An Original Research –Comparison of Intermaxillary Tooth Size Discrepancies among Different Malocclusion Groups in Jaipur Population

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ABSTRACT:
Aim: To compare the intermaxillary tooth size discrepancies among different malocclusion groups using Bolton's Analysis in Jaipur population
Method:180 dental casts were selected from the patient data of Department of Orthodontics and Dentofacial Orthopedics of Jaipur Dental College,Jaipur. The subjects were divided into Angle's Class I, Angle's Class II Division 1, Angle's Class II Division 2 malocclusions. Each group consists of 60 sets of dental casts among which 30 are males and 30 are females. The Statistical software IBM SPSS statistics22.0 (IBM Corporation, Armonk, NY, USA) was used for the analyses of the data and Microsoft word and Excel were used to generate graphs etc. ANOVA test was used to compare the difference between the groups (Class I, Class II Division 1, and Class II Division 2). The comparison between the gender was done using Unpaired 't' Test and compared with Bolton's norms.
Result: The Anterior ratio was compared between males and females and the result shows that there is no difference in males and females [Males-77.42±2.70, Females-77.88±3.19] in Class I & Class II Division 2 , while there was significant difference in males and females [Males-76.68±3.07, females-78.29±2.50] ratio in Class II Division 1. This shows that the anterior ratio was comparable between the groups. The Overall ratio was compared between males and females and the result shows that there is no difference in males and females ratio in Class II Division 1 & Class II Division 2 , while there was significant difference

in males and females ratio in Class I. This shows that the overall ratio was comparable between the groups.
Conclusion: There was a significant difference in the Bolton's anterior ratio between the groups but there was no statistically significant difference in the Bolton's overall ratio between the groups. There was no significant difference between the anterior and overall ratio between males and females.
KEYWORDS: Bolton's ratio, Angle's Classification.

I. INTRODUCTION

Malocclusion is multifactorial in aetiology, being affected by skeletal, dental and soft tissue factors, which in turn are influenced by environmental and genetic components. In orthodontics tooth size has been considered as the seventh key to normal occlusion[1]. we require a proper ratio between the teeth size in both the arches to achieve an optimal occlusion. A disproportion in the size of teeth in either arch makes it difficult to obtain good intercuspation and thereby an optimal occlusion and reflects in both arches as crowding or spacing[2].

Individuals with Angle's class I and class III malocclusions have shown to have greater prevalence of tooth size discrepancies than do individuals with class II malocclusion; class III subjects have higher tooth size ratios than class I and class II subjects [3,4] .Mean anterior tooth size discrepancy for Angle's class III subjects is usually greater than for class I subjects.[3,4]

There are variations in tooth size between different racial groups. There is a evidence of difference in the tooth size of males and females in a particular race. Male teeth are usually larger than females, particularly the canines.[5,6] A relation has been noted between tooth size and third molar eruption and impaction.[7].The various tooth size data sets can be used to predict the post treatment occlusion outcome mathematically and they might be taken as basic information for artificial tooth fabrication .Also, mesio-distal tooth width provides valuable information on human evolution[8].

Several studies were published describing the importance of a correct tooth size proportion between the upper and lower arches. Several methods have been described to evaluate interarch tooth size relationship such as Kesling's diagnostic setup[9], Neff's anterior coefficient[10] and Bolton's ratios for the six anterior teeth, and the overall ratio for the 12 teeth[11] .In 1958, Bolton published his now classical work on interpreting mesiodistal tooth-size dimensions and their effect on occlusion. He selected 55 cases with excellent occlusion and compared the sums of the mesiodistal widths of the maxillary and mandibular teeth. Using the mesiodistal width of 12 teeth, he obtained an overall ratio of 91.3% + 1.9%; using the 6 anterior teeth, he obtained an anterior ratio of 77.2% + 1.65 %.Later on other researchers proposed new methods to study tooth size discrepancies[12].Bolton method is still the most widely used till now for the diagnosis of tooth size discrepancies.

