

“BOLTON’S ANALYSIS OF FILIPINOS WITH DIFFERENT MALOCCLUSION GROUPS”

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ABSTRACT:

Background: The orthodontic “finishing” phase is recognized for the multitude of details necessary to achieve an excellent result. In some cases, the finishing phase is very difficult, requiring the production of complicated biomechanical forces to reach a satisfactory orthodontic solution. A high percentage of these finishing-phase difficulties arise because of tooth size imbalances that could have been detected and considered during initial diagnosis and treatment planning. Many difficulties encountered during the finishing phase of orthodontic treatment arise due to lack of intermaxillary tooth-size matching. Bolton ratio is one of the most useful calculations for precise orthodontic diagnosis as it shows if there is a correct ratio between dental proportions.

Objectives: The purpose of this study was to determine whether there was a prevalent tendency for intermaxillary tooth size discrepancies among different malocclusion groups Of Filipinos.

Methods: The sample consisted of 90 (45 Male and 45 Female) study models with Class I, Class II and Class III malocclusions. Tooth size measurements were performed by electronic digital calipers to an accuracy of 0.01 mm. Tooth size ratios were analyzed as described by Bolton. The incidence of mesio-distal tooth size discrepancies in the malocclusion groups was analyzed and compared between males and females in different malocclusions groups of Filipinos.

Results: The results showed no significant difference in the anterior and overall ratios of normal occlusion sample when compared to Bolton’s standards. No significant differences were found in gender for the tooth size discrepancies. ANOVA indicated that, no significant difference was determined in the anterior and overall ratio in different malocclusion groups.

Conclusion: it’s suggested that Bolton’s values can be used for Filipinos until a large representative sample is studied.

Keywords: Bolton Analysis, Digital Calliper , Filipinos ,Malocclusion, Study Models.

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

INTRODUCTION

In any given orthodontic case with significant malocclusion, it would be a challenge for the practitioner to predict whether the maxillary and the mandibular dental arches will fit properly in an excellent occlusion, after orthodontic treatment. A tooth-size discrepancy conventionally has been described as a relative excess of tooth structure in one arch in relation to the other arch. Orthodontic treatment comprises different phases, and each segment presents unique characteristics and challenges. The orthodontic “finishing” phase is recognized for the multitude of details necessary to achieve an excellent result. In some cases, the finishing phase is very difficult, requiring the production of complicated biomechanical forces to reach a satisfactory orthodontic solution. A high percentage of these finishing-phase difficulties arise because of tooth size imbalances that could have been detected and considered during initial diagnosis and treatment planning.

An excellent orthodontic treatment result with optimal occlusion and ideal intercuspation, overjet, and overbite is often jeopardized by tooth size discrepancies or problematical tooth anatomy.

The maxillary to mandibular tooth size relationship is important to achieve ideal overjet, overbite, and occlusal interdigitation following orthodontic treatment and is often referred to as the “seventh key” to an ideal occlusion(Mosby, 2001).

A tooth size discrepancy can affect the final outcome and stability of orthodontic treatment (W. A. Bolton,1958 and 1962). Previous studies have shown a correlation between the mesiodistal tooth widths of maxillary and mandibular teeth in Caucasians (American Journal of Orthodontics ,1946 and 1949). Ratios for the estimation of tooth size discrepancy have been reported as the “Bolton’s standards” (W. A. Bolton ,1958). The anterior ratio ,is obtained by measuring the sum of mesiodistal widths of the mandibular to maxillary anterior teeth and the overall ratio is the summation of mesiodistal widths of all mandibular to maxillary teeth from first molar to first molar.

Bolton’s ratio is the most commonly used index of tooth width proportion. It is calculated as the mean ratio of the six upper and lower teeth from the permanent central incisor to the first permanent molar. The posterior ratio and overall ratio are also used. Although each of these ratios has been studied extensively for a range of different racial and malocclusion groups (Araujo E, Souki M. 2003).

In orthodontics, dental casts are still considered as a fundamental diagnostic tool (Moyer’s,1983). From the dental cast, one can analyze tooth size, shape, alignment, rotations of the teeth, presence or absence of teeth, arch form and symmetry, and occlusal relationship.

Statement of the Problem

This study was to determine whether there was a prevalent tendency for intermaxillary tooth size discrepancies among different malocclusion groups of Filipinos.

