Original Research Article

Comparative evaluation of transverse discrepancies in different sagittal malocclusions-An observational study

Shalaka Raurale[1,*], Ravindra Manerikar[2], Sachin Durkar[3], Sonali Deshmukh[4], Jayesh Rahalkar[5]

[1]Student, [2,4]Professor, [3]Reader, [5]HOD, Dept. of Orthodontics and Dentofacial Orthopedics, Dr. D.Y. Patil Dental and Hospital, DPU Vidyapeeth, Pimpri Pune, Maharashtra, India

*Corresponding Author
Email: shalaka.raurale@gmail.com

Abstract

Introduction: Successful orthodontic treatment outcome depends on an accurate diagnosis along with clinical management of vertical and transverse discrepancies. Thus, this study is carried out to evaluate dental arch and alveolar width along with buccolingual inclination of maxillomandibular teeth in different malocclusions.

Materials and Methods: Based on the Angle's classification of malocclusion, 140 study models were selected and four separate groups were formed- normal occlusion, Class I malocclusion, Class II division 1 and Class II division 2 respectively. Maxillomandibular arch and alveolar widths at canines, 1st and 2nd premolars and first molars were measured. Buccolingual inclination of posterior teeth were measured. Lateral cephalogram of all the sample subjects was taken to calculate SNA, SNB, ANB angle, Wits Appraisal and McNamara Differential. Oneway Anova test was performed.

Results: Maxillary intercanine, interpremolars, intermolar and maxillary dentoalveolar width is more in normal occlusion when compared with Class I, Class II division 1 and Class II division 2 malocclusions. Class II division 1 has narrower intercanine and interpremolar width with similar intermolar width as compared to Class II division 2. For transverse discrepancy buccolingual inclination is fundamental.

Conclusion: Class II division 2 has a smaller arch width and Class II division 1 shows a significantly larger arch width than Class I malocclusions.

Keywords: Arch width, Alveolar width and Buccolingual inclination.

Introduction

The attainment of a stable, functional and esthetic arch form is of paramount importance in orthodontics.[1] Sagittal, vertical and transverse dimensions are interrelated and discrepancies in one plane affect the other. Successful treatment outcome is also dependent on an accurate diagnosis and clinical management of vertical and transverse discrepancies.

The buccolingual inclination of posterior teeth is another important transverse characteristic. A dental cast is an essential diagnostic tool which aids in evaluation of occlusal relationship, transverse dimension, and tooth morphology. Knowledge of arch widths associated with different malocclusions is essential for determination of objective treatment and later sequel for these malocclusions.[2]

Hence, in this study evaluation and comparison of dental arch and alveolar width along with buccolingual inclination in normal occlusion, Class I, Class II division I, and Class II division 2 malocclusions.

Materials and Methods

140 dental casts were selected and divided- 60 into Normal occlusion, 30 into Class I malocclusion, 30 into Class II division 1 malocclusion and 20 into Class II division 2 malocclusion. Local population subjects with no orthodontic treatment were selected. Minimum age group were based on previous writing suggesting that less changes occur at intermolar and canine widths after 13 and 16 years in girls and boys respectively. Therefore, subjects above 15 years were selected.

For normal occlusion, bilateral molar Class I relation with no/minimal crowding or spacing were included. For Class I malocclusion Angle's Class I malocclusion with crowding not less than 3mm were included. In samples with Class II division 1, bilateral Class II and/end-on/half cusp molar relationship in centric occlusion with protrusive maxillary incisors and overjet and overbite more than 4mm and in Class II division 2, Class II and/end-on/half cusp molar relationship on at least one side in centric occlusion with retroclination of at least 2 maxillary incisors were included. Lateral cephalogram of all the sample subjects was taken.

