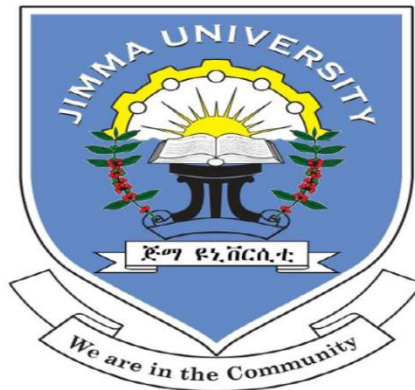**JIMMA UNIVERSITY INSTITUTE OF HEALTH SCIENCE ; SCHOOL OF MEDICINE, DEPARTMENT OF DENTISTRY**

TOOTH SIZE DISCREPANCY OF ANGLE'S DIFFERENT CLASSES OF MALOCCLUSION IN JIMMA MEDICAL CENTER DENTAL OUTPATIENTS AMONG 20 TO 25 AGE GROUPS

BY: Dr.GETACHEW KIFLE (DDM)

ADVISOR :Dr.CHALA HAILU(ASSISTANT PROFESSOR OF JU, ORTHODONTIST)

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JIMMA UNIVERSITY INSTITUTE OF HEALTH SCIENCE ;SCHOOL OF MEDICINE, DEPARTMENT OF DENTISTRY

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Investigator : Dr. Getachew Kifle (DDM)

Advisor(s):

Dr.CHALA HAILU(ASSISTANT PROFESSOR OF JU, ORTHODONTIST)

Executive Summary

Background: Tooth-size discrepancy refers to unbalance between the mesiodistal widths of the maxillary and mandibular individual teeth or groups of teeth. For normal occlusion to occur, the maxillary and mandibular teeth must be proportional in size. Bolton's ratios are a useful diagnostic tool used in clinical orthodontics to achieve ideal occlusion of the dentition for diagnosis and treatment planning.
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Objective: To assess the Bolton's anterior and overall tooth size discrepancy among different malocclusion groups in of Jimma medical center dental outpatients with 20 to 25 age groups

Methods: Hospital-based cross sectional study was conducted in Jimma University medical Center, Dental OPD, in Jimma medical center dental outpatients. A total of 105 patients were recruited among 20 to 25 age groups. Inter arch tooth size discrepancy was assessed using patient study models and mesiodistal tooth width was measured with digital vernier calliper.One-way ANOVA was used to assess the Bolton ratio difference between the groups as function of Angle's malocclusion and gender. The one sample t-test was used to compare the differences between the groups of the present study and Bolton's original sample.

Results: The differences in tooth size ratio of the study groups were not significant statistically, when the groups were compared on the basis of gender.A significant anterior tooth size discrepancy was observed in in the three classes. Statistically significant differences were exclusively observed between the study groups and Bolton's original sample for the anterior ratio. The frequency of the clinically significant tooth size ratio discrepancy was lower for the overall ratio (35.2%) compared to the anterior ratio (58%).

Conclusions: Bolton's analysis shows the clinically significant anterior tooth size discrepancy was more prevalent than that of the overall ratio. In both anterior and overall tooth size discrepancy the incidence of mandibular excess is greater than maxillary excess. In both anterior and overall TSD, class III malocclusion had highest incidence.

Key words: Angle's class I, II, and III malocclusion, *tooth size discrepancy, male and female dental outpatients*

ACKNOWLEDGEMENT

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Abbreviations and Acronyms

ABR-Anterior Bolton ratio

OBR-Overall Bolton ratio

ITSD- Interarch tooth size discrepancy

MDW-Mesiodistal width

TM- Tooth material

TSD- Tooth size discrepancy

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Tooth-size discrepancy (TSD) refers to unbalance between the mesiodistal widths (MDW) of the maxillary and mandibular individual teeth or groups of teeth. For normal occlusion to occur, the maxillary and mandibular teeth must be proportional in size. A TSD will result in either crowding in one arch, spacing in the opposing arch or may disrupt the normal functional relation of the dentitions of the opposing archs. It is widely accepted that orthodontic treatment is based on proper diagnosis, appropriate treatment planning and a perfect interpretation of all findings. Likewise, recognition of TSD is one of the key aspects to forecast treatment result, achieving normal occlusion and getting perfect intercuspation [1, 2]

The MDW of teeth were for the first time introduced by G.V.Black in 1902. He measured great numbers of teeth and prepared tables of average MDW of upper and lower teeth that are still used as references even currently. Several authors have studied TSD in relation to occlusion after G.V.Black's study. W.Bolton has proposed the widely accepted studies of TSD in relation to achieving normal occlusion. He examined mesio-distal tooth-size of 55 subjects with normal occlusions and formulated anterior and overall Bolton ratios for calculating TSD [2].

The anterior Bolton ratio(ABR) is calculated by the adding six anterior lower teeth divided by addition of six anterior upper teeth times 100.The overall Bolton ratio(OBR) is calculated by the adding twelve lower teeth anterior to second molar divided by addition of   twelve upper teeth anterior to second molar times 100 . Bolton's calculation summarizes that to obtain an acceptable TSD, the upper MDW of teeth should approximate desirable ratios, as compared to the lower MDW of teeth and if the ABR is less than 77.2% the mandibular anterior teeth are too small, the maxillary anterior teeth are too large or there is a combination of both. If the ratio is greater than 77.2% either the mandibular anterior teeth are too large, the maxillary anterior teeth are too small or there is a combination of both. Likewise if in the OBR is less than 91.3% the mandibular overall teeth are too small, the maxillary overall teeth are too large or there is a combination of both. If the ratio is greater than 91.3% either the mandibular overall teeth are too large, the maxillary overall teeth are too small or there is a combination of both [2]. Knowing TSD before treatment starts helps the orthodontist to prepare the treatment plan in a way that will consider TSD. If there is significant TSD, corrective treatment may be required like interproximal stripping, crown build up, or tooth extractions [3]

Many researchers have shown that TSD has different prevalence in the three Angle's classes of malocclusion. [4] In 1899, Edward Angle put malocclusion based on the anterioposterior relation of the maxillary and mandibular 1st molar teeth into three classes: class I,II and III. [5]. In Angle class I malocclusion:the lower 1st molar is in normal mesiodistal relation to the upper 1st molar with incorrect line of occlusion .In Angle class II malocclusion:the lower 1st molar is placed distal to the upper 1st molar tooth with unspecified line of occlusion. In Angle class III malocclusion:the lower 1st molar is placed mesial to the upper 1st molar with unspecified line of occlusion [1].

