Original Article

Pathognomonic features of Angle's Class II division 2 malocclusion: A comparative cephalometric and arch width study

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Abstract

Background: A thorough knowledge of the salient features of malocclusion helps the clinician in arriving at a proper diagnosis and treatment plan, and also to predict the prognosis, prior to the onset of treatment process. Among the four classes of Angle's classification of malocclusion, Class II division 2 occurs with the least frequency. There is still continuing debate in the literature whether the Class II division 2 patients ascribe the pathognomonic skeletal and dental features. **Aim of the study:** The aim of this study is to describe the unique features of Angle's Class II division 2 malocclusion to differentiate it from Angle's Class II division 1 malocclusion. **Materials and Methods:** A total of 582 pre-treatment records (study models and cephalograms), with the age of patients ranging from 15 to 22 years, were obtained from the hospital records of Vishnu Dental College, Bhimavaram and Geetam's Dental College, Visakhapatnam. Out of these, 11 pre-treatment records were excluded because of lack of clarity. In the rest of the sample, 283 were Class II division 1 and 288 were Class II division 2. The lateral cephalograms were analyzed by using digiceph and the arch width analysis was done based on the anatomical points described by Staley *et al.* and Sergl *et al.* **Results:** An intergroup evaluation was done by using unpaired Student's "*t*" test. The skeletal vertical parameters, dental parameters, and the maxillary arch width parameters revealed a statistically significant difference between the two groups of malocclusion. **Conclusion:** Angle's Class II division 2 malocclusion has a pronounced horizontal growth pattern with decreased lower anterior facial height, retroclined upper anteriors, and significantly increased maxillary arch width parameters.

Key words: *Class II division 2, facial height, growth pattern, malocclusion*

INTRODUCTION

Malocclusion is defined as the false arrangement of teeth in any three planes of space. Edward Hartley Angle, father of modern orthodontics, classified malocclusion in the anteroposterior plane based on the dental component and ignoring the skeletal component. A Class II malocclusion may be skeletal or dental or may be a combination of skeletal and dental components. The Class II malocclusion is classified into division 1 and division 2 based on the axial inclination of upper anteriors. Apart from these basic features, there are no characteristic features pertaining to Class II division 2 in the literature. The Class II division 2 malocclusion occurs the least often, and obtaining the sample for the purpose of evaluation has always remained a critical issue. Although Angle classified

Access this article online	
Quick Response Code:	Website: www.jispcd.org
	DOI: 10.4103/2231-0762.146212

the malocclusion in 1890s, there is still lack of clarity regarding the pathognomonic features of Class II division 2 malocclusion.

Moores *et al*.,[1] Buschang *et al*.,[2] and Walkow and Peck[3] evaluated the dental casts of Class II division 1 and division 2 and concluded that Class II division 2 malocclusion shows reduced intercanine width. Pancherz *et al*.[4] evaluated the cephalometric parameters between these two groups and concluded that mandibular retrognathism was a common clinical entity in both the groups.

In the 21st century, it is imperative for every dentist/orthodontist to follow the treatment principles and/or mechanotherapy based on the evidence available. According to Profitt, "the orthodontic practitioner is akin to the scientist who must continually evaluate new recent findings." Therefore, it is very important to get acquainted with the characteristic features of particular malocclusion, as this may help the clinician opting for better treatment planning.

The aim of this study is to differentiate the cephalometric and arch width parameters between Angle's Class II division 1 and Angle's Class II division 2 malocclusion groups to comprehend the diagnostic features of Class II division 2 malocclusion.

MATERIALS AND METHODS

The study models and the lateral cephalograms needed for the study were obtained from the hospital records of Vishnu Dental College, Bhimavaram and Geetam's Dental College, Visakhapatnam. A total of 582 pre-treatment records (study models and cephalograms) were obtained, with age of the patients ranging from 15 to 22 years. Out of these, 11 pre-treatment records were excluded because of lack of clarity. In the rest of the sample, 283 were Class II division 1 and 288 were Class II division 2 malocclusions.

The inclusion criteria were bilateral full cusp Class II molar relationship, with all the permanent teeth erupted and no history of previous orthodontic treatment, and an increased overjet and overbite greater than 5 mm and 4 mm, respectively, for Class II division 1 malocclusion and an overjet of 3 mm and 100% overbite for Class II division 2 group of malocclusion.

The lateral cephalograms were analyzed by using digiceph software. The arch width parameters were analyzed by using digital vernier calipers.

