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Original Research Article

Comparative Analysis of Cephalometric Parameters of Class II Malocclusion

Dr. Pradnya Atish Korwar (MDS)[1*]

[1]Department of Orthodontics, MGM Dental College and Hospital, Kamothe, Navi Mumbai, Maharashtra, India, Pin code: 410 209

***Corresponding Author:** Dr. Pradnya Atish Korwar (MDS)
Department of Orthodontics, MGM Dental College and Hospital, Kamothe, Navi Mumbai, Maharashtra, India, Pin code: 410 209

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Abstract: Class II malocclusions are of immense interest to orthodontists as they constitute a significant percentage of the cases they treat. This study aimed to recognize the importance of the variations of Class II malocclusion and its implications in determining the best treatment approach. The sample of this study was collected from cases that had been reported to private clinics in Navi Mumbai and had not undergone any previous or ongoing orthodontic treatment. 58 lateral cephalograms were selected from patients having Class II malocclusion. Cephalometric tracing was performed manually. Steiner, Tweed and Jarabak analyses were done. It was seen that there is a significant difference in the maxillary and mandibular incisor angulation and position of the mandible between Class II Division 1 and 2 malocclusion cases; between cephalometric parameters of females and males in cases with Class II Division 1 and 2 cases with respect to the mandibular incisor angulation, mandibular corpus length, posterior cranial base, facial depth and posterior facial height; between the cephalometric parameters of cases with less than and more than 14 years of age in individuals with Class II Division 2 malocclusion with respect to the gonial angle, mandibular plane angle, the maxillary and mandibular incisor angulation and position, angle of convexity, ramus height, facial depth, posterior and anterior facial heights; upper and lower lip position. Thus, Class II malocclusions show a significantly diverse array of skeletal, dental and soft tissue cephalometric parameters; hence a customized orthodontic treatment plan for each case is imperative.

Keywords: Class II malocclusion, Skeletal parameters, Dental parameters, Soft tissue parameters, Cephalometric evaluation.

INTRODUCTION

Class II malocclusions are of interest to practicing orthodontists since they constitute a significant percentage of the cases they treat. In individuals with normal occlusion and skeletal relationship, the amount of maxillary and mandibular growth is synchronized, resulting in a well-balanced and aesthetically pleasing profile. In individuals with Class II malocclusions, there is an anteroposterior discrepancy between the maxillary and mandibular dentitions, which may or may not be accompanied with a skeletal discrepancy [1].

Angle proposed a classification system based on the relationship of the mandibular first molars to the maxillary first molars. He characterized the Class II malocclusions as having a distal relationship of the mandibular teeth relative to the maxillary teeth of more than one-half the width of the cusp. Angle characterized two types of Class II malocclusions based on the inclination of the maxillary central incisors. Class II Division 1 malocclusions are described as having labially inclined maxillary incisors, and an increased overjet with or without a relatively narrow maxillary arch. The vertical incisor overlap may vary from a deep overbite to an openbite. The Class II Division 2 malocclusions are described as having excessive lingual inclination of the maxillary central incisors overlapped on the labial by the maxillary lateral incisors [2]. In some cases, both the central and the lateral incisors are lingually inclined and the canines overlap the lateral incisors on the labial [3]. The Class II Division 2 malocclusion is often accompanied by a deep overbite and minimal overjet [1].

Recognition of occlusal malocclusion severity is important to determine the best treatment approach. The same malocclusion although with differing severity will be amenable to very different treatment protocols [4, 5].

The aim of this study was to recognise the importance attributed to the variations of Class II malocclusion and to discuss its implications.

MATERIAL AND METHODS

Sample of this study was collected from cases that had reported to private clinics in Navi Mumbai and had not undergone any previous or ongoing orthodontic treatment. 58 lateral cephalograms were selected from cases having Class II malocclusion after taking patient consent; out of which 30 had Division 1 malocclusion and 28 had Division 2 malocclusion; among cases with Class II Division 1 malocclusion, 15 were females and 15 were males, 16 cases were less than 14 years and 14 cases were more than 14 years of age; among cases with Class II Division 2 malocclusion, 14 were females and 14 were males, 13 cases were less than 14 years and 15 cases were more than 14 years of age. Cephalometric tracing was performed manually (Figure 1) and Steiner, Tweed and Jarabak analyses were done by calculating angular, linear values and ratios of skeletal, dental, soft tissue parameters [6-8].