Several researches have been done on normal occlusions and various ethnicities. But, few studies have compared the TSD among different malocclusion groups.[6,7,8,9] The studies were also inadequate.The aim of the study was to compare TSD ratios among different Angle's malocclusion groups and between the two genders each in a sample of Jimma medical center dental clinic outpatients in 20 to 25 age groups.

1.2 STATEMENT OF THE PROBLEMS.

Tooth size discrepancy is one of the commonest causes for dental malocclusion. Its frequence is high which is from 17% to 30% in patients attending dental clinic [3].Increased MDW on upper arch results in moderate to severe overbite and overjet, crowding on upper arch,spacing on lower arch, lingually tipped maxillary anterior teeth and labially tipped mandibular anterior teeth. Whereas increased MDW on lower arch results in decreased overjet and overbite ,crowding of teeth on lower arch ,spaced incisors on upper arch, labial tipping of maxillary anterior teeth and lingual tipping of mandibular anterior teeth[10].

TSD of more than 1.5 mm compromise an acceptable orthodontic case finishing as a result should not be overlooked in diagnosis and treatment plan. [14].Precise MDW of teeth should be there between the upper and lower dentitions to obtain optimum overbite, overjet and intercuspation of teeth

TSD have been associated with diverse ethinicity, genetics and various classes of Angle's malocclusion groups [11]. In pure ethinic group in which ever malocclusion group the prevalence of TSD is small but in countries with multiple ethinic group like in Africa where multiple ethnicities are living its prevalence is higher [11]. Ethiopia is a country where more than 80 ethinic groups are living and hence prevalence of TSD is expected to be even greater although no research was done on TSD in different Angle's classes of malocclusion. Several studies have showed that Angle class III malocclusion cases are associated with greater clinically significant TSD than Angle class I and II malocclusions which emphasizes that in diagnosis and treatment plan TSD should not be overlooked especially in patients with Angle's class III malocclusion [9, 10, 11]

Even though tooth size discrepancy in relation to anterior and overall ratios were researched many times in different racial,ethinic,gender and malocclusion groups [8,9,10], such a study has not been done in Jimma medical center dental clinic outpatients in particular and in Ethiopian population in general. Previously in 2019 TSD was done in normal occlusion in Jimma town. Therefore, the study was aimed to evaluate ABR and OBR of different angle's class of malocclusions in Jimma medical center dental clinic outpatients and compare the result with the Bolton reference.

1.3 SIGNIFICANCE OF STUDY

- The study will provide a benchmark information on prevalence of tooth size discrepancy among angle's different classes of malocclusion in Jimma medical center dental outpatients,
- It also provides a benchmark information on average MDW of teeth for Jimma Medical center dental clinic outpatients with different angle's classes of malocclusion from those samples by which TSD is not clinically significant when they need correction of TSD
- In addition it will be helpful in identifying those of angle's malocclusion with high probability of tooth size discrepancy and sex predilection; and having this information will be very good input inorder not to overlook the effect of tooth size discrepancy during treatment planning and most importantly If these discrepancies are diagnosed early, the orthodontist will be able to plan proper solutions for TSD and optimum finishing in orthodontics can be better predicted.

CHAPTER TWO: LITERATURE REVIEW

On a study that had been done in Brazil aimed to assess the presence of ABR and OBR in Brazilian individuals with normal occlusion and Angle's Class I and Class II, division 1 malocclusions with 105 sample size which was divided in three groups (n=35 each): normal occlusion; Class I malocclusion; Class II, division 1 malocclusion with 24 males and 81 females aged from 13 to 17 years, OBR found was 90.36% (SD 1.70), 91.17% (SD±2.58) and 90.76% (SD±2.45); and ABR was 77.73% (SD 2.39), 78.01% (SD 2.66) and77.30% (SD 2.65) [16].

On study which was done in Portugal aimed to verify the validity of Bolton indexes in a sample of untreated Portuguese subjects based on Angle classification and evaluated the gender difference in 168 pre-treatment dental casts of orthodontics clinic with 59 males and 109 females and different malocclusions in 13 to 20 age groups , revealed that 78.3±3.5% anterior ratio and 92.1±2.2%   overall ratio and there were no differences between genders (p>0.05). Class I (anterior and overall ratios, p=0.001 and p<0.001, respectively), Class II/2 (anterior ratio,p=0.032) and Class III (overall ratio, p=0.041) were significantly different from Bolton's reference data[17].

On a study which was done in Pakistan aimed to compare inter-arch tooth size ratios among different malocclusion groups in outpatients visiting the Department of Orthodontics at the AgaKhan University Hospital aged from 13 to 30 on Pretreatment records of 110 patient cases with Class I = 40, Class II = 40, Class III = 30,showed that no significant difference was found in anterior, and overall Bolton's ratios among the three malocclusion groups and 40% percent of the entire sample had clinically significant discrepancy in anterior ratio, while 14.54% patients had discrepancy in overall ratios; in Class I malocclusion group, 37.5% patients had anterior ratios and 20% had overall ratios discrepancy outside 2 SD from Bolton's mean; in Class II group, 35% patients had anterior ratios and 12.5% had overall ratios outside this range; in Class III malocclusion group, 50% patients had anterior and 10% patients had overall ratio discrepancies outside 2 SD from Bolton's means; no significant difference was found between males and females when the three ratios were compared between the two genders in individual malocclusion groups as well as in the entire sample.[18]

On a study done in Nepal to assess the anterior and overall Bolton's ratio in Nepalese population in patients with normal occlusion, Class I malocclusion, and Class II malocclusion with 120 study models retrieved from department archives study sample consisted of the normal occlusion group (n =31), Class I malocclusion group (n =47), and Class II malocclusion group (n =42),showed that differences in tooth size ratio of the study groups were not significant statistically when the groups were compared on the basis of malocclusion or gender; Statistically significant differences were exclusively observed between the study groups and Bolton's original sample for the anterior ratio; the frequency of the clinically significant tooth size ratio discrepancy was lower for the overall ratio (9.1%) compared to the anterior ratio (22.5%). [19]

