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RESEARCH ARTICLE

"COMPARING ARCH WIDTH, ALVEOLAR WIDTH ANDBUCCOLINGUAL INCLINATION OF POSTERIOR TEETH IN SUBJECTS WITH CLASS IANDCLASS II MALOCCLUSION"

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Abstract

Aim: The aim of this study was to compare the arch width, alveolar width and buccolingual inclination of posterior teeth between Class I and Class II Div 1 malocclusion subjects.

Materials and method: A sample of120 subjects (60 males and 60 females) in the age group of 16-19 years with Class I and Class II Div 1 malocclusion were chosen and arch width, alveolar width and buccolingual inclination of posterior teeth were measured and compared between the groups.

Result: The maxillary posterior teeth showed more palatal inclination in Class II Div 1 malocclusion when compared with Class I group.

Conclusion: Transverse discrepancy in Class II Div 1 might be due to more palatal inclination of maxillary posterior teeth rather than arch width and alveolar width. Hence slow maxillary expansion should be preferred for correcting the palatal inclination rather than rapid palatal expansion.

Introduction:-

The World Health Organization, in 1987, defined malocclusion as "an anomaly which causes disfigurement or which impedes function, and requires treatment if the disfigurement or functional defect was likely to be an obstacle to the patient's physical or emotional well-being". One of the most common skeletal imbalances in the orthodontic population is class II malocclusion. In Brazil, a precise occlusal analysis revealed that Class II malocclusion accounts for over 50% of the malocclusions in the deciduous and mixed dentitions. In the mentioned study 15% of the students with Class II malocclusion showed mandibular deficiency. Maxillary proclination, mandibular deficiency, or both can be the cause for class II malocclusion. The sagittal correction of Class II malocclusion was the main area of attention for orthodontists in the past. Transverse morphology, and development potential of Class II patients has to be considered along with functional considerations during the treatment planning of Class II malocclusion.Arch width, alveolar width and inclination of teeth plays a major role in orthodontic diagnosis, treatment planning, smile aesthetics, and stability of the dentition[1]. Thus, the Orthodontists should anticipate the differences in arch size and form rather than treating all cases to a single ideal.

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Various studies were based on maxillary and mandibular arch width and alveolar width, however very few studies take into account, "the buccolingual inclination of posterior teeth". Therefore, this study is carried out to determine whether the transverse discrepancy is due to arch width, alveolar width or buccolingual inclination of maxillary and mandibular posterior teeth between Class I and Class II Div 1 malocclusion.

Materials and Method:-

The present study was carried out at the Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College & Hospital, Ahmedabad. It was approved by the Institutional Ethical Committee. For this study 120 subjects (60 males and 60 females) in the age group of 16-19 years visiting the Department of Orthodontics with Class I and Class II Div 1 malocclusion were chosen.

Inclusion Criteria:

1. Age group of 16 – 19 years.
2. Fully erupted teeth till second molars.
3. Subjects with skeletal Class I and molar Class I.
4. Subjects with skeletal Class II and molar Class II.

Exclusion criteria:

1. History of trauma.
2. Previous orthodontic, prosthodontic, maxillofacial and plastic surgery.
3. Crowding, crossbite or scissor bite in posterior teeth.
4. Missing teeth except third molars.
5. Abrasion or defect on the buccal crown of premolars and first molars.
6. Syndromic patients and patients with systemic disorders.

Armamentarium:

1. Pre-treatment lateral cephalogram.
2. Study models.
3. Inclinometer (modified universal bevel protractor).
4. Digital vernier caliper.
5. Levelling scale (gauge).
6. 2H pencil.
7. Set squares.

Selection Criteria:

Standardized cephalometric radiographs of chosen 120 subjects were taken in centric occlusion with lips relaxed and horizontally oriented Frankfort horizontal plane. These subjects were divided into skeletal Class I and Class II based on ANB angle, W angle, Yen angle, Beta angle,Wits appraisal and molar relation. 30 males and 30 females were selected in each group.

Arch Width:

It is a transverse dimension measured between the facial axis point (FA point) of right and left premolars and molar teeth.

1. Maxillary premolar width between the FA point of bilateral maxillary first (U4W) and second (U5W) premolars.
2. Maxillary intermolar width (U6W) between the FA point of bilateral maxillary first molars.
3. Mandibular premolar width between the FA point of bilateral mandibular first (L4W) and second (L5W) premolars.
4. Mandibular intermolar width (L6W) between the FA point of bilateral mandibular first molars.

