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# INTERMAXILLARY TOOTH SIZE DISCREPANCY IN CLASS II PATIENTS WITH DIFFERENT VERTICAL GROWTH PATTERNS

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#### ABSTRACT

Tooth size discrepancies have great influence on orthodontic treatment planning by determining the need for reduction (enamel stripping), increase (restorative measures), or removal (extractions) of teeth prior to finalization of occlusion. The objective of this study is to determine the inter-arch tooth size discrepancy in Class II patients with different vertical growth patterns in a tertiary-care hospital sample in Pakistan.

Our observational study was carried out at the Orthodontics department, Lahore Medical & Dental College for a duration of 6 months i.e. 25th September 2019 to 24th March 2020. A total of 95 skeletal Class II patients (ANB>4) patients between age 14-25 years were selected through non-probability consecutive sampling technique. Subjects with any morphologic tooth deformity of size and shape, extensive restorations of any tooth and current active orthodontic treatment were excluded. Impression of all the patients were taken and study casts made. On lateral cephalogram, vertical pattern of growth is assessed by SN-Mandible angle. Mesio-distal width measurements of (first)molar to (first) molar were recorded in both arches using a needle pointed divider.

This study was conducted with subjects of 14-25 years with a mean age of  $18.57 \pm 3.35$  years. Most of the subjects i.e. 57 (60.0%) were 14 to 20 years of age. Frequency of different vertical growth patterns in class II malocclusion patients were as follows; high angle in 35 (36.84%), low angle in 28 (29.47%) and normal angle in 32 (33.68%), whereas incidence of interarch tooth size difference in class II patients was found in 50 (52.63%) patients. However, intermaxillary tooth size discrepancy with respect to different vertical growth patterns in Class II patients was found to be insignificant suggesting that growth patterns do not affect tooth size.

Keywords: Class II malocclusion, vertical growth patterns, intermaxillary tooth size discrepancy

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#### **INTRODUCTION**

Tooth size difference is a significant basis in causing a malocclusion.<sup>1</sup> Bolton used a ratio to calculate this discrepancy and specified that a precise occlusion is likely with acceptable proportions of tooth dimensions.<sup>2</sup>Bennett and McLaughlin proposed absence of tooth size discrepancy as the seventh key to ideal occlusion.<sup>8</sup>

Tooth size discrepancies have great influence on orthodontic treatment planning by determining the need for tooth mass reduction (IPR), increase (restorative composites/crowns/veneers), or removal (extractions) of tooth/teeth prior to finalization of occlusion.<sup>2</sup>

Bolton's analysis is used to calculate tooth size difference by taking mesio-distal dimensions of each permanent tooth from permanent 1<sup>st</sup> molar

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to 1<sup>st</sup> molar in both jaws. Bolton's overall ratio mandibular teeth to maxillary teeth is calculated and corresponded to the standard Bolton's ratio of 91.3%. A further analysis is performed to evaluate the relationship of six upper and lower anterior teeth and compared to the standard ratio of 77.2%. If the overall and anterior ratios are less/more than the mentioned percentages, they will indicate maxillary and mandibular Bolton's discrepancy respectively.<sup>3</sup> Excess tooth mass in maxilla may appear as raised overjet, overbite, crowded maxillary arch, space in mandibular arch or retroclination of upper incisors. In the mandible, excess tooth material is expressed as decreased overbite and overjet, crowded in lower arch, spacing in upper arch or proclination of upper incisors.7,8

CANÇADO RH et al failed to show significant Bolton's ratio difference in various malocclusion groups.<sup>2</sup>However, Parsanna AL et al concluded that average Bolton's anterior ratio for Angle's Class III group was considerably higher than for Class I and Class II malocclusions.<sup>1</sup>Plaza AP et al found greater frequency i.e 40% of high angle patients than low angle (14%) in Class II malocclusion group.<sup>9</sup>

Leung EM et al compared not only tooth sizes in different malocclusions but also studied gender dimorphism and found no significant dissimilarities in both proportions. Conversely, the same study found females with significantly smaller teeth than males in Chinese population except the left lateral incisors in both arches and lower left and right central incisors.<sup>4</sup> Wright et al conducted a study on subjects with unilateral or bilateral maxillary lateral incisor anomalies and established that subjects had smaller than average tooth size hence the overall tooth size discrepancy.<sup>7</sup>