On other study that was done in Sudan aimed to assess Tooth Size Discrepancy among different Malocclusion Groups in a Sudanese Sample consisting 107 pretreatment sets of orthodontic study models collected from Mageet specialized dental clinic in Khartoum, showed that a clinically and statistically significant anterior TSD (p=0.002) existed in comparison to Bolton's anterior tooth ratio; ABR and OBR between malocclusion groups and the genders showed no significant differences(P=0.572, P=0.976 respectively; in Class II division 1 mean overall ratio was lower than Bolton's, and Class II division 2 mean overall ratio higher than Bolton's [overall ratio(91.3%,SD±2),anterior ratio(77.2,SD±2)];Class II division I patients showed a tendency towards excessive maxillary tooth material and Class II division 2 patients showed a tendency towards excessive mandibular tooth material.[20]

In Ethiopia only Inter arch tooth size discrepancy in normal occlusion was done in Jimma town population. However, no studies have been done to determine tooth width discrepancies that may exist between arches of cases with different angles's classes of malocclusion in Jimma medical center dental clinic outpatients, hence the need for the current study.
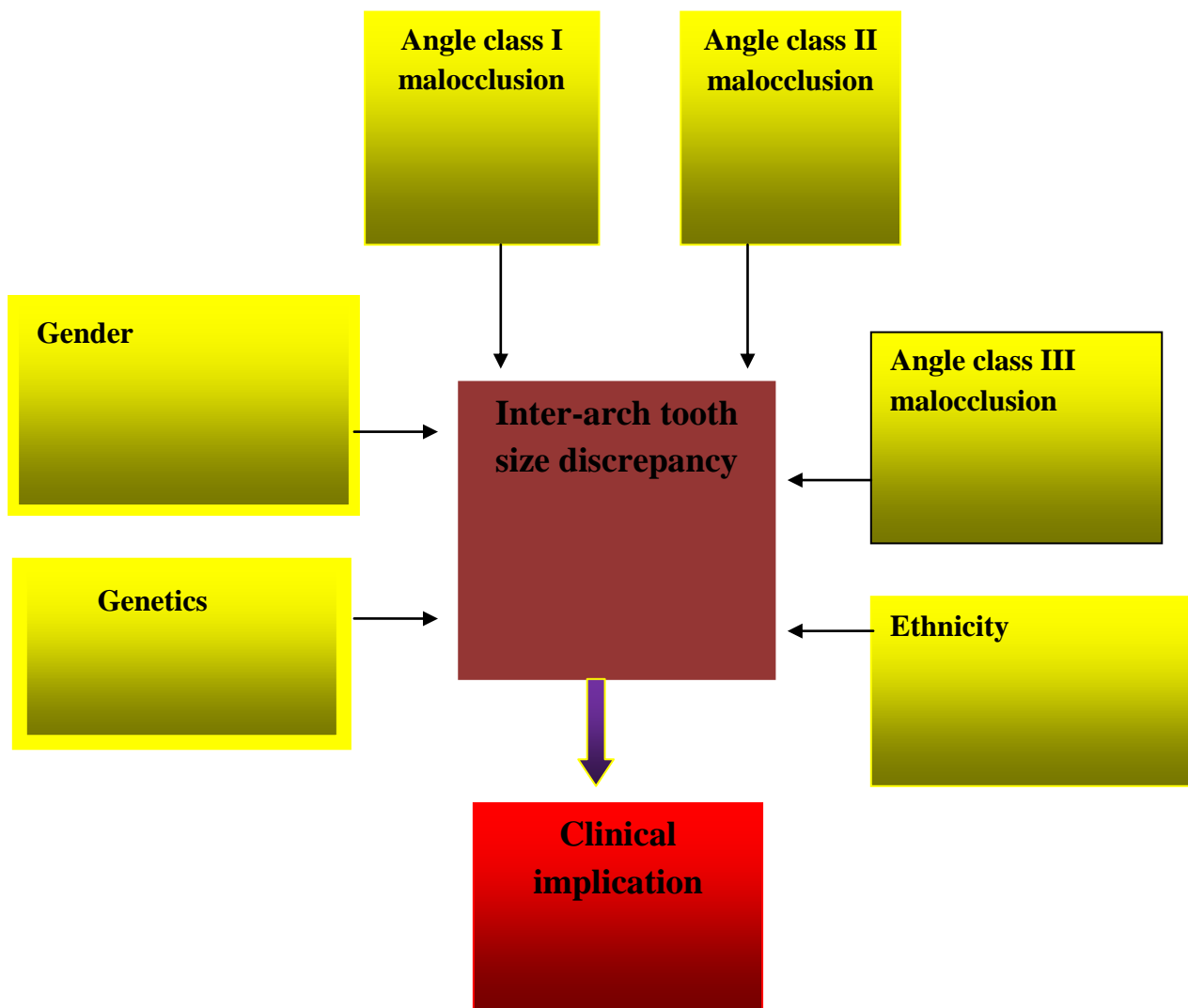
Figure 1: Conceptual frame-work

CHAPTER THREE: OBJECTIVES

3.1 General objective

To assess the Bolton's anterior and overall tooth size discrepancy of different Angle's classes of malocclusion groups in Jimma medical center dental clinic outpatients in age 20 to 25 from February to May 2022.

3.2 Specific Objectives

- To assess the possible gender related differences in tooth size ratios.
- To assess whether there is a difference in intermaxillary tooth size discrepancies among the malocclusion groups
- To assess the percentage of tooth size discrepancies outside 1.5 standard deviations from Bolton's inter arch tooth size ratio.
- To compare anterior ratio of different malocclusion groups in in Jimma medical center dental clinic outpatients with Bolton's standard.
- To compare overall ratio of different malocclusion groups in in Jimma medical center dental clinic outpatients with Bolton's standard

CHAPTER FOUR: MATERIALS AND METHODS

4.1 Study area and period

The study was conducted at Jimma University medical Center dental clinic outpatients which is one of the Public Medical Center found in south west Ethiopia. This Medical Center is a tertiary Medical Center where in Jimma Town which is 353 km far from Addis Ababa the capital city of Ethiopia. The study was conducted from February to Augest 2022.

4.2   Study Design

This is an cross sectional study, documenting prevalence of tooth size discrepancy among differentangle's classes of malocclusion groups in Jimma University medical Center dental clinic outpatients.

4.3   Population

4.3.1   Source Population

All Jimma University medical Center dental clinic outpatients aged from 20 to 25 who come for seeking any dental treatment.