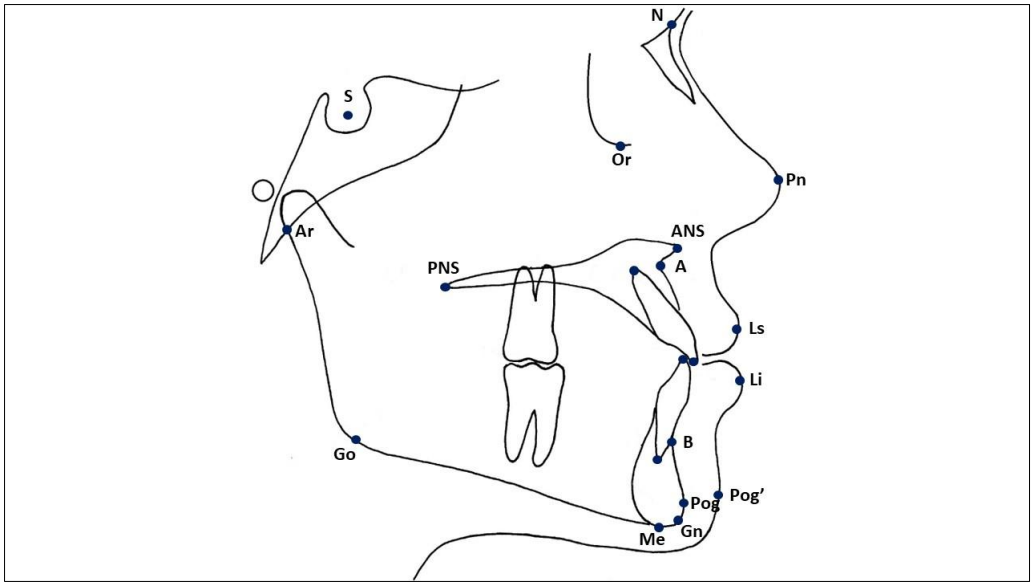

Figure 1: Template of the cephalometric tracing showing some of the cephalometric points used for measurements in this study: N (Nasion); S (Sella); Or (Orbitale); Ar (Articulare); A (Point A); B (Point B); ANS (Anterior Nasal Spine); PNS (Posterior Nasal Spine); Go (Gonion); Pog (Pogonion); Gn (Gnathion); Me (Menton); Pn (pronasale); Pog' (Soft tissue Pogonion); Ls (labrale superius); Li (Labrale Inferius)

Data collected was stored in electronic format (Microsoft Office Excel 97-2003 Worksheet). Statistical analysis was done with GraphPad Prism 9, for Windows. The measured values of the two divisions, sexes and age intervals were compared by applying the Kolmogorov-Smirnov and t-Student tests and p value ≤0.05 which corresponds to the 95% confidence interval which was considered statistically significant.

RESULTS

Table 1 denotes the statistically significant differences between the cephalometric parameters of Division 1 and 2 malocclusion cases. There is a significant difference between the maxillary and mandibular incisor angulation and position; and between the position of the mandible.

Table 1: The statistically significant differences observed between the cephalometric parameters of Division 1 and Division 2 malocclusion cases

	Division 1 (n=30)			Division 2 (n=28)			
	Mean	**SD**		**Mean**	**SD**		**p value**
Angular (^{O})							
Inter incisal	121.6533	12.4435		130.7753	10.6657		0.004*
Max1-NA	25.3894	12.6679		17.0087	6.4731		0.003*
Max1-SN	105.8411	10.0235		99.1147	8.2139		0.007*
IMPA	98.0136	6.9231		93.4427	7.6413		0.020*
Mand1-MeGo	98.6461	5.8869		93.0894	7.2314		0.002*

	Division 1 (n=30)			Division 2 (n=28)			
	Mean	**SD**		**Mean**	**SD**		**p value**
Linear (mm)							
Wits	5.0134	3.1132		2.7671	3.4651		0.011*
1u-NA	5.1321	2.8768		3.5464	2.3866		0.026*
1u-Npog	13.0342	4.1096		9.0132	5.5501		0.002*
Ratio (%)							
GoMe:SN	87.0135	8.0277		91.2421	6.0327		0.028*

Table 2 denotes the statistically significant differences between the cephalometric parameters of females and males in individual divisions. There is a significant difference between females and males in cases with Class II Division 1 and 2 malocclusions with respect to the mandibular incisor angulation; lengths of the mandibular corpus, posterior cranial base, facial depth and the posterior facial height.