An unpaired Student's "*t*" test was done to compare the cephalometric and arch width parameters between both the groups of malocclusion.

RESULTS

Intragroup evaluation was done to rule out the effect of gender within the study groups. After confirming that there was no effect of gender in either of the study groups, the males and females in either of the study groups were combined to evaluate the cephalometric and arch width parameters.

The cephalometric parameters [Figure1a–1d and Table 1] showed a statistically significant difference with respect to skeletal vertical parameters (Jarabak's ratio, lower anterior facial height, and mandibular plane angle) and dental parameters.

The maxillary arch width parameters [Figure 1e and Table 2] were increased in Angle's Class II division 2 group of malocclusion with a statistically significant difference. There was no significant difference with respect to the mandibular arch width parameters [Figure 1f and Table 2].

DISCUSSION

It was around 1950s that studies were conducted in the Department of Orthodontics, University of Illinois to know the dental and skeletal patterns in different classes of malocclusion.[5,6] Vallera and Nelson[7] reported that the information obtained from cephalometric analyses facilitates the treatment decisions of orthodontists. Staley *et al*.[8] and Sergl *et al*.[9] described that the arch width and also the apical bases have a diagnostic potential. Hence, we have evaluated both cephalometric and arch width parameters in this study.

Cephalometric parameters

The cephalometric parameters are shown in Figure 1a-d.

The SNA, SNB, and ANB angles were measured in both the groups because of their importance in orthodontic diagnosis. Other cephalometric parameters were adopted from McNamara analysis[10] and Schwartz analysis[11] as these parameters help in analyzing the relative size and position of bony bases. The dental parameters included in the study were upper incisor to sella-nasion plane (UI-SN plane) and lower incisor to mandibular plane (mandibular plane is taken from gonion to menton). According to Howell,[12] the soft tissue morphology influences the underlying dental