This study sought to answer the following questions:

1. What is the Bolton's analysis in class I malocclusion?
 - A) Male: Anterior and Overall ratio.
 - B) Female: Anterior and Overall ratio
2. What is the Bolton's analysis in class II malocclusion?
 - A) Male: Anterior and Overall ratio.
 - B) Female: Anterior and Overall ratio.
3. What was the Bolton's analysis in class III malocclusion?
 - A) Male: Anterior and Overall ratio.
 - B) Female: Anterior and Overall ratio.
4. What is the mean Values of Bolton's analysis for both male and Female in Class I,II and III?
5. Is there a significance different in Bolton's analysis for male and female in Class I Malocclusion?
 - A) Anterior ratio.
 - B) Overall ratio.
6. Is there a significance different in Bolton's analysis for male and female in Class II Malocclusion?
 - A) Anterior ratio.
 - B) Overall ratio.
7. Is there a significance different in Bolton's analysis for male and female in Class III Malocclusion?
 - A) Anterior ratio.
 - B) Overall ratio.
8. Is there a significant difference in Bolton's analysis for both male and female in Class I,II and III ?
 - A) Anterior Ratio.
 - B) Overall ratio.

Significance of the Study

The purpose of this retrospective study was to investigate the intermaxillary tooth size discrepancies among different malocclusion groups of Filipinos.

The following are expected to benefit from the results of this study:

To the Orthodontic and Dental Practitioners:

The result of this study will help the orthodontist and dental practitioners in understanding the problem of forth size discrepancy in malocclusion and come up with a better treatment plan for the patients.

To the Patients:

This study will provide the orthodontic patient with a correct treatment plan and better result in terms of dental interdigitation and occlusion.

To the Researchers:

This study will update the researcher in the prevalence of Bolton tooth size discrepancy among Filipinos in different type of malocclusion.

To the Public:

This study will contribute to the general information on what to expect in terms of Bolton analysis in Filipinos patients. The public may understand and anticipate the problem that may arise in the future and the importance of orthodontic treatment.

Conceptual Framework
Independent variable

Intervening Variable

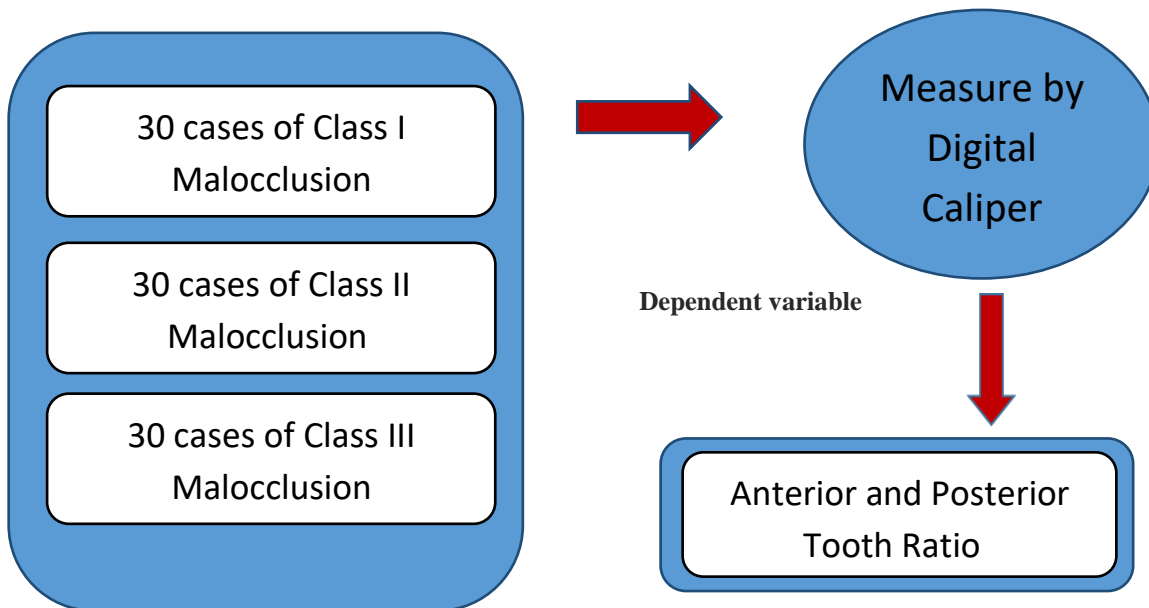


Fig.1:Paradiagram of the Study.