Alqahtani A in his study on Caucasian subjects with skeletal class III found no significant association between overall or anterior Bolton ratios, overbite, FMA, FMIA and IMPA.<sup>8</sup>

Asad S et al correlated overall and anterior Bolton's ratio in a local group of subjects with different growth patterns; the study shows slight variation in the ratios among high, low and normal angle patients.<sup>5</sup>In another study by Rajhbhoj AA et al, no significant association could be appraised between overjet and Bolton's overall and anterior ratio in subjects having high angle growth. According to the results, increased overjet found in Class II Division I patients in high angle group is linked with raised angle of Mandibular plane and decrease Jarabak's ratio rather than Bolton's ratio discrepancy.<sup>6</sup>

The rationale of this study was to find out if

there is a significant variation in the occurrence of tooth size discrepancy in Class II malocclusion group with different divergence of growth (Low angle, Normal angle and High angle) represented by Bolton's ratios, in our sample of population. The ratios thus found will help in management of the patients looking for orthodontic treatment.

# MATERIALS AND METHODS

Our cross-sectional study took place at the Orthodontic indoor unit, Lahore Medical & Dental College for a duration of 6 months i.e. 25<sup>th</sup> September 2019 to 24<sup>th</sup> March 2020. A total number of 95 subjects were entered in this study through non-probability consecutive sampling technique with 95% confidence level, 7% margin of error. Patients with age ranging from 14-25 years presenting with Skeletal Class II malocclusion and presence of complete permanent dentition (from right to left 1st permanent molars in both jaws) were included. Patients with any morphologic tooth defects, congenitally missing teeth, cavitated or grossly restored teeth and those who had any history of orthodontic treatment were excluded.

Approval was taken from the hospital's ethical review board for this study. Informed consent in writing was taken from the nominated patients fulfilling the inclusion criteria and willing to undergo orthodontic treatment. Impressions of all the patients were taken and study casts made. Lateral Cephalogram were recorded in centric occlusion with the patient's Frankfurt horizontal plane parallel to floor and lips at rest. On cephalogram, growth pattern is assessed by SN-Mandible angle and patients are categorized as high, normal and low angle.

The correct widths of maxillary and mandibular teeth from right to left 1<sup>st</sup> molar were recorded using a needle pointed dividers. These values were then used to calculate anterior and overall Bolton ratios as mentioned:

- (Mesio-distal widths of mandibular 12/Mesio-distal widths of maxillary 12)×100= Bolton's Overall ratio
- (Mesio-distal widths mandibular 6/ Mesio-distal widths of maxillary 6)× 100 = Bolton's Anterior ratio
- Overall ratio >/< 91.3% indicates discrepancy.
- Anterior ratio >/<77.2% indicates discrepancy.

All the data was documented on a pro forma and later entered and analyzed by using the software SPSS.v.21.0. Mean & Standard Deviation was calculated for quantitative variables (age). Frequency & percentages were derived for qualitative variable like gender. Chi square test was used to evaluate growth pattern and t-test was for mesio-distal widths of upper/lower dentition taking p-value  $\leq 0.05$  as significant. Data was stratified for age and gender. Post-stratification respective test was applied taking p-value  $\leq 0.05$  as significant.

# RESULTS

Age range for our study was 14 to 25 years with mean age of  $18.57 \pm 3.35$  years. Higher percentage of the subjects i.e. 57 (60.0%) were between 14 to 20 years of age.

Out of these 95 subjects, 27 (28.42%) were male and 68(71.58%) were female with male to female ratio of 1:2.5.