Maxillomandibular dental arch and alveolar widths of canines, premolars and 1st molars were measured with a vernier caliper having sensitivity of 0.01mm. Buccolingual inclination was calculated with help of the Orthodontic Torque Angulation Device (TAD). The evaluation was carried out two times.
Measurements used:

Arch Width:
1. Maxillary and mandibular intercanine width- Distance between right and left permanent canine at the cervical margin (UC-C) (LC-C).
2. Maxillary and mandibular interpremolar width- Distance between the right and left permanent first and second premolars at central fossa (UP_1-P_1) and (UP_2-P_2) (LP_1-P_1) and (LP_2-P_2).

3. Maxillary and mandibular Intermolar width- Distance between the right and left permanent first molars at central fossa (UM-M) (LM-M).

Alveolar width:
1. Alveolar width of maxillary arch- junction of mucogingiva above the tip of mesiobuccal cusp of bilateral premolars (UAP-P) and first molar (UAM-M).
2. Alveolar width of mandibular arch- junction of mucogingiva below the buccal groves bilateral premolar (LAP-P) and first molars (LAM-M).

Buccolingual Inclination: Bilateral maxillomandibular buccolingual inclination of first, second premolars and first molars.

Statistical Analysis
1. Microsoft Excel was used to compile the data.
2. Sample size was calculated by relative prevalence of the groups using the formula n= z^2p(1-p)/d^2.[3]
3. Using one way ANOVA mean and standard deviation (SD) were calculated.
4. Significant difference in the means of different groups were determine with help of Bonnferoni's Post Hoc Analysis
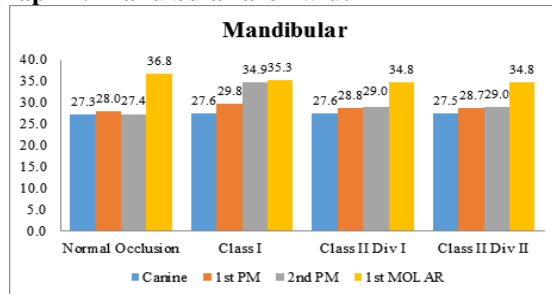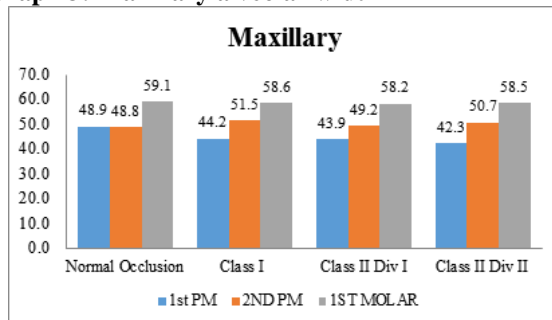
Results

Graph 1: Maxillary arch width
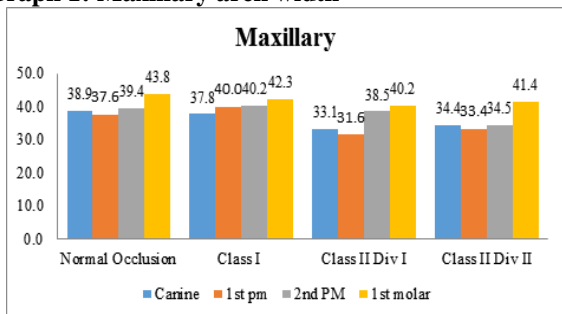
Graph represents that mean value of intercanine width in Class II division 1 is less than Class I and Class II division 2 malocclusions. The mean value of Class I was more than Class II division 2 malocclusion. For intermolar width, normal occlusion mean value was more than that of other maolocclusions. There is no difference in 1st and 2nd premolar's width in normal occlusion and other malocclusions. Thus, interpremolar width was statistically insignificant.