4.3.2   Study Population

All Jimma University medical Center dental clinic outpatients aged from 20 to 25 who come for seeking any dental treatment that fulfill the inclusion criteria during the study period.

4.4 Inclusion and Exclusion criteria

The inclusion criteria were

1. Good-quality pretreatment models

2. Complete permanent dentition from first molar to first molar in both arches;

3. No tooth deformities;

4. No partially erupted teeth;

5. No size alterations of teeth;

6. No mesiodistalandocclusal abrasion, caries, or class ii restorations.

The exclusion criteria were

1. Gross restorations, buildups, crowns, onlays, Class II amalgams, or composite restorations that affected the tooth's mesiodistal diameter

2. Congenitally defective or deformed teeth

3. Interproximal orocclusal wear to teeth; and

4. Congenitally missing teeth or any missing permanent tooth from first molar to first molar.

5. Previous orthodontic treatment

4.5 Sample Size Determination and Sampling Procedures

4.5.1 Sample size Determination

The sample size (n) required for the study supposed to be calculated using the formula to estimate a single population proportion formula, considering the following assumptions.since the prevalence of interarch tooth size discrepance was not known in Jimmahospital;P=50% $Z\alpha/2$=critical value for normal distribution at 95% confidence level which equals 1.96 (Z value at alpha=0.05),d=margin of error 0.05 is used.Based on the formula of the sample size as n=((Za/2)^2PQ)/D^2,n=((1.96)^2 0.5(0.5)/0.05^2=385,then expected non-response rate =10% which is 39,so N=424,but since it was difficult to get that number of patients by our set up the study was conducted on 105 sample sizes by using other literature as a guide[18,19,20,21]

4.5.2 Sampling Procedures

The number of patients visiting Jimma university medical center were identified, then the representative study *participants* were identified by convenience sampling technicque and our final sample size were allocated proportionally for males and females.

4.6 Study Variables

4.6.1 Dependent

Tooth size discrepancy

4.6.2 Independent variables

- Gender
- Angle class I patient
- Angle class II patient ,
- Angle class III patient

4.7 MATERIALS

The following materials were used during the study: alginate, dental stone, bowl, mixer, spatula, metal impression tray, 5% gularaldhide, alcohol, mask, glove,vernier caliper and questioner
Study models of untreated cases with malocclusion of different classes were prepared after taking impression from the patients who came to Jimma University medical center dental OPD.

Figure 1. Study models (Frontal View)

Figure 2. Study models (Occlusal View)

PHOTOPLATE 1 Sample models

PHOTOPLATE 3 Class I malocclusion models
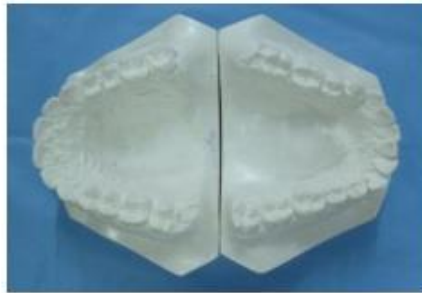
PHOTOPLATE 4 Class II malocclusion models
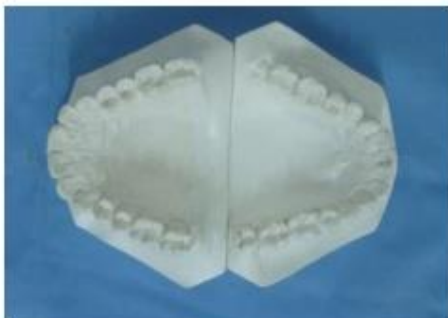
PHOTOPLATE 5 Class III malocclusion models
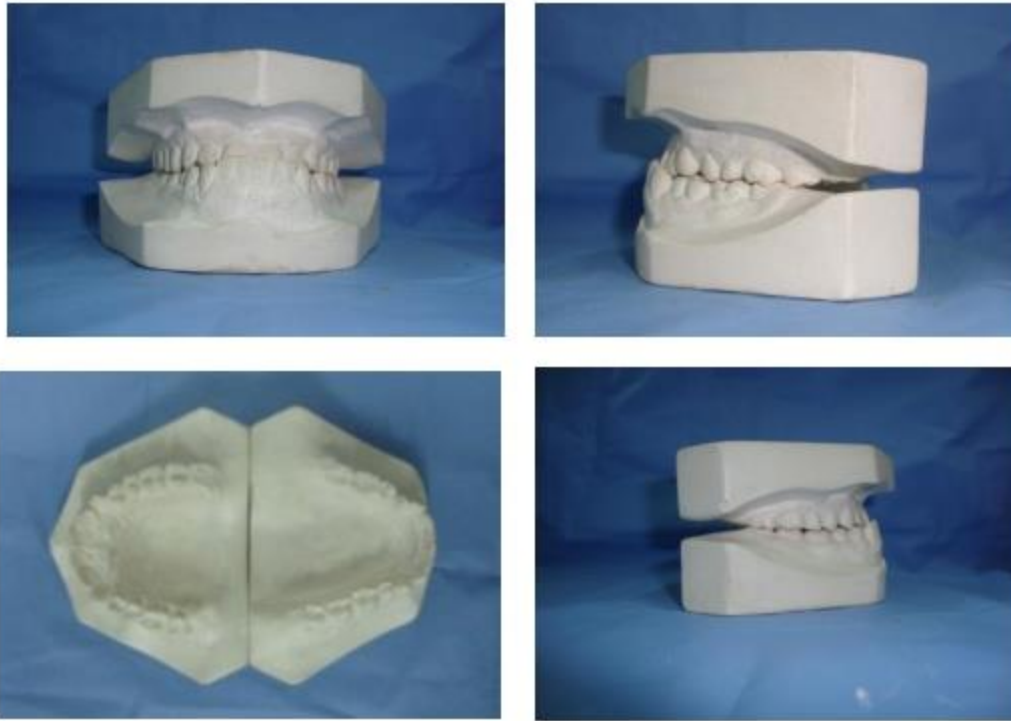
An electronic digital verniercalliper (Fowler Co. Inc., Sylvac, Switzerland) as shown in Figure 4, was used with precision to measure the mesio-distal crown widths of all permanent teeth excluding second and third permanent molars. The digital verniercalliper is preferred for use because of its precise reproducibility and significant speed as compared to a manual verniercalliper (Othman and Harradine, 2007b).
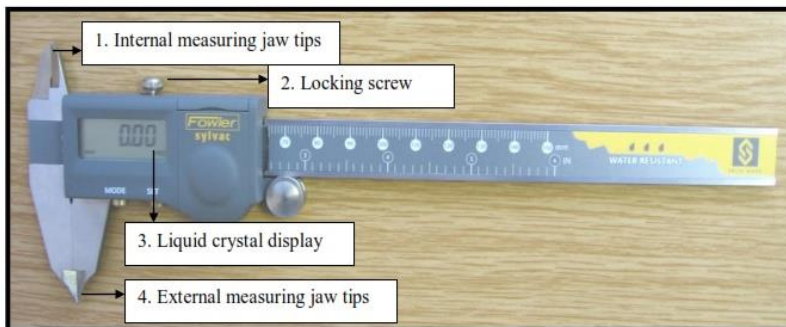
Figure 4. Digital vernier calliper