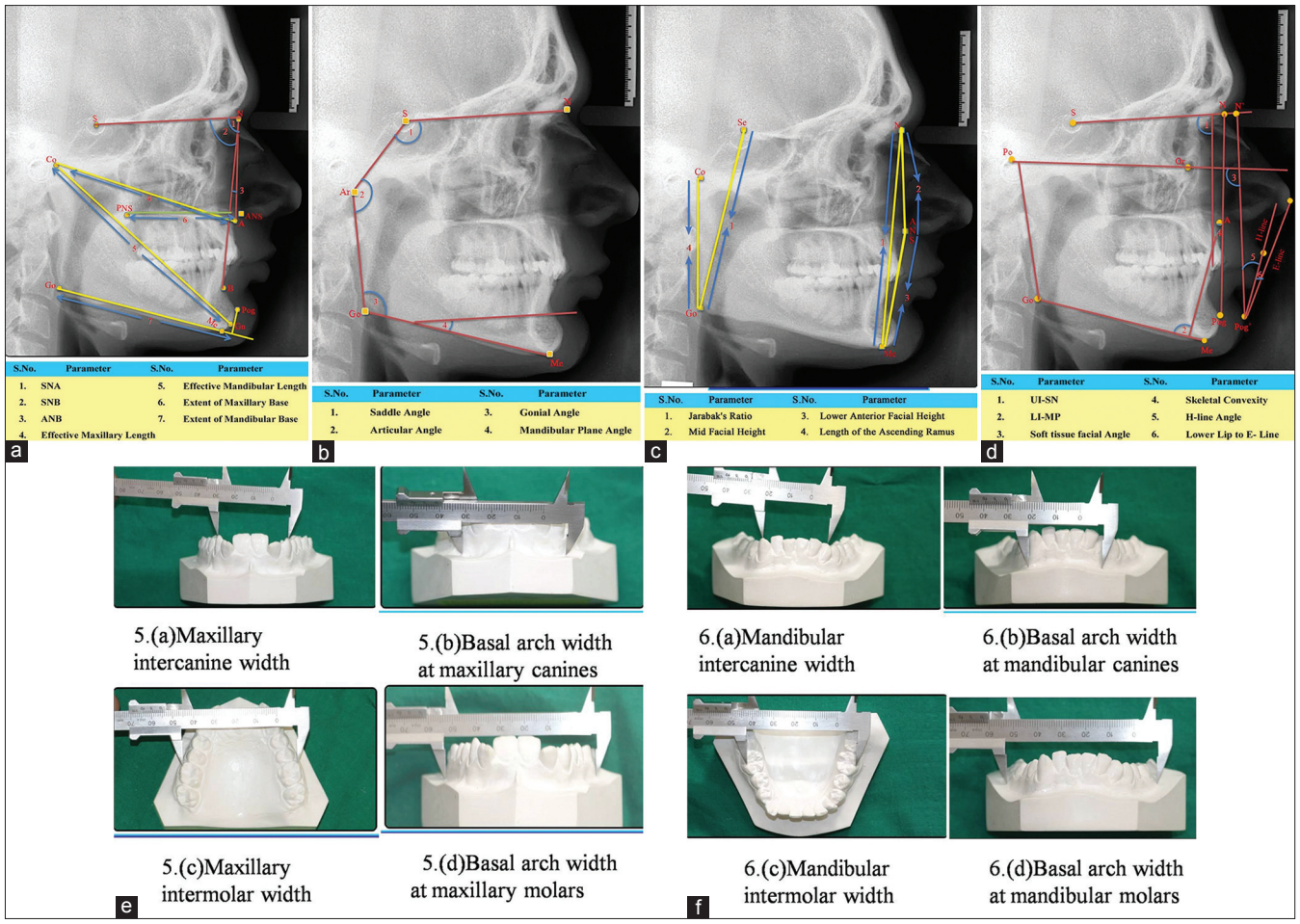

Figure 1: (a) Skeletal sagittal parameters. (b) Skeletal vertical parameters – angular. (c) Skeletal vertical parameters – linear. (d) Dental parameters and soft tissue parameters. (e) Maxillary arch width parameters. (f) Mandibular arch width parameters

structures; hence, the soft tissue parameters like facial angle, skeletal convexity, H-line angle, and lower lip to Rickett's E-line were included as a part of the study.

The sagittal parameters [Figure 1a, Table 1] did not show any statistically significant difference between the study groups. Both the groups were shown to have orthognathic maxilla with mild retrognathic mandible. These results were in accordance with those of Pancherz *et al.*[4] and Isik *et al.*[13] and were in contrast to those of Rosenblum,[14] Demisch *et al.*,[15] and Peck *et al*.[16] The concept of posterior mandibular displacement was not seen in the study population.

The skeletal vertical parameters [Figure 1b] showed a clear hypodivergent growth pattern with decreased lower anterior facial height in Class II division 2 group of malocclusion [Table 1]. This is in accordance with the reports of Houston,[17] Pancherz *et al.*,[4] Karlsen,[12] and Peck *et al*.[16] This forward growth rotation in Class II division 2 malocclusion may be because of lack of incisor support.

The upper central incisors were clearly retroclined in the Class II division 2 group in accordance with the definition of Angle's Class II division 2 malocclusion. Lower incisors were mildly proclined or near normal in both the study groups [Table 1]. These results were in accordance with those reported by Thompson.[18]

The soft tissue parameters [Figure 1d, Table 1] did not show any statistically significant difference between the groups except for the linear measurement of lower lip to Rickett's E-line. The lower lip was slightly behind the Rickett's E-line in Class II division 2 group. This might be the reason for the prominent chin, deep mentolabial sulcus, and increased risk of relapse (excessive pressure exerted by lower lip on the upper anteriors)[19] observed in patients with Class II division 2 malocclusion.

The maxillary arch width parameters [Figure 1e and Table 2] were increased with respect to intercanine width, intermolar width, and also basal arch width

Table 1: Mean comparison of cephalometric parameters between class II division 1 and class II division 2 groups