There are many studies in the literature that correlated malocclusion with the tooth size discrepancy[13,14,15]. But there is a scanty literature available on comparison of tooth size discrepancies among different malocclusion groups in Rajasthan[16,17]. especially in Jaipur population. Hence a study, was carried out in the Department of Orthodontics, Jaipur Dental college, Jaipur, to compare intermaxillary tooth size discrepancies among patients with Angle's Class I , Angle's Class II Division 1, Angle's Class II Division 2 malocclusion in Jaipur population.

II. AIM AND OBJECTIVES
1.Comparison of Anterior tooth ratio between males and females of Angle's Class I, Angle's Class II Division 1, Angle's Class II Division 2 malocclusion groups.
2. Comparison of overall tooth ratio between males and females of Angle's Class I, Angle's Class II Division 1, Angle's Class II Division 2 malocclusion groups.

3.Comparisons of anterior and overall tooth ratios of present study with Bolton's tooth ratios.

III. METHOD AND MATERIAL
The study was conducted in the Department of Orthodontics and Dentofacial Orthopedics at Jaipur dental college,Jaipur. 180 sets of dental casts were selected from the patient data of the Department of Orthodontics and Dentofacial Orthopedics at Jaipur dental college,Jaipur.

Study Location: Department of Orthodontics and Dentofacial Orthopedics of Jaipur Dental College ,Jaipur
Study Duration: January 2015 to December 2016.
Sample size: 180 patients.

The subjects belonged to the age range of 13 to 30 years. The subjects were divided into three malocclusion groups:
Group I—class I (CI1),
Group II—class II division 1 (CIIdiv1),
Group III— class II division 2 (CIIdiv2)
Each group comprised of 60 sets of dental casts.

Inclusion criteria
1.Good quality pretreatment models
2.Complete permanent dentition from 1st molar to 1st molar in both arches
3.Absence of mesiodistal and occlusal abrasions or caries or Class II fillings
4.Absence of dental prosthesis.
5.Absence of partially erupted teeth.
Exclusion criteria
1.Gross restorations, buildups, crowns, onlays, Class II amalgams, or composite restorations that affect the tooth's mesiodistal diameter.
2.Congenital defects or deformed teeth.
3.Obvious interproximal or occlusal wear of teeth.
4.No missing teeth.

A digital vernier caliper calibrated to the nearest 0.01 mm was used to measure the mesiodistal measurements of the teeth on the patients cast. Bolton's analysis was than performed on each set of values obtained from the casts.Bolton anterior (canine to the canine) and overall (first molar to first molar) ratios were calculated with the following formulas ·

$$\frac{\text{sum mandibular ``12''}}{\text{sum maxillary ``12''}} \times 100 = \text{overall ratio (\%)}$$

$$\frac{\text{sum mandibular ``6''}}{} \times 100 = \text{anterior ratio (\%)}$$

sum maxillary ''6''

Bolton normal range values were used in the classification of normal and malocclusion groups. According to Bolton analysis[11], a significant discrepancy was defined as one whose value was outside of 2 SD from Bolton mean and approximately 95% of Bolton cases were within this range. Therefore, for the overall ''12'' ratio, a significant discrepancy is defined as a ratio below 87.5 or above 95.1, with ratios in-between falling within 2 SD of Bolton mean. Similarly, any ratio below 73.9 or above 80.5 is considered to be a significant discrepancy for the anterior ''6'' ratio.