Graph 2: Mandibular arch width

Graph represents that similar mandibular mean value of intercanine and interpremolar's width in normal occlusion and all malocclusions. For intermolar width normal occlusion mean value was more than other maolocclusions with value of 43.83^0 and standard deviation of 0.58^0.
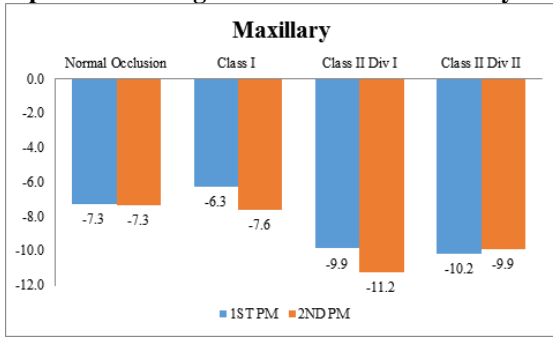
Graph 3: Maxillary alveolar width

Graph represents that mean value for 1st premolar in Class II division 2 were less than Class I and Class II division 1 malocclusions, but mean value of Class I was more than Class II division 1 malocclusion. For intermolar width normal occlusion mean value was more than other maolocclusions.

Graph 4: Mandibular alveolar width
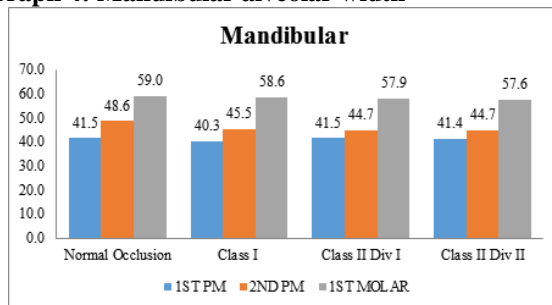
Graph represents that mean value for 1st premolar in Class II division 2 was less than Class I malocclusions and normal occlusion, but mean value of Class I was more than Class II division 1 malocclusion. For intermolar width normal occlusion mean value was more than other maolocclusions.

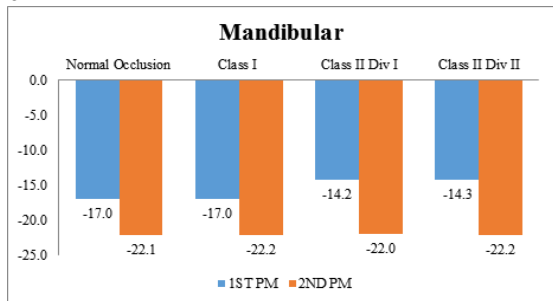**Graph 5: Buccolingual inclination of maxillary arch**

Graph represents that mean value for 1st premolar in Class II division 2 was less than Class I malocclusions and normal occlusion, but mean value of normal occlusion was more than Class I malocclusion.

Graph 6: Buccolingual inclination of mandibular arch

Graph represents that mean value for 1st premolar in Class II division 2 was less than Class I malocclusions and normal occlusion, but mean value of normal occlusion was more than Class I malocclusion.

Fig. 1: Maxillary intercanine width

Fig. 2: Maxillary interpremolar width

Fig. 3: Maxillary intermolar width

Fig. 4: Mandibular intercanine width

Fig. 5: Mandibular interpremolar width

Fig. 6: Mandibular intermolar width

Fig. 7: Maxillary alveolar width of premolar and molar

Fig. 8: Mandibular Alveolar Width measurement

Fig. 9: TARG

Discussion

One of the ultimate goals in orthodontics is long-term stability, which starts with proper diagnosis of malocclusion in the all three planes. Sagittal and vertical dimensions are the most commonly used dimensions for diagnosis in orthodontic patients. Three dimensionally different combinations of skeletal as well as dental components exist in malocclusion.[4]

In Class II, along with sagittal and vertical components, transverse discrepancy is also essential, and has been intensively investigated. Staley et al[5] considered that most of the Class II Division 1 malocclusion was accompanied by a long and narrower arch form, which is partly caused by a palatal tilt of the posterior teeth. Sayin and Turkkahraman[6] also held a similar opinion.