Frequency of different vertical growth patterns in Class II malocclusion patients were as follows; high angle in 35 (36.84%), low angle in 28 (29.47%) and normal angle in 32 (33.68%) as shown in Table I. Frequency of inter-arch tooth size difference in Class II patients was found to be 52.63% as shown in Table II. Intermaxillary tooth size discrepancy with respect to different vertical growth patterns was found to be

### TABLE 1: FREQUENCY OF DIFFERENT VERTI-CAL GROWTH PATTERNS IN CLASS II MALOC-CLUSION PATIENTS (N=95).

Vertical growth pat- tern	Frequency	Percentage
High angle	35	36.84
Low angle	28	29.47
Normal angle	32	33.68

#### TABLE 2: INCIDENCE OF INTERMAXILLARY TOOTH SIZE DISCREPANCY IN CLASS II PA-TIENTS (N=95).

Intermaxillary tooth size discrepancy	Frequency	percentage
Yes	50	52.63
No	45	47.37
Total	95	100.0

### TABLE 3 : STRATIFICATION OF INTERMAX-ILLARY TOOTH SIZE DISCREPANCY WITH RESPECT TO DIFFERENT VERTICAL GROWTH PATTERNS

Vertical growth	Intermaxillary tooth size discrepancy		P-value
pattern	Yes	No	
High	26	09	0.002
Low	14	14	
Normal	10	22	

TABLE 4: STRATIFICATION OF INTERMAXIL-LARY TOOTH SIZE DISCREPANCY WITH RE-SPECT TO GENDER

Gender	Intermaxillary tooth size discrepancy		P-value
	Yes	No	
Male	11	16	0.144
Female	39	29	

statistically insignificant but statistically significant in females as compared to males.

### DISCUSSION

Tooth proportions have significant importance because it appreciates information on developing human changes in accordance with their diet.<sup>10</sup> Clinically, mesiodistal tooth width is associated to arch configuration and larger teeth are related with crowding.<sup>10-13</sup> Moreover, an association has been noted concerning size of teeth to third molar eruption and impaction.<sup>14</sup> Variation in tooth size has been related in

During finishing stages, inter-arch tooth dimensions are imperative to attain precise occlusal interdigitation.<sup>19,20</sup> Numerous approaches have been described to appraise intermaxillary tooth size relationship such as Kesling's diagnostic setup,<sup>21</sup> Neff's anterior coefficient,<sup>22,25</sup> and Bolton's ratios.<sup>19,22</sup>

Our aim for this study was to determine the incidence of intermaxillary tooth size discrepancy in patients with Class II malocclusion with respect to their vertical growth. In this study, the frequency of intermaxillary TSD in different vertical growth patterns in class II malocclusion group was statistically insignificant; high angle in 35 (36.84%), low angle in 28 (29.47%) and normal angle in 32 (33.68%). The frequency of intermaxillary tooth size difference in class II patients was found in 50 patients. Plaza AP et al found greater frequency i.e 40% of high angle patients than low angle (14%) in Class II malocclusion group.<sup>9</sup>

Asad S et al also co-related anterior and overall Bolton's ratio in a local population with different vertical patterns of growth but did not specify which malocclusion groups were included in their study. However, the study concluded slight but insignificant variation in the ratios among high, low and normal angle patients.<sup>5</sup>

In this study, intermaxillary tooth size discrepancy with respect to gender was found to be significant which was supported by the studies of Struijic et al and Lavelle. $^{14,15,16}$ 

Sperry et al<sup>23</sup> and Fattahi et al<sup>24</sup> reported raised overall Bolton's ratio for Class III malocclusion subjects.

The latter can be justified by the significant variances amongst ethnic groups, in the sizes and proportionality of dentition.<sup>25</sup> Motta et al<sup>26</sup> studied 161 casts of South American subjects and established that patients with Class III malocclusion presented average anterior teeth ratios corresponding to those described by Bolton,<sup>27</sup> whereas Class I and Class II demonstrated ratios that were diverse. However, a study by O'Mahony et al<sup>28</sup> found insignificant results in anterior ratio amongst the malocclusion groups.

According to a study by Fattahi et al, the average anterior ratio for their study subjects were considerably unlike from Bolton's ratio (77.20); however overall ratio results were insignificant.<sup>31</sup> Toshiya et al studied Bolton's ratio in a Japanese population and revealed no significant differences amongst various malocclusion groups.<sup>32</sup> Batool et al established noticeably greater mean anterior tooth ratios for Class II subjects, whereas other corresponded to Bolton's norms.<sup>33</sup> Lopatiene also compared Bolton's (overall and anterior) ratios and found no significant differences among the three Angle's malocclusions.<sup>34</sup> Similarly in a study of Jordanian population, Al Khateeb and Abu Alhaija<sup>35</sup> established that tooth size difference among all three malocclusion groups were insignificant.