The digital verniercalliper has external and internal measuring jaw tips (Numbers 1 and 4). The external measuring jaw tips (Number 4) were used to carry out the measuring procedure. The calliper has a liquid crystal display (Number 3) where the measured values can be read. The locking screw (Number 2) once tightened after a measurement was taken, ensured that the jaw tips did not move until the measurement was recorded. The calliper was set to zero using the reset button with the jaw tips in the closed position after every reading to ensure standardization. Measurements will be recorded in millimetres to two decimal places.

4.8 METHOD

The following teeth were measured from the study models:
 The permanent incisors and canines in all quadrants
 The first premolar, the second premolar and the first permanent molar in all quadrants
The study models were placed flat on a table and orientated on its posterior aspect to facilitate measuring the mesio-distal widths of the relevant teeth as shown in Figure 5. The operator was at eye level with the study model such that the contact points of the teeth that has to be measured is visible. Sharp tips of the external jaw tips facilitate accuracy of insertion and measurements. The tips of the calliper was held at 90 to the long axis of the tooth and positioned from the labial or buccal aspects of the dental cast to engage the greatest mesio-distal width of the teeth at the contact points (Hunter and Priest, 1960).
Once the tips of the digital calliper engaged the mesial and distal contact points of the tooth, the locking screw were tightened to ensure the calliper was not shift off the point where the measurement is taken. The value was read from the liquid crystal display and recorded in the appropriate data sheet especially formulated for this study as shown in Appendices A, B, C and D. Each table represented male maxillary measurements, male mandibular measurements, female maxillary measurements and female mandibular measurements.

Figure 5. Measuring of mesio-distal width of teeth is illustrated.

Readings were taken to the nearest 0.1mm for each tooth. The measurements will be carried out by a two investigator who measured each tooth, from right first permanent molar to left first permanent molar for each arch three times. Ten study models were measured two hours a day, for ten days (Yeun, Tang and So, 1998). Once a tooth is measured, the correct model number and measurement from the liquid crystal display thenl read off and recorded by the scribe onto a data record sheet to avoid bias. Ngesa (2004) recommended that by increasing the number of times a tooth is measured reduces the chances of measurement errors. Ten pairs of pre-treatment orthodontic study models willbe measured per day over a period of 21 days in order to reduce visual fatigue. The data was then entered into an Excel programme from the data collection sheets (Version 2002, Microsoft Corporation, Redmond, USA) to enable accuracy and efficiency of data analysis. The three measurements were then averaged using the Excel programme to maintain accuracy (Bernabé, Major and Flores-Mir, 2004).

CALCULATION

Overall ratio =

Sum of mesiodistal widths of mandibular 12 teeth (first molar-first molar) x100

Sum of mesiodistal widths of maxillary 12 teeth (first molar-first molar)

Anterior ratio =

Sum of mandibular anterior 6 teeth x100

Sum of maxillary anterior 6 teeth

4.10 STATISTICAL ANALYSIS

Demographic data of the patients represented by the study models was summarized by descriptive statistics. Tooth width comparisons was done using the 2-Sample *t* test to establish gender differences. For each group the mean, standard deviation and coefficient of variation will be calculated. Tooth width ratios was thereafter calculated for each gender. Gender differences for the mean anterior as well as the overall tooth width ratios between males and females was tested by comparing 95% confidence intervals, and by hypothesis testing (2-Sample *t* tests).

The anterior and overall tooth width ratios (%) was calculated for each study model using an Excel programme. For analytical purposes the following four groups were identified:

 Group 1: Males' anterior tooth width ratio
 Group 2: Females' anterior tooth width ratio
 Group 3: Males' overall tooth width ratio
 Group 4: Females' overall tooth width ratio

The tooth width ratios for the select sample was then be compared to Bolton's original sample using the 2-Sample *t* test. The null hypotheses Ho: $\mu=77.2$ and Ho:$\mu=91.3$ was tested for the

combined datasets for the anterior and overall tooth width ratios respectively (1-Sample *t* test). All statistical procedures were performed on SPSS run under Microsoft® Windows®® Release 9.1.3, XP for a personal computer. All statistical tests were two-sided and *p* values = 0.05 was considered significant.

4.11 Data Collection Tools and Procedure

The data was collected by face to face interviews by keeping appropriate distances and all data collectors and participants worn protective material such as facemask, glove, and spatula then the data collectol changed glove and take impression after guessing the size of the jaw,then the impression was immersed in 5% glutaraldehyde solution for a period of 10 minutes after that the study model then prepared using dental stone.It were collected by well trained and experienced data collectors by once the study model is set MDW of teeth then measured by digital varnier caliper from contact point to contact point from tooth number 16 to 26 on upper and from 36 to 46 on lower arch. During impression taking all data collectors worn glove and mask and use disinfected mixer and bowel and sterile impression tray to avoid infection transmission.

4.12 Data Quality Assurances

Conceptual and operational definitions of terms were used according to the objective of the study. Training was given to data collectors. A pretest was conducted on 5% of the samples before actual data collection. Amendment of the questioner was done after the pilot test. Facilitators and supervisors were assigned to control and guide the data collection and sample collection process, and by so doing it was increased the chances of consistency in data collection.The data was cleaned and checked for completeness and consistency before data entry and double data entry into Epi-data 3.1 will be done.

4.13. Data management and Analysis

The data entered into Epi-data 3.1 was exported to SPSS. Then the data generated was analyzed using Statistical Package for Social (SPSS version 24). Categorical variables are expressed as absolute values (frequency and percentage) and continuous variables was expressed as mean value ± (standard deviation). For comparison between genders and obtained values, and those from the Bolton standard, was used the Student's t test. One-way ANOVA was used for comparisons among the 3 groups, with a significance level of 5% (p<0.05) .