Zachrisson stated that the negative corridor and consequently decrease in fullness of a smile is due to lingually tilted posterior teeth. Because buccolingual inclination is yet another important transverse characteristic of occlusion, it is necessary in a transverse discrepancy in Class II Division 1 malocclusion to identify the role of buccolingual inclination.[7]

Arch Width

Subjects with no crowding were included in the normal occlusion sample, whereas subjects with crowding were included in the Class II groups. Narrow arches would be found in Class I group with crowding on comparing with Class I group without crowding.[2]

Staley et al and Lux et al concluded, on comparison of II-2 subjects with normal and II-I occlusion arch width were intermediate between the groups.[5,8] In present study, intercanine width of maxillary arch for normal occlusion shows statistically significant difference on comparison between all the groups. Malocclusion with Class I also showed significant difference when compared with Class II division 1 and Class II division 2 malocclusion. Class II division 1 malocclusion and Class II division 2 malocclusion samples also showed significant difference.

Thus, the conclusion was that arch width dimensions in intercanine region of Class II division 2 subjects were less than Class I but more than Class II

Division I, on comparison with Class I and Class II division 1 malocclusions. Between Class II division 1 and Class II division 2 malocclusions no significant differences were seen.

Sayin and Turkkahraman concluded that Class I and Normal occlusion had broader maxillary arch when compared with Class II subjects and Class I group had maxillary 1st and 2nd intermolar widths were significantly larger than Class II division I, however mandibular intermolar widths did not differ significantly between groups.[6]

Fro˙hlich stated no difference was appreciated in the arch widths of the Class II and Normal occlusion childrens.[9]

Balan RA et al found that in Class II division 1 group, intercanine maxillary width was shorter with larger intercanine mandibular width when compared with Class II division 2 and mandibular intercanine width shorter on comparing with Normal occlusion.[10]

Rui Shu el al compared maxillomandibular arch width in posterior region between Class II Division 1 malocclusion and Class I occlusion and concluded that the arch width of posterior teeth is not different between the two gropus.[11]

In our study, maxillary and mandibular 1st and 2nd premolar width showed no significant differences within the groups. Maxillomandibular 1st and 2nd premolar arch width has significant difference with Class II division 2 arch narrower than Class II Division I.

According to our results, statistical difference was found in maxillomandibular intermolar width between the groups. Maxillomandibular intermolar width in Class II division 1 and Class II division 2 malocclusion showed no statistical difference were found between.

Uysal et al comparison showed in Class II/2 group, the maxillary interpremolar, mandibular intercanine and inter premolar widths were significantly shorter than in normal occlusion control group with larger maxillary intermolar width.[2]

Alveolar Width

Uysal et al comparison showed that all the mandibular alveolar width, intercanine and interpremolar width in alveolar region of maxilla were larger in Normal group when compared with Class II/2 group.[2]

In the present study, the normal occlusion samples has maxillomandibular interpremolar alveolar widths that are expanded as compared to the other malocclusions groups. On comparison of Class I malocclusion with Class II division 1 and Class II division 2 malocclusions, significant difference seen. Maxillary and Mandibular interpremolar alveolar width has no significant difference between Class II division 1 and Class II division 2 samples. Comparison of Class I malocclusion with Class II division 1 and Division II showed width in alveolar region of maxillomandibular

interpremolar were narrower in both Class II type malocclusions. Also, on comparison with Normal occlusion, upper alveolar intermolar width was narrower in all three groups of malocclusion and maxillomandibular intermolar width was greater in Class II division 1 malocclusion on comparing with normal occlusion

Munjal S et al in his study found alveolar width in maxillary premolar region was narrower in both Division I and division II type of Class II malocclusion than normal occlusion. Male and Female group among different malocclusions showed difference in dental arch and alveolar widths.[12]

Staley et al stated that, larger maxillomandibular alveolar widths seen in Class I group.[5]

Depending on the etiology different malocclusions suggestions have been viewed in literature for the treatment of transvers discrepancy. According to Sayin and Turkkahraman in Class II Division 1 patient's transverse discrepancy is not due to maxillary alveolar base but because of maxillary posterior teeth. Therefore, slow maxillary expansions suggested as a part of treatment.[6]

Different treatment with different orthodontic appliances requires differentiation of skeletal as well as dental constriction.