Figure 1:- Interpremolar width.

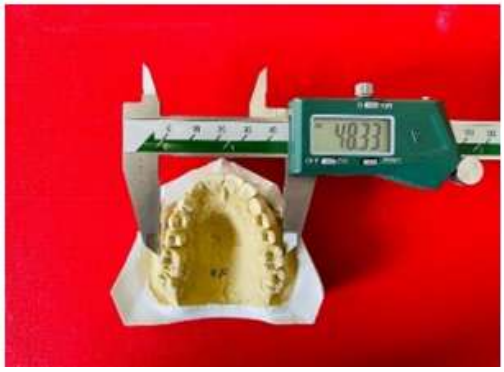

Figure 2:- Intermolar width.

Alveolar Width:

It is measured between the mucogingival junction below the FA point of premolar and molar respectively.

1. Maxillary premolar alveolar width between the mucogingival junctions below the FA point of bilateral first (U4AW) and second (U5AW) premolars.
2. Maxillary molar alveolar width (U6AW) between the mucogingival junctions below the FA point of bilateral first maxillary molars.
3. Mandibular premolar alveolar width between the WALA point below the FA point of bilateral first (L4AW) and second (L5AW) premolars.
4. Mandibular molar alveolar width (L6AW) between the WALA point below the FA point of bilateral first mandibular molars.

Figure 3:- Premolar Alveolar width.

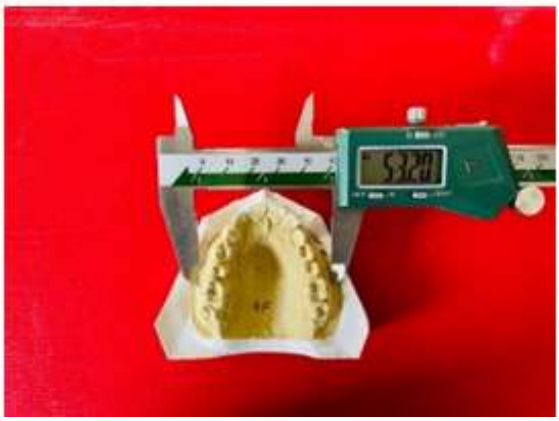

Figure 4:- Molar Alveolar width.

Buccolingual Inclination:

Buccolingual inclination of maxillary and mandibular posterior teeth is measured with Inclinometer.

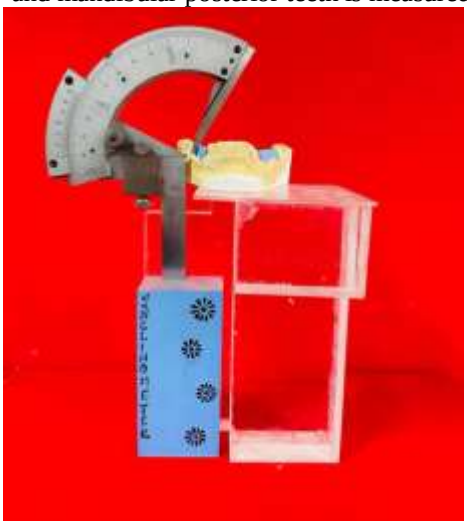

Figure 5:- Inclinometer (modified universal bevel protractor).

Inclinometer (Universal bevel protractor) is a 320° angular measuring device which is taken and modified according to the need for measuring the buccolingual inclination of teeth. It is then mounted into the clear acrylic block and a platform for the cast is attached. The trimmed casts are then put onto the platform and the measuring limb is adjusted tangential to the FA (facial axis) point along the FACC (facial axis of clinical crown). The adjusting screw is present on the backside of the apparatus which is adjusted during measurement. The buccolingual inclination between the teeth crown and the posterior occlusal plane is then measured. For measuring this, the posterior occlusal plane has to be determined and oriented for which the levelling scale (gauge) is used.