Table 2: The statistically significant differences observed between the cephalometric parameters between females and males in cases with class II division 1 and class II division 2 malocclusion

	Division 1						**Division 2**				
	Female (n=15)		Male (n=15)				Female (n=14)		Male (n=14)		
	Mean	SD	Mean	SD	p value		Mean	SD	Mean	SD	p value
Angular (^{O})											
IMPA	96.0738	6.8411	103.0138	7.8566	0.015*		92.8466	5.2513	93.3751	5.1077	0.789
Linear (mm)											
S-Ar	35.3371	3.0124	36.3721	3.0231	0.355		32.9971	4.0127	36.3241	4.2786	0.043*
Go-Me	63.3566	6.1562	69.3782	6.7392	0.016*		60.5256	6.3376	65.0359	6.3761	0.071
N-Go	111.0358	8.4277	117.1089	7.3386	0.044*		107.3483	7.2178	114.7144	11.0562	0.046*
S-Go	78.4891	7.2894	80.3875	6.6289	0.461		73.1277	7.2981	80.4145	13.2614	0.038*

Table 3 denotes the statistically significant difference between the cephalometric parameters of cases with less than and more than 14 years of age in individual divisions. There is a significant difference in cases with Class II Division 2 malocclusion with respect to the gonial angle, mandibular plane angles, the maxillary and mandibular incisor angulation and position, angle of convexity, ramus height, facial depth, posterior and anterior facial heights and their ratio; upper and lower lip position.

Table 3: The statistically significant differences observed between the cephalometric parameters of cases with less than and more than 14 years of age in individuals with class II division 1 and class II division 2 malocclusion

	Division 1						**Division 2**				
	<14 years (n=16)		>14 years (n=14)				<14 years (n=13)		>14 years (n=15)		
	Mean	SD	Mean	SD	p value		Mean	SD	Mean	SD	p value
Angular (^{O})											
SN-GoGn	31.0183	6.2975	30.0253	7.0675	0.687		34.0587	7.0233	27.0354	6.0833	0.008*
FMA	28.0116	6.9613	26.0622	8.3754	0.491		31.2731	7.0345	25.3169	7.6654	0.042*
ArGoMe	130.7652	7.9851	129.7319	7.7665	0.722		132.1755	6.3562	123.7652	6.5541	0.002*
NGoAr	53.0873	5.1299	54.3766	5.0354	0.494		54.3861	4.4677	50.9771	4.0599	0.044*
NGoMe	74.8702	6.8712	74.3317	8.3569	0.847		78.0654	4.0263	72.9632	7.0644	0.029*
SN-GoMe	35.7253	6.5892	35.2977	8.1165	0.874		38.3876	6.2877	32.6649	6.1561	0.022*
NAPog	168.2865	5.5527	167.4766	5.5589	0.693		168.6511	4.0742	172.3561	3.0287	0.010*
Inter incisal	119.9731	8.7232	126.5756	18.9535	0.22		127.0355	9.8663	137.8566	8.3782	0.004*
Max1-NA	24.9429	8.4297	23.1165	17.0465	0.707		19.3692	9.4387	13.1098	4.3821	0.029*
Max1-SN	106.0268	8.7243	104.0638	13.7684	0.64		102.9876	7.0823	97.0792	6.0644	0.024*
Mand1-NB	31.1073	5.1854	25.9625	8.0644	0.044*		28.9862	6.0743	24.0924	6.1362	0.044*
Linear (mm)											
Ar-Go	48.0138	6.1147	52.5428	7.0331	0.069		43.2238	6.0154	53.3122	9.7671	0.003*
N-Go	113.8766	9.9812	115.0173	7.6743	0.731		108.1327	6.0144	118.8521	11.0568	0.004*
S-Go	78.0192	6.5587	81.1098	6.1207	0.194		71.1175	8.9813	82.1397	12.0328	0.011*
N-Me	116.6531	10.0287	119.1039	12.9775	0.564		111.5632	7.1398	118.0713	8.9687	0.045*
Wits	5.8764	2.9861	6.1329	4.9943	0.863		1.4532	3.9655	4.1056	2.6521	0.044*
Pog-NB	2.5582	0.8874	2.5211	0.9403	0.912		1.9466	1.0853	3.3498	1.9542	0.029*
1l-NPog	4.7554	3.9854	3.129	5.0221	0.331		4.3661	3.0367	1.7427	2.0845	0.012*
Ls-PnPog’	-0.8601	2.6911	-1.7824	5.0133	0.527		-1.9952	2.4581	-4.2558	2.2439	0.017*
Li-PnPog’	0.7154	3.0122	-0.7344	3.6207	0.241		-0.2511	3.0731	-3.1422	3.946	0.042*
Ratio (%)											
SGo:NMe	68.0983	4.4508	69.1853	7.9712	0.642		65.4529	7.0141	72.4538	6.0284	0.008*

DISCUSSION

The present study assessed the comparison between the quantitative cephalometric parameters and relations of the bone, dental and soft tissue structures of Class II malocclusion with its divisions on sexes and age groups.