Enlow and Hans addressed the dental and skeletal features and the facial growth of Class II malocclusion without differentiating Class II Division 1 from Class II division 2 and stated that long, narrow palates and maxillary arches exists in Class II patients.[13]

Studies by Tollaro et. Observed that Class II, Division 1 patients had narrower maxillary intermolar widths with PTID than patients without PTID and Class I subjects, thus Class II patients with PTID needed a preliminary expansion of the maxillary arch. No difference between groups seen in Mandibular intermolar widths.[14]

From deciduous to mixed dentition stage, transverse discrepancy in Class II malocclusion was evaluated and compared with ideal occlusion as control group by Baccetti et al. They reported that treatment for correction of Class II problem could be initiated by rapid maxillary expansion (RME), extraoral traction, and functional jaw orthopedics as transverse interarch discrepancy determined in deciduous dentition persisted into the mixed dentition.[15]

Buccolingual Inclination

For treatment results in orthodontics, Andrews six keys for normal occlusion serve as analysis.[16] For proper occlusion, as a diagnostic aid in initial phase of treatment, analysis of maxillomandibular tooth proportionality is required. Establishment of crown inclination norms for local population is a need and requires comparison with the norms established by Andrews, as they form the basis in preadjusted edgewise appliance systems for the bracket

prescription. Posterior occlusion and overbite are affected by maxillary and mandibular crown inclination. The upper posterior crowns are forwardly placed of their normal position when maxillary anterior teeth crowns are insufficiently inclined; with proper inclination of anterior crowns, the maxillary posterior teeth are placed into their normal position. With the increase in positive anterior crown inclination, the contact points move distally.[17]

In the maxillary arch premolars have negative inclination of crowns. Buccolingual inclination of maxillary 1st and 2nd premolars is more in Class II division 1 and Class II division 2 malocclusions on comparing with Normal occlusion and Class I malocclusion. Comparing Class II division 1 and Class II division 2 malocclusions show significant difference. Our result coincides with Staley et al.[19] In Normal occlusion or Class I occlusion, the posterior teeth of maxilla are positioned more buccally than the posterior teeth of mandible. Mandibular posterior teeth are less lingually tilted in Class II division 2 and there is clinical no significant difference seen in between groups. If the jaws of a Class I occlusion put into Class II relationship, the overjet would increase and make a scissor bite in the posterior region. To compensate for this condition and create occlusal contact, the maxillary posterior teeth would be more palatally positioned or more palatally tilted. At the same time mandibular posterior teeth would move or tilt buccally.

Our research suggests, the palatal tilt of the posterior teeth of maxilla played the most important role in such compensation. The maxillary premolars in a Class II Division 1 malocclusion demonstrated significantly greater lingual tilt than those in Class I occlusion. Differences in mandibular inclination seemed less significant. First premolars of mandible were lingually tilted in Class I occlusion when compared with Class II division 2 malocclusion, but no significant differences were seen in the mandibular second premolars and first molars. However, all mandibular posterior teeth showed a less lingual tendency, which was in accordance with the compensation hypothesis. According to our results, lingually tilted maxillary posterior teeth may induce a narrow arch width. Our results showed a narrow maxillary arch tendency for Class II division 1 malocclusion. We concluded that, rather than arch width, the buccolingual inclination played a major role in transverse discrepancy in Class II division 1 malocclusion.

Conclusion

The Class II division 2 group had mean maxillary intercanine arch width significantly smaller than Normal occlusion and Class I malocclusion but significantly larger than Class II Division 1 malocclusion. Maxillary interpremolar width was significantly narrower in the Class II Division 1 group.

Mandibular intercanine and interpremolar width measurements were narrower and maxillary intermolar width measurements were larger in Class II division 2 subjects when compared with the Class II division 1 subjects.