Araujo and Souki<sup>36</sup> categorized a sample of 300 subjects into three malocclusion groups based on their skeletal analysis. Each group comprised of 100 subjects. The mean anterior ratios found in Class III group were significantly greater in comparison to Class I and Class II groups. However, differences in dental proportions were predominantly found in both Class I and Class III patients. Hashim<sup>37</sup> failed to appreciate discrepancies in Bolton's ratios between different malocclusions when studying 55 orthodontic patients. Alkofide and Hashim<sup>38</sup> studied interarch tooth size difference in a Saudi population of 240 subjects with different malocclusions. They designated sixty participants to each group. Class III group exhibited a marked significance for Bolton's anterior ratio.

The present study is limited by a single (Class II) malocclusion group. A more thorough research on intermaxillary TSD in different malocclusion groups with different vertical growth patterns should be done to provide further insight into establishing a definitive conclusion. Furthermore, digitizing the casts of subjects for measurements will reduce the chance of human error.

#### CONCLUSION

• This study determined the frequency of different vertical growth patterns in Class II malocclusion patients were as follows; high angle in 36.84%, low angle in 29.47% and normal angle in 33.68% and

frequency of intermaxillary tooth size discrepancy in class II patients was found in 52.63% patients.

- Intermaxillary tooth size discrepancy with respect to different vertical growth patterns in Class II patients was found to be insignificant.
- There was a statistically significant intermaxillary TSD in females in comparison to males.

However, orthodontists should be critical of such differences and their possible effects on achieving optimum occlusion and finishing in orthodontic treatment.

#### REFERENCES

- 1 Prasanna AL, Venkatramana V, Aryasri AS, Katta AK, Santhanakrishnan K, Maheshwari U. Evaluation and comparison of intermaxillary tooth size discrepancy among class I, class II division 1, and class III subjects using bolton's analysis: an in vitro study. J Int Oral Health. 2015;7(9):58.
- 2 Cancado RH, Goncalves Junior W, Valarelli FP, FREITAS KM, Crêspo JA. Association between Bolton discrepancy and Angle malocclusions. Braz oral res. 2015; 20:29(1)-6.
- 3 Rakosi T, Jonas I, Graber TM. Orthodontic diagnosis.1<sup>st</sup>ed. New York: Thieme Medical Publishers 1993:207-234
- 4 Leung EM, Yang Y, Khambay B, Wong RW, McGrath C, Gu M. A Comparative Analysis of Tooth Size Discrepancy Between Male and Female Subjects presenting with a Class I malocclusion. Sci World J. 2018; 2018.
- 5 Rajbhoj AA, Bhat SR. A Rational Factor for Overjet in Class II Division 1 Malocclusion–Growth Pattern or Bolton's Discrepancy. IOSR-JDMS. 2017;16(1): 101-108.
- 6 Asad S, Naeem S, Ul-Hamid W. Bolton Analysis For Different Sagittal Problems & Its Correlation With Dental Parameters. Pak Oral Dental J. 2008;28(1):91-8.
- 7 Wright J, Bosio JA, Chou JC, Jiang SS. Maxillary lateral incisor agenesis and its relation to overall tooth size. J Prosthet Dent. 2016;115(2):209-14.
- 8 Alqahtani A. Bolton Tooth Size Discrepancy in Caucasians with Skeletal Class III Malocclusion. State University of New York at Buffalo; 2017.
- 9 Plaza SP, Reimpell A, Silva J, Montoya D. Relationship between skeletal Class II and Class III malocclusions with vertical skeletal pattern. Dental Press J Orthod. 2019;24(4):63-72.
- 10 Bermudez de Castro JM, Nicolas ME. Posterior dental size reduction in hominids: the Atapuerca evidence. Am J Phys Anthropol 1995;96:335–356.
- 11 Lundstrom A. Changes in crowding and spacing of the teeth with age. Dent Pract Dent Rec 1969;19:218–224.
- 12 Doris JM, Bernard BW, Kuftinec MM, Stom D. A biometric study of tooth size and dental crowding. Am J Orthod 1981;79:326–336.
- 13 Radnzic D. Dental crowding and its relationship to mesiodistal crown diameters and arch dimensions. Am J Orthod Dentofacial Orthop 1988;94:50–56.
- 14 Forsberg CM. Tooth size, spacing, and crowding in relation to eruption or impaction of third molars. Am J Orthod Dentofacial Orthop 1988;94:57–62.
- 15 Lavelle CL. Maxillary and mandibular tooth size in different racial groups and in different occlusal categories. Am J Orthod 1972;61:29–37.
- 16 Buchang PH, Demirjian A, Cadotte L. Permanent mesiodistal

tooth size of French-Canadians. J Can Dent Assoc 1988; 54:441–444.