Table 1 : Comparison of Age(years) between the groups

Age	Mean ±SD	SD	F-value	p-value
Group I(n= 60)	19.28	3.76		
Group II(n= 60)	19.38	3.24	0.85	0.55
Group III(n= 60)	18.85	3.02		

Graph 1: Comparison of Age (years) between the groups
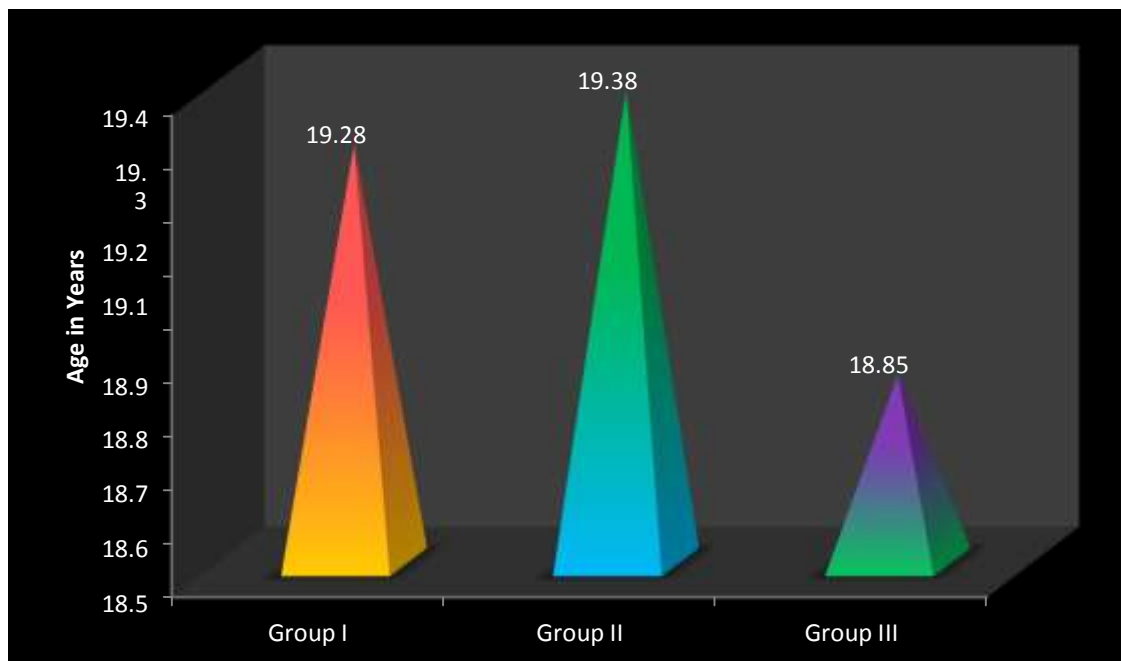
Table 2: Bolton ratios (mean,SD,SE) for pooled (n=60) for all three groups

	Groups	mean	SD	SE	f-value	p-value
Anteriorratio	Group I	77.56	2.94	0.46		
	GroupII	78.49	2.77	0.43	5.08	0.01*
	GroupIII	78.98	2.94	0.46		
	GroupI	90.52	2.90	0.45		