Parameters	Males		Females		*P*	Significant
	Mean	SD	Mean	SD		
Skeletal sagittal parameters						
SNA (°)	82.15	4.11	83.23	4.35	0.24	NS
SNB (°)	76.61	3.74	77.48	3.32	0.29	NS
ANB (°)	5.55	1.77	5.74	2.16	0.52	NS
Effective maxillary length (Co-A) (mm)	91.29	4.74	92.94	5.86	0.22	NS
Effective mandibular length (Co-Gn) (mm)	115.41	7.44	114.71	9.29	0.74	NS
Extent of maxillary base PNS- A.perp (mm)	52.15	3.47	51.69	4.14	0.63	NS
Extent of mandibular base Go-Pog (mm)	76.97	7.03	78.39	6.24	0.40	NS
Skeletal vertical parameters						
Saddle angle (°)	126.00	4.70	124.61	5.13	0.22	NS
Articular angle (°)	143.61	5.95	143.39	6.20	0.88	NS
Gonial angle (°)	120.42	7.51	117.97	7.11	0.31	NS
Sum of the posterior angles (°)	390.45	5.32	385.97	6.60	0.00	S
Mandibular plane angle (°)	29.70	5.70	24.97	6.31	0.00	S
Jarabak's ratio (PFH/AFH%)	63.76	20.36	73.59	6.34	0.01	S
Mid facial height N-ANS (mm)	52.76	3.24	53.68	3.38	0.27	NS
Lower anterior facial height ANS-Me (mm)	67.53	5.30	62.71	8.22	0.01	S
Length of ascending ramus (mm)	60.65	6.43	60.32	7.39	0.85	NS
Dental parameters						
UI-SN (°)	119.21	7.28	88.87	7.49	0.00	S
LI-MP (°)	103.27	18.36	98.94	9.45	0.26	NS
Soft tissue parameters						
Facial angle (°)	86.97	3.46	88.35	4.00	0.14	NS
Skeletal convexity (mm)	3.71	2.15	3.77	2.89	0.91	NS
H-line angle (°)	21.45	3.57	21.35	3.65	0.98	NS
Lower lip-E. line (mm)	2.57	2.67	0.90	2.55	0.01	S

NS=Not significant, SD=Standard deviation, S=Significant

Table 2: Mean comparison of arch width parameters between class II division 1 and class II division 2 groups

Parameters	Males		Females		*P*	Significant
	Mean	SD	Mean	SD		
Maxillary arch						
Intercanine width	34.59	2.68	34.98	3.26	0.59	NS
Intermolar width	50.62	3.71	52.24	2.91	0.05	S
Basal arch width at first molars	59.01	3.63	59.35	4.69	0.75	NS
Basal arch width at canines	37.38	3.48	39.80	5.34	0.03	S
Mandibular arch						
Intercanine width	26.57	3.18	26.73	3.08	0.84	NS
Intermolar width	47.26	3.35	47.41	3.45	0.86	NS
Basal arch width at first molars	56.51	3.22	57.06	5.82	0.64	NS
Basal arch width at canines	29.00	2.74	30.73	5.59	0.11	NS

NS=Not significant, SD=Standard deviation, S=Significant

at canines and molars in Class II division 2 group of malocclusion. The present results were in accordance with those of Buschang *et al.*,[2] Staley *et al.*,[8] and Sayin and Turkkahraman.[20] As there is increase in the maxillary arch widths, the orthodontist should preferably opt for a non-extraction mode of therapy, unless the profile of the patient demands for an extraction.

The mandibular arch width parameters [Figure 1f and Table 2] did not show any statistically significant difference between the two groups of malocclusion. As there is normal or increased maxillary arch width and narrowing of mandibular arch width, there are high chances for the occurrence of crowding in the lower arch in Class II

division 2 group. This may necessitate a single incisor extraction most often.

Limitations

As per the soft tissue paradigm, the extraoral features of the patient are the main determinant criteria for the treatment plan. The main limitation of the study is that we have concentrated only on the cephalograms and study models, not considering the clinical examination.

We had concentrated only on the local population in the study, and therefore, some results may be contradicting with the universal scenario.

CONCLUSION

The pathognomonic features of Angle's Class II division 2 group of malocclusion by which it can be differentiated from Angle's Class II division 1 are as follows:

1. Orthognathic maxilla and a mild retrognathic mandible
2. Marked horizontal growth pattern with forwardly rotated mandibular base
3. Skeletal deep bite
4. Retroclined upper incisors with near-normal lower anteriors
5. Lower lip placed slightly behind E-line with prominent chin
6. Increased maxillary arch width parameters (intercanine and intermolar width, basal arch width at canines and molars)
7. Restricted mandibular arch width, and hence, increased chances for crowding in the lower arch.

ACKNOWLEDGMENTS

Financial interest, direct or indirect, for any of the authors does not exist for this article. Sources of outside support of the project are none for this article.

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How to cite this article: Prasad SE, Indukuri RR, Singh R, Nooney A, Palagiri FB, Narayana V. Pathognomonic features of Angle's Class II division 2 malocclusion: A comparative cephalometric and arch width study. J Int Soc Prevent Communit Dent 2014;4:S105-9.

Source of Support: Nil, **Conflict of Interest:** None declared.