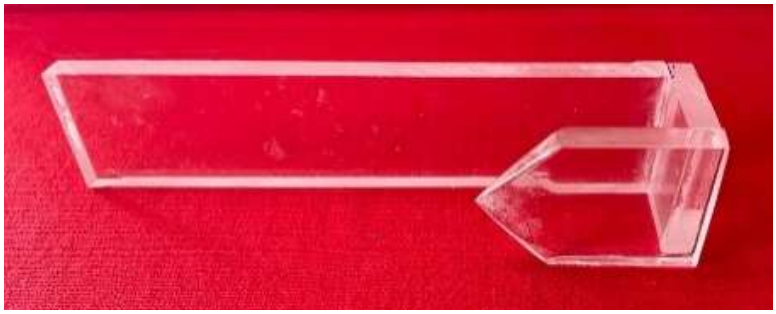

Figure 6:- Levelling scale (gauge).

Levelling scale (gauge) for determining and standardising posterior occlusal plane is fabricated with two horizontal arms connected by one vertical arm. The end of the short horizontal arm points to mark the base of the cast. The two horizontal arms parallel to each other helps to transfer the posterior occlusal plane to the base of the cast.

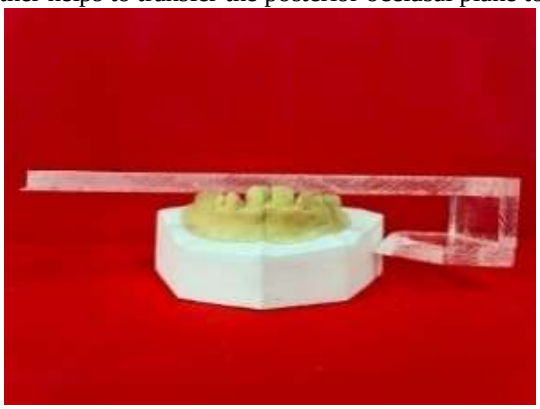

Figure 7:- Transferring the posterior occlusal plane.

The long arm of this levelling scale is seated on at least the three most prominent cusps on the first molar and premolar region. By adjusting the direction of the long arm of this scale two points are marked on the lateral wall of the cast. The same procedure is repeated on the other side of the cast.

The bases of the casts are trimmed to the plane formed by three points on the lateral wall, which are parallel to the posterior occlusal plane (POP). The facial axis of clinical crown (FACC) and its midpoint, the facial axis point (FA point) are marked on the buccal surface of first and second premolars and first molars. The measurements are made on these oriented and prepared study models with an inclinometer.

1. Maxillary premolar buccolingual inclination of bilateral maxillary first(U4IN) and second (U5IN) premolars.
2. Maxillary molar buccolingual inclination (U6IN) of bilateral maxillary first molars.
3. Mandibular premolar buccolingual inclination of bilateral mandibular first (L4IN) and second (L5IN) premolars.
4. Mandibular molar buccolingual inclination (L6IN) of bilateral mandibular first molars.

Results and Discussion:-

Data was analyzed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between the groups was done using T TEST.

Table I:- Arch width, alveolar width and buccolingual inclination of maxillary and mandibular teeth.

Arch	Parameters	Dimensions	Class I	Class II Div 1
MAXILLA	ARCH WIDTH	U4W	43.99±3.49	43.18±1.23
		U5W	48.81±3.28	47.98±2.22
		U6W	54.41±3.10	54.37±1.76
	ALVEOLAR WIDTH	U4AW	46.74±2.53	46.18±1.65
		U5AW	52.74±2.69	52.24±1.57
		U6AW	58.47±2.85	58.16±1.57
	INCLINATION	U4 IN	-14.47±1.5	-18.18±1.93
		U5IN	-16.3±1.17	-20.39±1.06
		U6 IN	-16.6±0.37	-20.47±1.57
	ARCH WIDTH	L4W	37.42±2.89	37.61±1.78
		L5W	42.57±3.09	43.92±1.25
		L6W	48.34±3.73	49.59±1.92
		L4AW	39.14±3.53	38.72±1.22

MANDIBLE	ALVEOLAR WIDTH	L5AW	46.39±2.63	46.82±1.32
		L6AW	54.40±2.79	54.34±1.14
	INCLINATION	L4 IN	-20.96±1.57	-20.76±1.69
		L5 IN	-25.64±1.58	-25.15±1.54
		L6 IN	-26.97±1.68	-26.14±1.96

"-" shows **palatal** inclination

Table 2:- Comparison of maxillary arch width, alveolar width and buccolingual inclination between Class I and Class II Div 1 group.