Overall ratio	GroupII	90.78	2.80	0.44	1.45	0.11
	GroupIII	90.89	2.09	0.33		

Graph 2: Bolton ratios (mean,SD,SE) for pooled (n=60) for all three groups
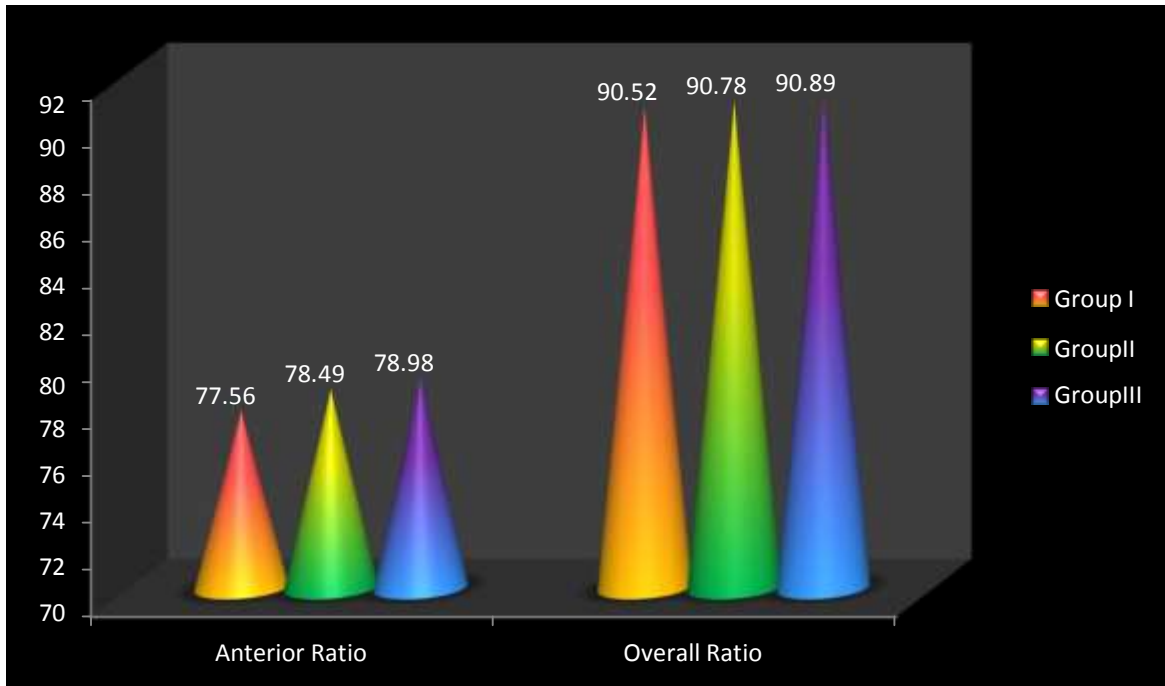
Table 3: **Bolton ratios (mean,SD,SE) for males (n=30) for three groups.**

	groups	Mean	SD	SE	F value	p-value
Anterior ratio	Group I	77.24	2.70	0.59	6.73	0.01*
	Group II	76.68	3.07	0.67		
	Group III	78.62	2.92	0.64		
Overall ratio	Group I	89.45	2.66	0.58	2.86	0.03*
	Group II	90.98	2.72	0.59		
	Group III	91.10	2.08	0.45		

*Significant

Graph 3: Bolton ratios (mean,SD,SE) for males (n=30) for three groups.
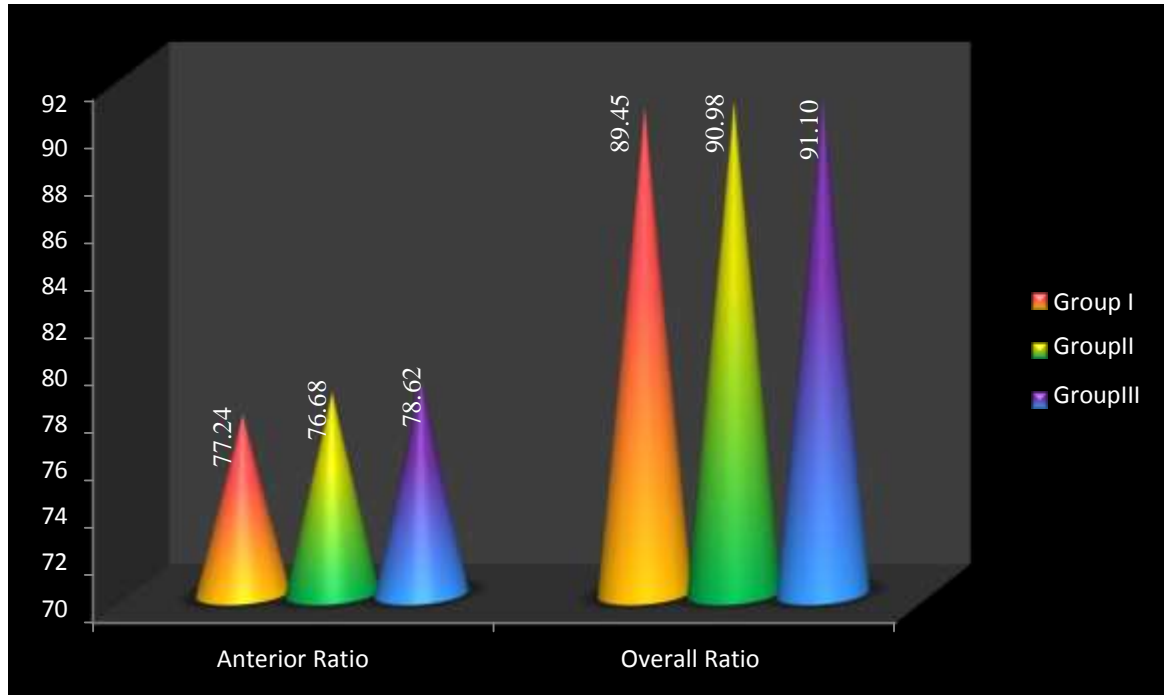
Table 4: Tooth ratios (mean,SD,SE) for Females (n=30) for three groups.