4.14 Operational definition

Occlusion-is relationship of the maxillary and mandibular teeth when they are in functional contact during activity of mandible.

Normal occlusion-An occlusion having Class I molar relation and normal line of occlusion

Malocclusion-is any unacceptable deviation from normal occlusion of teeth.

Angle class I malocclusion-a malocclusion characterized by mesio-buccal cusp of the maxillary first permanent molar occludes in the buccal groove of mandibular first permanent molar

Angle class II malocclusion-a malocclusion characterized by class II molar relation where the distobuccal cusp of the upper first permanent molar occludes in the buccal groove of the lower first permanent molar.

Angle class III malocclusion- a malocclusion characterized by a class III molar relationship when the mesio -buccal cusps of the maxillary permanent first molar occluding in the interdental space between the mandibular first and second molars.

Interarch tooth size discrepancy- a disproportion in the mesiodistal dimensions of teeth of opposing dental arches

Contact point-Area of proximal height of contour of the mesial or distal surface of a tooth that touches the adjacent tooth in the same arch

4.15 Ethical Consideration

Before data collection begin ethical clearance was obtained from institutional review board (IRB) of Jimma University institute of health science, Permission was obtained from JUMC director office. Informed consent will be obtained from individual participants. All the interviews with subjects were handled confidentially after getting informed consent of the participants and assuring the confidential nature of the responses. Participants confidentiality were maintained by not recording his/her name,ID number,or telephone number on questioner just numbered as 1,2,3…. and were promised and reassured not to disclose their case verbally to anybody who is not involving in the study. The right of the participants to refuse the answers for questioner and impression procedure were respected. The data was planned to be taken within 9 days; 10 patients will be evaluated every day.For every patient the data collector will wear a mask ,one spatula which is non reusable and two gloves :one during clinical examination and second during impression taking .The data collector had 5 metal impression trays ,2 plastic bowels, 2 plastic mixers due to this 5 cases were evaluated in the morning and 5 in the afternoon. And before reusing the metal impression tray it would be sterilize by the dental department Steam autoclave at 121° C and 15 psi pressure for 20 minutes ,while before reusing the the plastic bowel and plastic mixer they will be disinfected with 5% glutaraldehyde solution for a period of 10 minutes, again once impression was taken it was immersed in 5% glutaraldehyde solution for a period of 10 minutes to control infection transmission between patients ,data collectors and patients. And after the study was completed, if there are patients with clinically significant TSD in which ever malocclusion group, I had given my recommended corrective means atleast to let know them that TSD has contributed for their malocclusion and also linked them to the orthodontic unit to get appropriate orthodontic treatment..

4.16 Plan for Dissemination and Ensuring Utilization of Findings

A final document having interpreted results, discussion and recommendations is going to be submitted to JU academic and research office and each department. The abstract then will be presented at national level conferences including in Ethiopian medical association meeting and Later on the article will be published in a reputable journal to be accessed by the public, and policy makers.

CHAPTER FIVE: RESULT

The study conducted on 105 casts of patients coming to JUMC dental clinic in the two genders and the three Angle's classes of malocclusion groups with age group range of 20 to 25 (table 1).The independent t-test showed that there is no significant difference between male and female patient in terms of anterior and over all tooth size ratio (table 2).Oneway ANOVA showed that there is a significant difference among Angle's classes of malocclusion groups in terms of anterior tooth size ratio (table 3).The Post Hoc(Tukey) test showed that Angle's class III malocclusion is the only class that contributed for for the difference in anterior tooth size ratio (table 4). Oneway ANOVA showed that there is no significant difference among Angle's classes of malocclusion groups in terms of overall tooth size ratio (table 5).The one sample t-test was used to assess the difference between the present study group and Bolton's original sample .A significant difference ,however, limited to the anterior ratio only was observed between the Angle's class III groups of the present study group and the Bolton's original samples (table 6).The frequency of clinically significant discrepancy (mean $\pm$ SD) for anterior ratio(58%) compared to the overall ratio(35.2%). The clinically significant anterior ratio discrepancy was most frequently observed in class III (68%),for overall ratio too the most prevalent group was class III (44%). For both anterior and overall ratios higher incidence of mandibular excess was observed in all Angle' class of malocclusion groups(table 7 & 8).The mean and SD of the mesiodistal width of maxillary and mandibular teeth from 1st molar to 1 st molar using SPSS was evaluated in both males and females. In the study the mesiodistal dimension of teeth for males were slightly larger than that of females but no sexual dimorphism was observed (table 9 & 10).

Table 1 : Group characteristics.

Group	Male	Female	Total	Mean age(years)
Angle class I malocclusion group	15	37	52	22.42 $\pm$1.95
Angle class II malocclusion group	12	16	28	21.68 $\pm$1.63
Angle class III malocclusion group	10	15	25	21.88 $\pm$1.98
Total	37(35.2%)	68(64.8%)	105(100%)	22.10$\pm$1.89

Table 2 : Independent T-test for comparison of tooth size ratio between male and female

Tooth size ratio	Sex	N	Mean	Std. Deviation	p-value
Anterior ratio	Male	37	78.26	2.79	.112
	Female	68	78.49	3.87	
Overall ratio	Male	37	78.49	1.77	.053

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Female	68	91.73	2.37	

Table 3 : Oneway ANOVA for comparison of anterior tooth size ratio between Angle's class I,class II and class III malocclusion groups.

Angle's class	N	Mean	Std. Deviation	P-value
Class I	52	77.48	.35	
Class II	28	78.44	.59	0.003
Class III	25	80.33	.95	
Total	105	78.41	.34	

Table 4: Post Hoc(Tukey) test to identify which class has contribution to the significant difference in anterior ratio

Tooth size ratio	Angle class	P-value
	Class I	.441
Anterior ratio	Class II	.441
	Class III	.002

Table 5 : Oneway ANOVA for comparison of overall tooth size ratio between Angle's class I, class II and class III malocclusion groups.