Significant differences were observed between some of the cephalometric parameters of Class II Division 1 and Division 2 malocclusion cases with respect to the maxillary incisor angulation and position (inter incisal angle, maxillary incisor to NA, maxillary incisor to SN, maxillary incisor to NA, maxillary incisor to N-Pog) and mandibular incisor angulation (inter incisal angle, IMPA, mandibular incisor to Me-Go) (Table 1).

In Class II Division 1 malocclusion, the maxillary incisors and the lower incisors were proclined and the interincisal angle was reduced; while in Class II Division 2 malocclusion, the lower incisors were at a normal inclination and the interincisal angle was significantly increased. Class II skeletal pattern and reduced interincisal angle were common features of Class II Division 1 malocclusion while Class II skeletal pattern, increased interincisal angle, and skeletal deep bite were common features of Class II Division 2 malocclusion [9].

Maxillary incisors compensated for the discrepancy in the sagittal dimension by retroclining in Class II Division 2 malocclusion [10]. Mandibular incisors compensated in Class II Division 2 malocclusion by retroclining as compared to those in Class II Division 1 malocclusion.

There is a statistically significant difference between the ratio of lengths of mandibular corpus to anterior cranial base (Go-Me:S-N) and also between the skeletal sagittal jaw relationship (Wits appraisal). Maxilla was prognathic in both malocclusions. The mandible was more retrognathic in Class II Division 1 than in Class II Division 2.

There is a statistically significant difference between the cephalometric parameters of females and males in cases with class II division 1 malocclusion with respect to the mandibular incisor angulation (IMPA); lengths of mandibular corpus (Go-Me) and facial depth (N-Go) (Table 2). The dimensions of the mandible are significantly larger in men than that in women.

There is a statistically significant difference between the cephalometric parameters of females and males in cases with class II division 2 malocclusion with respect to posterior cranial base (S-Ar), facial depth (N-Go) and the posterior facial height (S-Go). The dimensions of the cranial base are significantly larger in men than that in women [11].

There is statistical significant difference between the cephalometric parameters of cases with less than and more than 14 years of age in individuals with Class II division 2 malocclusion with respect to the gonial angles (Ar-Go-Me, N-Go-Ar, N-Go-Me), mandibular plane angles (FMA, SN-GoGn, SN-GoMe), the maxillary and mandibular incisor angulation and position (Inter incisal, maxillary incisor-NA, maxillary incisor -SN, mandibular incisor -NB, Pog-NB, mandibular incisor-NPog), angle of convexity (NAPog), skeletal sagittal jaw relationship (Wits appraisal), ramus height (Ar-Go), facial depth (N-Go), posterior and anterior facial heights and their ratio (S-Go, N-Me, S-Go:N-Me); upper and lower lip position (Ls-PnPog', Li-PnPog') (Table 3).

There is a statistically significant difference between the cephalometric parameters of cases with less than and more than 14 years of age in individuals with Class II Division 1 malocclusion with respect to the mandibular incisor angulation (mandibular incisor to NB).

In general, the overall growth patterns of untreated Class II Division 1 individuals do not seem to differ from those observed in normal subjects [1]. Lande found that the maxilla and mandible, on average, grow in a downward and forward direction [12]. This explains the increase in anterior facial heights in Class II cases with increased age.

Mandibular growth is unhindered anteriorly in Class II Division 1 as compared to Class II Division 2 malocclusion where the sagittal mandibular growth development is restricted due to retroclined maxillary incisors [13].

The skull base angle itself does not seem to play a key role in the development of malocclusions. The skull base angle is relatively stable at the ages of 5 to 15 years old. A more obtuse skull base flexion, in association or not with a greater length of the anterior skull base, can contribute to the development of Class II Division 1 malocclusion [14].

Orthodontists should consider cephalometric evaluation of facial and growth axes as a routine practice [10]. Class II Division 1 and Division 2 malocclusions can occur with various skeletal and dental components in the anteroposterior and vertical dimensions. Class II Division 2 malocclusion should be considered as a separate entity, which differs in almost all of its skeletal and dental features from Class I and Class II Division 1 malocclusions [9].

CONCLUSION

Class II malocclusion cases shows a significantly diverse array of skeletal, dental and soft tissue cephalometric parameters with respect to its divisions, sexes and age groups. Hence it is requisite to employ a discrete and customised orthodontic treatment plan for each case.

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