	groups	Mean	SD	SE	F value	p-value
Anteriorratio	Group I	76.60	3.19	0.70	13.45	0.01*
	Group II	80.30	2.50	0.55		
	Group III	79.35	3.00	0.65		
Overall ratio	Group I	91.58	2.80	0.61	1.37	0.13
	Group II	90.57	2.93	0.64		
	Group III	90.68	2.13	0.46		

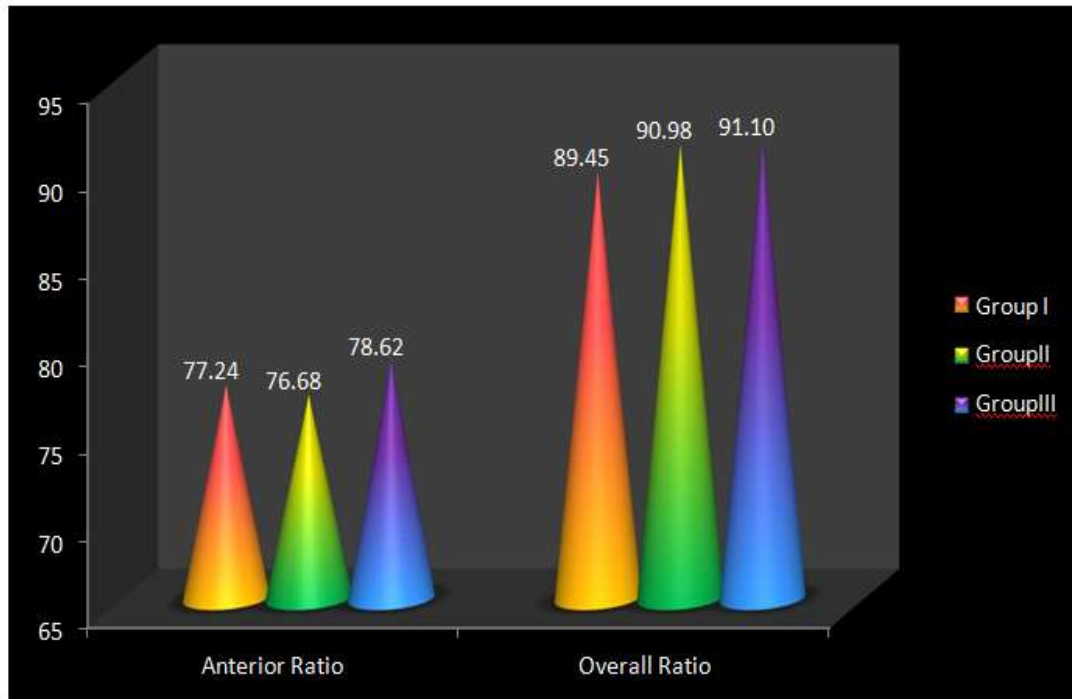**Graph 4: Tooth ratios (mean,SD,SE) for Females (n=30) for three groups.**