Parameters	Dimensions	Class I	Class II Div1	T test (P value)
ARCH WIDTH (a)	U4W	43.99±3.49	43.18±1.23	0.76
	U5W	48.81±3.28	47.98±2.22	0.81
	U6W	54.41±3.10	54.37±1.76	0.77
ALVEOLAR WIDTH (b)	U4AW	46.74±2.53	46.18±1.65	0.78
	U5AW	52.74±2.69	52.24±1.57	0.89
	U6AW	58.47±2.85	58.16±1.57	0.76
INCLINATION (c)	U4 IN	-14.47±1.5	-18.18±1.93	0.0001*
	U5IN	-16.3±1.17	-20.39±1.06	0.0001*
	U6 IN	-16.6±0.37	-20.47±1.57	0.0001*

Table 3:- Comparison of mandibular arch width, alveolar width and buccolingual inclination between Class I and Class II Div 1 group.

Parameters	Dimensions	Class I	Class II Div 1	T test (P value)
ARCH WIDTH (a)	L4W	37.42±2.89	37.61±1.78	0.85
	L5W	42.57±3.09	43.92±1.25	0.79
	L6W	48.34±3.73	49.59±1.92	0.85
ALVEOLAR WIDTH (b)	L4AW	39.14±3.53	38.72±1.22	0.78
	L5AW	46.39±2.63	46.82±1.32	0.83
	L6AW	54.40±2.79	54.34±1.14	0.79
INCLINATION (c)	L4 IN	-20.96±1.57	-20.76±1.69	0.83
	L5 IN	-25.64±1.58	-25.15±1.54	0.82
	L6 IN	-26.97±1.68	-26.14±1.96	0.88

Discussion:-

Growth and development of dentition and arch changes that take place with age has to be considered for prevention and interception of certain orthodontic problems which is necessary to treat developing malocclusion[35]. The size and shape of the arch plays a significant role in the diagnosis and treatment of orthodontic issues. Dental arch morphology also has considerable implications in space availability, esthetics and stability of the dentition[25]. The need for extraction or non-extraction treatment can be determined by these factors in association with the antero-posterior changes of the dentition.

Alveolar width of maxillary and mandibular posterior region plays an important role in determining whether tipping or bodily movement of teeth is needed especially during arch expansion procedures. Buccolingual crown inclination is one of the Andrew's six keys of normal occlusion[2]. Optimum buccolingual inclination of both maxillary and mandibular posterior teeth is necessary for obtaining a proper occlusion with maximum intercuspation, avoiding functional interferences and maintaining periodontal health by avoiding fenestrations and dehiscence[4,5]. The purpose of this study is to determine whether the transverse discrepancy in Class II Div 1 malocclusion is due to arch width, alveolar width or buccolingual inclination of teeth.For this study, pre-treatment lateral cephalometric radiographs

and study models of 120 subjects with the age group of 16 to 19 years were taken as a sample. The samples were equally divided into Class I occlusion (30 males and 30 females), Class II Div 1 malocclusion (30 males and 30 females). Class I subjects were taken as control group and the measured readings were analysed using SPSS version 26.0 (SPSS Inc., Chicago, IL).The results thus obtained shows:

Maxillary arch width, alveolar width, mandibular arch width, alveolar width and buccolingual inclination of premolars and molars shows least variability between Class I and Class II Div 1 group. Whereas, maxillary buccolingual inclination of premolar and molar shows higher variability between Class I and Class II Div 1 group.

Statistically highly significantdifference was found in the inclination of upper posterior teeth between Class I and Class II Div 1(P=0.0001). This finding is in accordance with the study conducted by **Rui Shu et al.[2] and Shalaka Raurale et al.[29]**The difference in the maxillary arch width and alveolar width between Class I and Class II Div 1 is statistically not significant which is in accordance with the study conducted by **M.Ozgur Sayin et al.[15]** and **Rui Shu et al.**[2]But is in contrast with the study conducted by **Tancan Uysal et al.[1]**

Maxillary and mandibular arch width and alveolar width shows no significant difference between Class I and Class The arch width, alveolar width and buccolingual inclination of mandibular posterior teeth between Class I and Class II Div 1 did not show any significant difference. The difference of mandibular arch width is in occordance with the study conducted by **Jyoti Dhakal et al.[33], Rui Shu et al.[2], Hyder Abdula et al.[16], Jamal K. Mahmod et al.[21] and Marwa Sameh Shamaa[37]**. The difference in lower **first premolar inclination** between Class I and Class II Div 1 isstatistically not significant(P=0.83). This finding is in accordance with the study conducted by **Shalaka et al.[29]**Whereas this is in contrast with the study conducted by **Rui Shu et al.[2]**This might be due to ethnic variation.