Hypothesis

Ho1: There is no significant difference of intermaxillary tooth size among three different types of malocclusion.

Scope and Limitations of the Study

This study was conducted on three different types of malocclusion based on the following:

Inclusion Criteria

- Filipinos 75% up to third generation.
- Dental casts without bubbles and deformity.
- Gender (Male & Female).
- Group A: Class I Malocclusion.
- Group B: Class II Malocclusion.
- Group C: Class III Malocclusion.
- Patients who did not undergo previous orthodontic treatment.
- Age 15-40 years old.

Exclusion Criteria

- Filipinos less than 75% up to third generation.
- Dental casts with bubbles and deformity.
- Patient who underwent previous orthodontic treatment.
- Age less than 15 and more than 40 years old.
- Dental cast with prosthodontics restoration.
- Patients with missing one or more teeth in Maxillary and Mandibular arch.
- Anomalies in tooth number, size or shape.
- Patient with attrition in proximal surface and Class II restoration.

Definition of Terms

The following terms were defined contextually and operationally in this study:

Anterior ratio: the sum of mesiodistal diameter of the 6 mandibular anterior teeth should be 77.2 percent of the mesiodistal widths of 6 maxillary anterior teeth. If the anterior ratio is greater than 77.2 percent, then the mandibular anterior tooth material is excessive. If the anterior ratio is less than 77.2 percent, then the maxillary anterior tooth material is excessive (Gurkeerat Singh,2008).

Bolton Tooth Ratio Analysis: bolton studied the interarch effects of discrepancies in tooth size to devise a procedure for determining the ratio of total mandibular versus maxillary tooth size and anterior mandibular versus maxillary tooth size. Study of these ratios help in estimating the overbite and overjet relationships that will likely obtain after treatment is finished (Angle Orthodontist 2005).

Class I: the mesiobuccal cusp of the upper first molar occludes with the buccal groove of the lower first molar (Mosby's,2015).

Class II: The mesiobuccal cusp of the upper first molar occludes anterior to the buccal groove of the lower first molar (Mosby's,2015).

Class III: the mesiobuccal cusp of the upper first molar occludes more posterior than the buccal groove of the lower first molar (Mosby's,2015).

Digital Calliper: an electronic digital display on which the reading is displayed as a single value. Some digital caliper can be switched between centimetre or millimetres , and inches. All provide for zeroing the display at any point along the side. Allowing the same sort of different measurements as the dial caliper. Ordinary 6-in/150-mm digital calipers are made of stainless steel or plastic, have rated accuracy of 0.001 in(0.02) and resolution of 0.0005 in (0.01 mm). The same technology is used to make longer 8-in and 12-in caliper; the accuracy for bigger measurements declines to 0.001 in (0.03) for 100-200 mm and 0.0015 in (0.04) for 200-300 mm.(Oxford Dictionaries,2019).

Filipinos: are people who stay in Philippines with Filipinos nationality and both parents are Filipinos were used in this study.

Malocclusion: can be defined as an appreciable deviation from the ideal that may be considered aesthetically or functionally unsatisfactory. Malocclusion has been described in numerous ways, ranging from specific classifications to indices of treatment need and outcome. Unlike a disease process, when the presence of specific features classifies the disease, a wide range of occlusal traits can constitute a malocclusion (Mosby's,2009).

Overall ratio: the sum of the mesiodistal widths of 12 mandibular teeth should be 91.3 percent of the sum of mesiodistal widths of 12 maxillary teeth, according to Bolton. The sum of the 12 maxillary and 12 mandibular teeth for a given patient is inserted into the formula and the overall ratio is determined. If the overall ratio is greater than 91.3 percent, then the mandibular tooth material is excessive. If the overall ratio is less than 91.3 percent, then the maxillary tooth material is excessive. (Gurkeerat Singh,2008)

Study Models: are essential diagnostic records, which help to study the occlusion and dentition from all three dimensions. (Gurkeerat Singh,2008).

CHAPTER II REVIEW OF RELATED LITERATURE AND STUDIES

This chapter includes discussion on related literature and studies to the comparison of Bolton's Analysis among Different Malocclusion Groups In different countries.