- 17 Crosby DR, Alexander CG. The occurrence of tooth size discrepancies among different malocclusion groups. Am J Orthod Dentofacial Orthop 1989;95:457–461.
- 18 Hattab FN, Al-Khateeb S, Sultan I. Mesiodistal crown diameters of permanent teeth in Jordanians. Arch Oral Biol 1996;41:641-645.
- 19 Neff CW. Tailored occlusion with the anterior coefficient. Am J Orthod 1949;35:309–313.
- 20 Bolton A. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. Angle Orthod 1958;28:113–130.
- 21 Kestling HD. The philosophy of the tooth positioning appliance. Am J Orthod 1945;31:297–340.
- 22 Neff CW. Size relationship between the maxillary and mandibular anterior segments of the dental arch. Angle Orthod 1957;27:138–147.
- 23 Bolton WA. The clinical application of a tooth size analysis. Am J Orthod 1962;48:504–529.
- 24 Sperry TP, Worms FW, Isaacson RJ, Speidel TM. Toothsize discrepancy in mandibular prognathism. Am J Orthod. 1977;72(2):183-90.
- 25 Fattahi HR, Pakshir HR, Hedayati Z. Comparison of tooth size discrepancies among different malocclusion groups. Eur J Orthod. 2006;28(5):491-5.
- 26 Lavelle CL. Maxillary and mandibular tooth size in different racial groups and in different occlusal categories. Am J Orthod. 1972;61(1):29-37.
- 27 Motta ATS, Rodrigues S, Quintão CCA, Capelli Jr J. Análise da discrepância de tamanho dentário em pacientes da Clínica de Ortodontia da FO/UERJ. R Dental Press Ortodon Ortop

Facial. 2004;9(3):83-90.

- 28 Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. Angle Orthod. 1958;28:112-30.
- 29 O'Mahony G, Millett DT, Barry MK, McIntyre GT, Cronin MS. Tooth size discrepancies in Irish orthodontic patients among different malocclusion groups. Angle Orthod. 2011 Jan;81(1):130-3.
- 30 Crosby DR, Alexander CG. The occurrence of tooth size discrepancies among different malocclusion groups. Am J Orthod Dentofacial Orthop. 1989;95(6):457-61.
- 31 Fattahi HR, Pakshir HR, Hedayati Z. Comparison of tooth size discrepancies among different malocclusion groups. Eur J Orthod 2006 Oct;28(5):491-495.
- 32 Endo T, Abe R, Kuroki H, Oka K, Shimooka S. Tooth size discrepancies among different malocclusions in a Japanese orthodontic population. Angle Orthod 2008 Nov;78(6): 994-999.
- 33 Batool I, Abbas A, Rizvi SA, Abbas I. Evaluation of tooth size discrepancy in different malocclusion groups. J Ayub Med Coll Abbottabad 2008 Oct-Dec;20(4):51-54.
- 34 Lopatiene K, Dumbravaite A. Relationship between tooth size discrepancies and malocclusion. Stomatologia 2009;11(4): 119-124.
- 35 Al-Khateeb SN, Abu-Alhaija ES. Tooth size discrepancies and arch parameters among different malocclusions in a Jordanian sample. Angle Orthod 2006 May;76(3):459-465.
- 36 Araujo E, Souki M. Bolton anterior tooth size discrepancies among different malocclusion groups. Angle Orthod 2003;73: 307-13.
- 37 Hashim HA. Bolton tooth size ratio among different malocclusion groups: A pilot study. J Pak Dent Assoc 2002;11:81-85.

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Principal Investigator, Data collection, Article writing, data analysis, interpretation of data, and drafted the initial manuscript
Concept, supervision, proof reading
Data Collection
Data Collection
Statistics Data Analysis
Data Interpretation