The difference in lower **firstmolar inclination** between Class I and Class II Div 1 isstatistically not significant. This finding is in accordance with the study conducted by **Rui Shu et al.[2]**and **Shalaka Raurale et al.[29]**where statistically no significant difference was noted.

There have been several studies on relationship between transverse measurement of dental arch and malocclusion, the results vary. This might be due to different land marks, ethnic variation, different sample size, age group and difference in measuring technique.

Arch width, a transverse dimension measured between the cusp tip/FA point of premolar and molar region both in maxillary and mandibular arch. Alveolar width also is a transverse measurement at the mucogingival junction below the FA point at premolar and molar region.

Buccolingual inclination of upper and lower premolars and molars is an angle formed between the long axis of the crown and posterior occlusal plane. For standardising posterior occlusal plane, the study models are oriented using leveling scale and the casts are trimmed to the plane formed by three points on the lateral wall of the base of the cast, which is parallel to the posterior occlusal plane (POP).

The buccolingual inclination of posterior teeth plays an important role in smile esthetics and interdigitated occlusion which has become an intriguing part for researchers. Zachrisson also stated that lingually tilted posterior teeth would increase the negative corridor and decrease the fullness of a smile.

Arch width, alveolar width and buccolingual inclination of posterior teeth were compared between Class I and Class II Div 1 malocclusion. This would give an insight to understand the etiology of transverse discrepancy in the posterior region of upper and lower arch in Class II Div 1 which may be treated accordingly.

Maxillary and mandibular arch width and alveolar width shows no significant difference between Class I and Class II Div 1 group. Whereas highly significant difference was found in inclination of maxillary premolars and molar which is evident in Table II and III. In Class I occlusion maxillary posterior teeth are buccally positioned to mandibular posterior teeth for maintaining optimal occlusal contact. In Class II Div 1 malocclusion if mandible is positioned posteriorly with the same inclination as in Class I occlusion, it might lead to posterior scissor bite. In order to prevent this scissor bite, maxillary posterior teeth shows compensatory palatal inclination in Class II Div 1 malocclusion which creates optimal occlusal contact with mandibular posterior teeth. Mandibular posterior teeth are

less lingually tilted in Class II Div 1 when compared to Class I (Table 3) which might also be due to this compensation hypothesis, but the difference is not significant.

There is a tendency for Class II Div 1 malocclusion to have narrow maxillary arch when compared to Class I (Table 2), but the difference is statistically not significant. Hence, buccolingual inclination of maxillary posterior teeth plays a major role in transverse discrepancy rather than arch width.

Hence, Class II Div 1 shows transverse discrepancy in palatal inclination of maxillary posterior teeth namely premolars and molars. Therefore, slow maxillary expansion may be carried out for correction of transverse discrepancy which induces more change in inclination which could be retained more stably. This unlocks the mandibular arch allowing mandible to passively glide forward in achieving Class I normal occlusion and improves the negative corridor space thereby increasing the fullness of a smile.

Summary and Conclusion:-

Class II malocclusion is considered as a second most common type of malocclusion. Orthodontic treatment plan is mostly focused on the sagittal discrepancy in Class II malocclusion. Transverse discrepancy needs to be taken into consideration during the management of Class II malocclusion. Attaining functional efficiency, structural balance and esthetic harmony is the prime importance in Orthodontics.

The conclusion of this study are,

1. The maxillary posterior teeth shows more palatal inclination in Class II Div 1 malocclusion when compared with Class I group.
2. No statistically significant difference is found in buccolingual inclination of mandibular posterior teeth between Class I and Class II Div 1 group.
3. No statistically significant difference is found in maxillary arch width and alveolar width between Class I and Class II Div 1 group.
4. No statistical significant difference was found in mandibular arch width and alveolar width between Class I and Class II Div 1 group.
5. Transverse discrepancy in Class II Div 1 malocclusion might be due to more palatal inclination of maxillary posterior teeth. Hence arch expansion should be considered for correcting the inclination of posterior teeth before sagittal correction.
6. Increased sample size and comparison with various skeletal malocclusions would be more conclusive.

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