**Table 5:Comparison of anterior and overall ratios between males and females:**

Total Ratio (%)	Males (n=25)		Females(n=25)	p-value
	Groups	Mean ±SD	Mean ±SD	
Anterior	Group I	77.42 ± 2.70	77.88± 3.19	0.330
	Group II	76.68 ± 3.07	78.29 ± 2.50	0.03*
	Group III	78.62 ± 2.92	79.35 ± 3.00	0.25
Overall	Group I	89.45 ± 2.66	91.58 ± 2.80	0.01**
	Group II	90.98 ± 2.72	90.57 ± 2.93	0.387
	Group III	91.10 ± 2.08	90.68 ± 2.13	0.198

*p<0.05, **p<0.01

Graph 5: Comparison of anterior and overall ratios between malesand females.
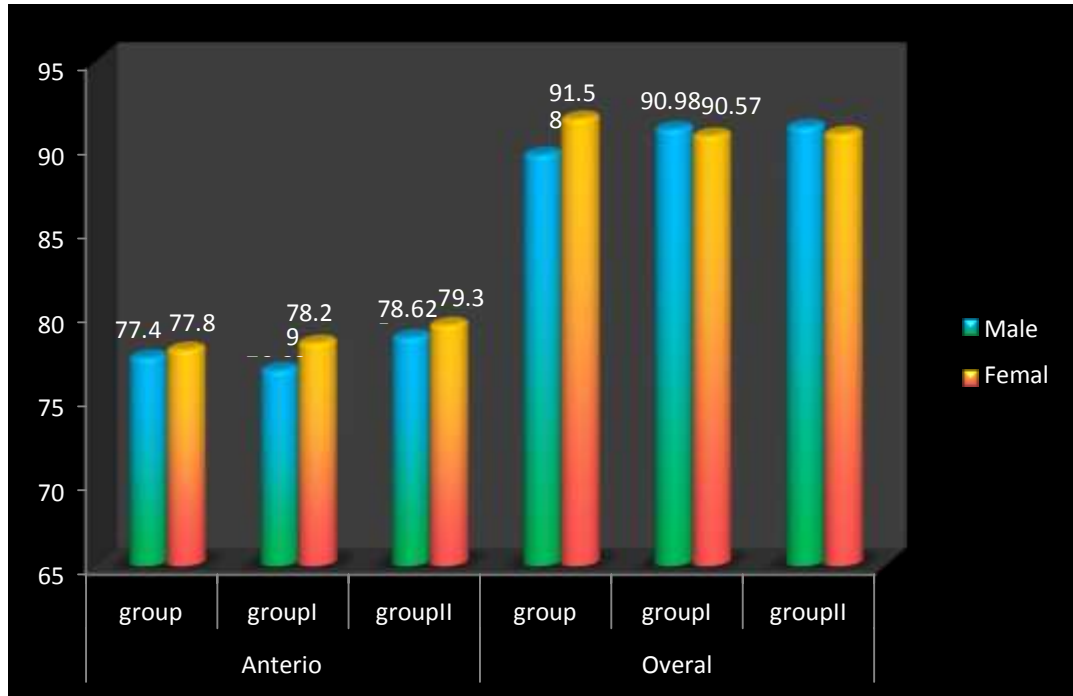
IV. RESULTS

The obtained data was compiled systematically and coded in MS Excel sheet and subjected to statistical analysis with the consult of a statistician. Statistical procedures were carried out in 2 steps:

1.Data compilation and presentation
2.Statistical analysis

Descriptive and inferential statistical analyses were carried out in the present study.The Statistical software IBM SPSS statistics 22.0 (IBM Corporation, Armonk, NY, USA) was used for the analyses of the data and Microsoft word and Excel were used to generate graphs etc**.**ANOVA test was used to compare the difference between the groups (Class I, Class II Div1, and Class II Div2). The comparison between the gender was done using Unpaired 't' Test .Results on continuous measurements were presented on Mean $\square$ SD. Level of significance was fixed at p=0.05 and any value less than or equal to 0.05 was considered to be statistically significant.

