saudi children.

B. Vertical measurements (SN/Go-Gn, FMA, Y-axis)

The malocclusion's complex aetiology and wide range of morphologic and functional characteristics have prompted a considerable amount of research [3,16,17] to achieve a more accurate diagnosis, allowing appropriate and compatible therapy for many kinds of Class II division 1 malocclusion [28]. The correlational studies between multiple cephalometric analyses that identify face types have enabled orthodontists to observe many variations of these analyses, allowing them to choose the optimum measures to better characterize the diagnosis and therapy for their patients [29]. According to Riedel [30] the angle between the skull base (sella to nasion (SN)) and the base of the jaw (Gonial to Gnathion (Go-Gn) is important in determining current and future growth.

According to Tweed [31] if the Frankfort mandibular plane angle is between 20 and 30 degrees, then the direction of facial growth is normal. McNamara [32] used the facial axis angle to define the outcomes of the anterior and lower growth vector of the mandible, whereas Steiner [33] used the Y-axis of "Downs" to establish a vertical cephalometric study. After measuring the SN/Go-Gn angle, about half of our sample showed vertical growth pattern (48.82 %), while 7.06% showed horizontal growth pattern, and the remaining 44.12% showed normal growth pattern. This means that 48.82% of the cases had downward and backward mandibular rotation. The increased Y axis and Frankfort – Mandibular plane angle measurements indicated increased vertical growth relation which was in agreement with the finding of SN-GoGn angle measurements.

Our findings were in agreement with Al Ayoubi et al. [34] who compared the Syrian and Hungarian adolescents with Class II division 1 malocclusion and found that Syrian adolescents showed noticeably exaggerated vertical development (hyper-divergent facial patterns) in comparison to Hungarian adolescents. Our findings were in concur with the findings of Saltajia [35] who found a strong correlation between the overjet and the tendency for hyper-divergent patterns. This is also in agreement with the findings of Al Jundi & Riba [26] where the craniofacial growth pattern showed a vertical tendency in the studied Saudi adult sample.

Dental measurements

Regarding the proclination of upper and lower incisors (angular measurements), our findings showed that most patients with skeletal class II had proclined lower and retroclined upper incisors. This means that in most of skeletal class II cases the incisors were in a compensated position in order to mask the skeletal discrepancy and reduce the overjet. The proclined lower incisor position agrees with what was found by Al Jundi & Riba [26] and Woitchunas et al. [36].

CONCLUSIONS

Skeletal Class II malocclusion in a sample of the Palestinian population was characterized by retrognathic mandible, vertical growth relations with compensated incisors. Regarding gender, there was a significant difference between males and females in two measurements: the SN/Go-Gn angle and L1-NB angle, where Female subjects had more vertical growth and more lower incisor proclination.

It is feasible that the ethnic background of the studied sample has played the major role in determining the craniofacial characteristics of the Class II pattern. The data is of prime importance to help identify the ideal method for managing skeletal class II malocclusion according to their etiology.

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