Angle's class	N	Mean	Std. Deviation	P-value
Class I	52	91.91	1.92	
Class II	28	91.16	2.55	0.074
Class III	25	92.52	2.09	
Total	105	91.86	2.18	

Table 6: Comparison of Bolton's sample with the present study group

	Study group	Mean+SD	Bolton original	P-value
Anterior ratio	Class I	77.48+.35	77.2+1.65	.441
	Class II	78.44+.59	77.2+1.65	.441
	Class III	80.33+.95	77.2+1.65	.002
	Combined	78.41+.34	77.2+1.65	.003
Overall ratio	Class I	91.91+1.92	91.3+1.91	.300
	Class II	91.16+2.55	91.3+1.91	.300
	Class III	92.52+2.09	91.3+1.91	.478
	Combined	91.86+2.18	91.3+1.91	.074

Table 7: Frequency of distribution of subjects with anterior ratio beyond mean$\pm$ SD of Bolton's norm(77.2$\pm$1.65).

Angle class	N	Subjects with discrepancy beyond 2 SD		Maxillary excess	Mandibular excess
		Number	%		
Class I	52	27	51.9	12	15
Class II	28	17	60.7	5	12
Class III	25	17	68	4	13
Total	105	61	58	21	40

Table 8: Frequency of distribution of subjects with overall ratio beyond mean$\pm$ SD of Bolton's norm(91.3$\pm$1.91).

Angle class	N	Subjects with discrepancy beyond 2 SD		Maxillary excess	Mandibular excess
		Number	%		
Class I	52	17	32.7	5	12
Class II	28	9	32.1	4	5
Class III	25	11	44	1	10
Total	105	37	35.2	10	27

Table 9:Mean and standard deviation for the mesiodistal dimention of teeth from 1st molar to 1st molar on upper arch for males and females (mm)

Maxilla	sex	N	Mean	SD	p-value
UAR6	male	37	10.43	.76	.2177
	female	68	10.09	.60	
UAR5	male	37	6.69	.48	
	female	68	6.66	.43	
UAR4	male	37	7.22	.53	
	female	68	7.14	.50	
UAR3	male	37	7.86	.49	
	female	68	7.57	.47	
UAR2	male	37	6.95	.48	
	female	68	6.67	.66	
UAR1	male	37	8.92	.53	
	female	68	8.63	.53	
UAL1	male	37	8.87	.57	
	female	68	8.59	.59	
UAL2	male	37	6.87	.58	
	female	68	6.65	.72	
UAL3	male	37	7.86	.44	
	female	68	7.49	.45	
UAL4	male	37	7.20	.53	
	female	68	7.10	.50	
UAL5	male	37	6.76	.49	
	female	68	6.65	.47	
UAL6	male	37	10.43	.65	
	female	68	10.08	.58	

Table 10:Mean and standard deviation for the mesiodistal dimention of teeth from 1st molar to 1st molar on lower arch for males and females (mm)

mandible	sex	N	Mean	SD	p-value
LAR6	male	37	11.27	.68	
	female	68	10.96	.62	
LAR5	male	37	7.11	.48	
	female	68	6.98	.47	
LAR4	male	37	7.24	.54	
	female	68	7.06	.49	
LAR3	male	37	6.95	.44	
	female	68	6.55	.46	
LAR2	male	37	5.96	.37	'
	female	68	5.81	.34	4
LAR1	male	37	5.53	.34	0
	female	68	5.43	.35	0
LAL1	male	37	5.55	.34	
	female	68	5.40	.33	
LAL2	male	37	6.04	.40	
	female	68	5.85	.36	
LAL3	male	37	6.95	.44	
	female	68	6.60	.40	
LAL4	male	37	7.24	.56	
	female	68	7.04	.48	
LAL5	male	37	7.18	.60	
	female	68	6.99	.46	
LAL6	male	37	11.27	.68	
	female	68	10.94	.63	

CHAPTER SIX: DISCUSSION

The aims of the study were to assess Bolton's anterior and overall tooth size ratios in JUMC dental male and female outpatients with Angle's class I, II, III malocclusions. The present study has less number of males(35.2%) than females(64.8%) this because the number of male patients who came to the JUMC dental clinic for seeking orthodontic treatment were less as the three batch frequency of male and female distribution showed(M:F ratio in 2008th batch was1:4,in 2010th and 2011th batch was 1:2.5).The class III samples were least in number, the class II less while the class I most prevalent among patients who came to the dental clinic in seeking orthodontic treatment as the three batch sum patient showed the ratio of Class I:class II:class III was 5:3:1(counted from all residents cases).

In the present study, no significant differences were found between males and females regarding the sum of teeth dimensions and Bolton's anterior and overall ratios. There is conflicting evidence regarding the extent of sexual dimorphism with respect to the tooth size ratio. The findings are similar to that reported by Rajeev Kumar Mishra .et al.in Nepalese population[19] Akyalçin et al.In Turkish population [21], Machado et al. In Portuguese population[17], and Ismail et al. In Sudanese population [20]. However, in the Nepalese subjects, Jaiswal et al. have reported significant difference between male and female subjects for anterior ratio only[22]. Smith et al. Who studied the Bolton interarch ratio for 3 population groups, namely, Blacks, Hispanics, and Whites, concluded that interarch tooth size relationships are population and gender specific [12]. They have reported significant difference between the genders for the overall ratio but not for the anterior ratio.

In this study, a significant differences,the difference contributed by class III malocclusion only, were observed with regard to anterior ratio and no significant difference were observed in overall ratios when compared as a function of Angle's malocclusion. The findings agree with. Araujo and Sauoki who reported that the anterior tooth size ratio for Angle's Class III subjects was significantly greater than that of Class I and Class II subjects [23]. Nie and Lin have reported significant difference between malocclusion groups with respect to both anterior and overall ratios [24]. These ratio values were highest for Class III and lowest for Class II groups. Similar findings have been reported by Prasanna et al. in Indian population [27]. However it contrasts the previous studies reported from different population groups which showed that there were no significant difference among Angle's classes interms of both anterior and overall ratios[21,25,26]. The main reason that can be traced from those studies which disagrees with the present study was that Class III subjects were not included in their studies that are why the significant difference not observed in there finding otherwise they agree in other classes as well as in overall ratios.

Statistically significant differences were observed between the Class III groups of the study when separately compared with Bolton's original sample for the anterior ratio and also when all the three groups were combined together for comparison. However, no significant differences were observed for the overall ratio. This is similar to the findings reported by Hashim et al. [26] who have found significant difference between Qatari population (malocclusion characteristics unspecified) and Bolton's original sample with respect to anterior ratio only. Shastri et al. who studied tooth size discrepancy in North Indian population have reported that the mean anterior ratio for Angle's Class III subjects was significantly greater compared to Bolton's mean anterior ratio [28]. However, contrasting findings have been reported by Ricci et al. [29] who have reported significant difference with respect to the anterior ratio for Class I malocclusion groups and with respect to the overall ratio for the normal occlusion groups.