The groups were matched according to age and gender. The mean age of patients in Group I was 19.28±3.76 years. The mean age for Group II patients was 19.38±3.24 years and for Group III patients was 18.5±3.02 years. The ANOVA test result shows there is no difference between the age group of the patients with respect to age with F

value 0.85 and p value 0.55. This confirms that the age was matched between the groups. The study includes 30 males and 30 females in each group so there is no difference in groups with respect to gender. (Table 1)(Graph 1)

In the Bolton analysis the Anterior ratio was compared by using ANOVA test. The mean anterior ratio for Group I was 77.56±2.94, Group II was 78.49±2.77 and Group III was 78.98±2.94. The test result shows significant difference between the groups with F value 5.08 and p value 0.01.

Group III > Group II > Group I

In the Bolton analysis the Overall ratio was compared by using ANOVA test. The mean anterior ratio for Group I was 90.52±2.90, Group II was 90.78±2.80 and Group III was 90.89±2.09. The Test result shows no significant difference between the groups with F value 1.45 and p value 0.11.

Group III ≈ Group II ≈ Group I(Table 2, Graph 2).

The Bolton analysis for male was compared by using ANOVA test. The mean anterior ratio for Group I was 77.24±2.70, Group II was 76.68±3.07 and Group III was 78.62±2.92. The Test result shows significant difference between the groups withF value 5.08 and p value 0.01.

Group III > Group I > Group II
The mean Overall ratio for Group I was 89.45±2.66, Group II was 90.98±2.72 and Group III was 91.10±2.08. The Test result shows significant difference between the groups with F value 2.86 and p value 0.03.

Group III ≈ Group II > Group I(Table 3, Graph 3)
The Bolton analysis for females were compared by using ANOVA test. The mean anterior ratio for Group I was 76.60±3.19, Group II was 80.30±2.50 and Group III was 79.35±3.00. The Test result shows significant difference between the groups with F value 13.45 and p value 0.01.

Group II> Group III > Group I
The mean Overall ratio for Group I was 91.58±2.66, Group II was 90.57±2.93 and Group III was 90.68±2.13. The Test result shows no significant difference between the groups with F value 1.37 and p value 0.13.

Group III ≈ Group II ≈ Group I (Table 4, Graph 4).
The anterior ratio was compared between males and females by using t test. The anterior ratio for male in Group I was 77.42±2.70 and for females was 77.88±3.19 with p value 0.33. There is no difference in males and females ratio in Group I.The anterior ratio for male in Group II was 76.68±3.07 and for females was 78.29±2.50with p value 0.03. There is significant difference between males and females ratio in Group II.The anterior ratio for male in Group III was 78.62±2.92 and for females was 79.35±3.00 with p value 0.25. There is no difference between males and females ratio in Group III.

The Overall ratio was compared between males and females by using t test. The Overall ratio for male in Group I was 77.42±2.70 and for females was 77.88±3.19 with p value 0.01. There is significant difference in males and females ratio in Group I.The Overall ratio for male in Group II was 90.98±2.72 and for females was 90.57±2.93 with p value 0.387. There is no difference between males and femalesratio in Group II.
The Overall ratio for male in Group III was 91.10±2.08 and for females was 90.68±2.13 with p value 0.19. There is non-significant difference between males and females ratio in Group III.(Table 5, Graph 5).

V. DISCUSSION
The Bolton tooth-size analysis is an intermaxillary ratio analysis designed for the purpose of localizing differences in tooth size. It was first advocated by Bolton WA[11] in 1958, who believed that the correct maxillary and mandibular mesiodistal tooth size relationship is important in the achievement of proper occlusal interdigitation in the finishing stages of orthodontic treatment.