All maxillary alveolar widths, mandibular premolar and molar alveolar widths were significantly narrower in the Class II division 1. All mandibular alveolar widths were significantly more in Normal occlusion.

The maxillary posterior teeth are significantly more lingually inclined in Class II division 1 malocclusion compared with Class I malocclusion and normal occlusion.

Hence, arch expansion is recommended in Class II division 1 malocclusion along with correction of crown inclination of posterior teeth.

References

1. Patel D, Mehta F, Patel N, Mehta N, Trivedi I, Mehta A. Evaluation of arch width among Class I normal occlusion, Class II Division 1, Class II Division 2, and Class III malocclusion in Indian population. Contemp Clin Dent. 2015;6(Suppl 1):202-9.
2. Uysalt, Memili B, Usumez et al. Dental and alveolar arch widths in normal occlusion, Class II division 1 and classII division 2. Angle Orthod 2005;75:941-947.
3. Daniel WW. 7th edition. New York: John Wiley & Sons; 1999. Biostatistics: A foundation for analysis in the health sciences.
4. Loren Mills: Arch width, arch length and tooth size in young adult males. Angle Orthod 1964;34:124-128.
5. Huth J, Staley RN, Jacobs R, Bigelow H, Jakobsen J, Arch widths in Class II-2 adults compared to adults with Class II-1 and normal occlusion, Angle Orthod, 2007, 77(5):837–844.
6. Sayin MO, Turkkahraman H; Comparison of Dental Arch and Alveolar Widths of Patients with Class II, Division 1 Malocclusion and Subjects with Class I Ideal Occlusion: Angle Orthod 2004;74:356–360.
7. Zachrisson BU. Premolar extraction and smile esthetics. Am J Orthod Dentofacial Orthop. 2003;124:11A–12A.
8. Lux CJ, Conradt C, Burden D, Komposch G, Dental arch widths and mandibular-maxillary base widths in Class II mal- occlusions between early mixed and permanent dentitions, Angle Orthod, 2003, 73(6):674–685.
9. Fro ̈hlich FJ. A longitudinal study of untreated Class II type malocclusion. Trans Eur Orthod Soc. 1961;37:137–159.
10. Bălan RA, Popa G, Biţă R, Fabricky M, Jjvănescu A, Bratu DC. Alveolar and dental arch morphology in Angle Class II division 2 malocclusion: a comparative study. Rom J Morphol Embryol. 2014;55(3 Suppl):1093-7.
11. Shu R, Han X, Wang Y, Xu H, Ai D, Wang L, Wu Y, Bai D. Comparison of arch width, alveolar width and buccolingual inclination of teeth between Class II division 1 malocclusion and Class I occlusion. Angle Orthod. 2013 Mar;83(2):246-52.
12. Munjal S, Duggal R, Kahlon SS, Bansal S. Comparison of dental and alveolar arch width in patients with normal occlusion, Class II division 1 and Class II division 2 malocclusion. J Indian Orthod Soc 2010; 44:42-7.
13. Enlow DH, Hans MG, Essentials of facial growth, 1st edition, W.B. Saunders, Philadelphia, 1996, 1–280.
14. Tollaro I, Baccetti T, Franchi L, Tanesescu CD. Role of posterior transverse interarch discrepancy in Class II, division 1 maloc-clusion during the mixed dentition phase. Am J Orthod Dentofacial Orthop. 1996;110:417-422.
15. Baccetti T, Franchi L, McNamara JA Jr, Tollaro I. Early dentofacial features of Class II malocclusion: a longitudinal study from the deciduous through the mixed dentition. Am J Orthod Dentofacial Orthop. 1997;11:502-509.
16. Andrews LF. The six keys to normal occlusion. Am J Orthod 1972;62:297-309.
17. Doodamani GM, Khala AS, Manohar M. Assessment of crown angulations, crown inclinations, and tooth size discrepancies in a South Indian population. Contemporary clinical dentistry. 2011 Jul 1;2(3):176.