In this study, the frequency of clinically significant tooth size discrepancy (beyond ±2 SD of Bolton's mean) was higher the anterior ratio(58%) when compared with the overall ratio(35.2%). Our findings are in concordance with that reported by the previous studies[30,31,32]. But higher than. Endo et al. have reported that, in Japanese population, the clinically significant anterior tooth size discrepancy was present in 14.4% of subjects, while the prevalence of clinically significant overall ratio was seen in 6.66% [31]. Othman and Harradine have reported prevalence 17.4% and 5.4% for clinically significant anterior and overall ratios [33]. Cancado et al. in Brazilian population have reported the prevalence of anterior ratio discrepancy in 23.4% subjects and overall ratio discrepancy in 6.5% subjects [32]. The reason for variation in results for these studies is variation in the composition, selection and number of examiners doing the measurements. Freeman et al1 had 24 different examiners and this can introduce errors in measurement as inter-examiner errors were not reported by them. Although Othman et al did perform intra and inter-examiner systematic and random errors but their sample size was very small having only 40 dental students from University of Malaya[30]. The greater prevalence of clinically significant anterior tooth size discrepancy compared to overall ratio discrepancy may be due to greater variations in the size of the anterior teeth.

The prevalence of anterior tooth size discrepancies in this sample was very high and serves as an indicator of how important it is to perform a thorough diagnosis before orthodontic treatment. In this study, 58% of the samples had anterior tooth size discrepancies greater than ±2 SD using the Bolton analysis parameter with class III having highest prevalence (68%), and class I least prevalence of anterior TSD.Having similarity with Eustaquio et al. (56%)[34]Richardson and Malhotra (33.7%)[29].On the other hand 35.2% have overall tooth size discrepancy greater than $\pm$ 2SD from mean with class III the highest prevalence and class II least prevalence of overall TSD which is similar with Eustaquio et al. [34] . Lavelle speculated that Class III individuals had disproportionally smaller maxillary teeth than Class I and Class II subjects did when maxillary and mandibular dentition sizes were compared, but this was not found in the present study. A part of the results of the present study is consistent with the

results of Crosby and Alexander, who also found no statistically significant differences when comparing Class I and Class II subjects. However, it is important to remember that Lavelle did not study the Bolton proportions and that Crosby and Alexander did not evaluate Class III patients in their study[4,6,8].

Nie and Lin after analyzing 360 Chinese individuals for tooth size discrepancies using Angle classification as a variable are in agreement with the results of this investigation.[35] Data from both these studies found that Class III patients demonstrate greater tooth size discrepancy when compared with patients of Classes II and I. These findings also corroborate the initial investigations by Sperry et al.It has been suggested that mesiodistal lateral incisor tooth size is smaller in Class III subjects and serves as an explanation of anterior Bolton tooth size discrepancy. In this study, however, individual tooth sizes were compared, and no differences were discovered in lateral incisor size among the three study groups. Therefore, the Bolton discrepancy in the Class III sample must be attributed to the accumulation of minor discrepancies of individual teeth plus may be explained by the strong genetic mix of theEthiopian population .

LIMITATIONS OF THE STUDY

- Difficulty of getting adequate number of the Angle's class of malocclusion group for the two genders which fulfill the inclusion criteria.
- Difficulty of measuring casts with tooth having severe rotation due to lack of measuring device with thin and sharp tip.
- The available time has significantly limited the study work.

CONCLUSION

(1) There was no significant difference between male and female subjects for anterior and overall tooth size ratios.

(2) There was no significant difference between Angle class I, ClassII, and Class III malocclusion groups with respect to overall tooth size ratios; but there was a significant difference with respect to anterior ratio only in class III groups.

(3) Statistically significant differences were observed only for anterior tooth size ratio when the study groups were compared with Bolton's original ratio even only with class III groups.

(4) The prevalence of clinically significant anterior tooth size discrepancy was higher than that of the overall ratio.

(5) Anterior tooth size discrepancy is most prevalent in the class III group while least prevalent in class I.

(6) Overall tooth size discrepancy is most prevalent in class III group while least prevalent in class II.

(7) In both anterior and overall tooth size discrepancy the incidence of mandibular excess is greater than maxillary excess.

Thus it is probably necessary to do precise TSD analysis based on our own data to make an accurate diagnosis and treatment plan in orthodontics for orthodontic patients. Although such an analysis may appear to be time consuming, the benefits would seem to outweigh this minor inconvenience by allowing more efficient diagnosis of problems, more specific treatment planning, and good success rate in achieving optimal occlusions.

RECOMMENDATION

The study has showed higher incidence of both anterior and overall tooth discrepancy even if it needs further study; all professionals who evaluates an orthodontic patient should not overlook significant TSD in their diagnosis and plan appropriately for it to minimize problems of achieving an ideal occlusion during finishing.

Further studies based on larger sample size, are required to confirm the applicability of the results of the present study on Ethiopian population.

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DATA COLLECTION

Topic*: Tooth size discrepancy of Angle's different classes of malocclusion in Jimma medical center dental outpatients in 20 to 25 age groups.*

Data collector: *Dr.Getachew Kifle*

Advisor: *Dr.Chala Hailu*

Part I: Questions related to the socio demographic characteristics of the patient

No	Questions	Responses
1.	Age	_____
2.	Sex	**1.** Male 2.female

Angle class I malocclusion☐ **Angle class II malocclusion**☐ **Angle class III malocclusion**☐

Measurement on cast

Upper arch	Tooth no	6	5	4	3	2	1	1	2	3	4	5	6
	Mesiodistal width(mm)												
Lower arch	Tooth no	6	5	4	3	2	1	1	2	3	4	5	6
	Mesiodistal width(mm)												

ASSURANCE OF PRINCIPAL INVESTIGATOR

The undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the thesis and for provision of the required progress reports as per terms and conditions of Faculty of Public Health in effect at the time of grand is forwarded as the result of this application.

Name of the student:Dr.Getachew Kifle

Date --------------------------   signature---------------------------

Name of advisor: Dr.Chala Hailu

Date--------------------------   signature-----------------------