Therefore the following study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Jaipur Dental College, Jaipur. The study consisted of study models of 180 patients in the age range of 13 to 30 years (Table 1). This age group was chosen because it was found to be the best sample for tooth size measurements as there are fewer chances of mutilation and attrition in early permanent dentition[18].

The test result shows there is no significant difference between the age group of the patients. This shows that the age was comparable between the groups.In the present study there was a significant difference in the Bolton's anterior ratio between the groups i.e. Group III > Group II > Group I.(Table 1, Graph 1)There was no statistically significant difference in the Bolton's overall ratio between the groups i.e. Group III ≈ Group II ≈ Group I.(Table 2, Graph 2).This shows that overall ratio was comparable between the Groups.

For males, the test result in the Bolton's anterior ratio shows significant difference between the groups, i.e. Group III > Group I > Group II. The overall ratio also shows the significant difference between the Group II and Group I and together they are not significant with Group III. i.e. Group III ≈ Group II > Group I (Table 3, Graph 3).This shows that the Bolton's Anterior ratio was not comparable between the groups but overall ratio was comparable.

For females, the test result in the Bolton's anterior ratio shows significant difference between the groups, i.e. Group II> Group III > Group I. The overall ratio shows that there is no significant difference between the Groups. i.e. Group III ≈ Group II ≈ Group I (Table 4, Graph 4).This shows that the Bolton's Anterior ratio was not comparable between the groups but overall ratio was comparable.

The Anterior ratio was compared between males and females and the result shows that there is no difference in males and females[Males-77.42±2.70, Females- 77.88±3.19] in Group I& Group III, while there was significant difference in males and females[Males-76.68±3.07, females-78.29±2.50]ratio in Group II. This showsthat the anterior ratio was compared between the groups.

The Overall ratio was compared between males and females and the result shows that there is no difference in males and females ratio in Group II & Group III, while there was significant difference in males and females ratio in Group I. (Table 5, Graph 5).This shows that the overall ratio was compared between the groups.

The result of the present study was in accordance with Araujo and Souki[19] and Imran et al[20] who found significantly higher anterior mean ratios in Class III groups as compared to Class I and Class II groups.The study was also in agreement to that of Batool et al[21] , Endo et al[22] and Ta et al[23] who found significantly higher mean anterior tooth ratios for Class II patients and also reported other ratios to be within close range of Bolton's norms in their study.Fattahi et al[24] analyzed tooth size ratios of Angle Class I, Class II division 1, Class II division 2, and Class III groups in an Iranian population and demonstrated significant gender differences in the anterior ratio among the malocclusion groups.

The findings of the present study are inconsistent with that of Nie and Lin[25]who did study on Southern Chinese population showed no significant difference exist in anterior and overall ratios of males or females in different malocclusion groups. Al-Khateeb et al[26] also reported non-significant differences in the Bolton's anterior and overall ratios among the males and females of Jordanian population. Mirzakouchaki et al[27] determined tooth size ratio in Iranian- Azari population, and found that values and degree of variation were similar to the original data by Bolton, thereby indicating that Bolton's analysis for Caucasian samples could be applied to an Iranian-Azari population. Al-Tamimi et al[28] with their study on normal class I occlusion in a Saudi population found no significant difference in the anterior and overall ratio from that of Bolton's study.

VI. CONCLUSION
The study was carried out to compare the intermaxillary tooth size discrepancies among different malocclusion groups using Bolton's Analysis in Jaipur population.

- The test result shows there is no difference between the age group of the patients.This shows that the age was comparable between the groups.
- There was a significant difference in the Bolton's anterior ratio between thegroups but there was no statistically significant difference in the Bolton's overall ratio between the groups.

- There was no significant difference between the anterior and overall ratio between males and females.

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