Tooth Size Discrepancies among Different Malocclusion Groups

Jalan Abdul Aziz (2013), reported about Anterior tooth size discrepancies among different malocclusion. Discrepancies between tooth sizes can cause orthodontic problems such as crowding and improper occlusion. By identifying these problems, better orthodontic treatment outcome can be achieved. The aim of this study was to identify anterior tooth size discrepancies among 3 different types of malocclusion Class I, Class, II and Class III. A retrospective study was carried out using 200 orthodontic study models where 50 study models were taken for each of the malocclusion groups. All anterior teeth were measured by the same examiner at the largest mesio-distal dimension, using a digital caliper recorded up to 0.01 mm. Comparison between the 3 groups of malocclusion were made intra-arch using individual tooth size

measurement and inter-arch using Anterior Bolton Index. For the intra-arch assessment, Class II division 1 had significantly the largest upper and lower anterior tooth size except for its upper canine and lower central incisor. Class III group had insignificantly the smallest mandibular anterior teeth compared to other malocclusion groups. For inter-arch assessment, Anterior Bolton Index of all samples was $79.2 \pm 3.94\%$. The highest Anterior Bolton Index was noted in Class II division 2. However, no significant differences were found among the 3 malocclusion groups.

Hashim, AL-Sayed and AL-Hussain (2018) reported about Bolton tooth size ratio among Qatari population sample. The current study consisted of 100 orthodontic study participants (50 males and 50 females) with different malocclusions and age ranging between 15 and 20 years. An electronic digital caliper was used to measure the mesiodistal tooth width of

all maxillary and mandibular permanent teeth except second and third molars. The results of their study. There were no significant differences between the present study and Bolton's study for overall ratio where as a significant difference was observed in anterior ratio.

Guvenc, Basarana, Seleka, Hamamcib and Akkus (2006) reported about Intermaxillary bolton tooth size discrepancies among different malocclusion groups in Turkey. This study involved 60 subjects who served as the normal occlusion group and 300 patients divided into five malocclusion groups (ie, Class I, Class II, Class II division 1, Class II division 2, and Class III). Tooth size measurements were performed on the models of the normal occlusion group and the pre-treatment models of the patients. The tooth size ratio and the one-way analysis of variance test showed no sexual dimorphism for these ratios in each of five groups, so the sexes were combined for each group. Then, these ratios were compared among different malocclusion groups. The results showed no significant difference between subcategories of malocclusion, so these groups were combined as Class I, Class II, and Class III. No significant difference was found for all the ratios between the groups.

Uysala and Sari (2005), reported about Intermaxillary tooth size discrepancy and mesiodistal crown dimensions for a Turkish population. The data were derived from dental casts of 150 Turkish subjects (72 men, mean age 22 years and 78 women, mean age, 21 years) with normal occlusions. The mean,

standard deviation, and minimum and maximum values were calculated for individual tooth size, and overall and anterior ratios, separately for men and women. The mesiodistal dimensions of the maxillary teeth showed greater variability than the mandibular teeth with the first molar dimensions having the greatest variability. A statistically significant sex difference was found only in overall ratio .

Al-Gunaid, Yamaki and Saito (2012), studied about Mesiodistal tooth width and tooth size discrepancies of Yemeni. This study involved 176 subjects aged 13–25 years (94 females and 82 males) with different types of malocclusions (94 Angle Class I, 37 Class II division 1, 36 Class II division 2, and 9 Class III) were included in the present study. The mean mesiodistal tooth size width and Bolton's ratios were determined. Further, the results revealed that there were no significant differences in the tooth size width between right and left sides. The findings of the present study indicate that there was no significant difference between Bolton's ratio and that of Yemeni population.

Araujo and Souki (2003), studied about Bolton anterior tooth size discrepancies among different malocclusion groups in Brazilian population. The assessed mesiodistal width of six anterior teeth in 300 patients selected randomly. These patients were allocated to three groups according to their malocclusion the largest mesiodistal dimension using a digital caliper accurate to 0.01mm. Individuals with Angle Class I and Class III show significantly greater prevalence of tooth size discrepancies than do individuals with Class II. The anterior tooth size discrepancy for Angle Class III subjects was significantly greater than for Class I and Class II subjects.

Mahonya,Declan,Mark, Grant and Cronin (2011), reported about Tooth size discrepancies in Irish orthodontic patients among different malocclusion groups. From 850 pre-treatment sets of orthodontic models at a university clinic, 240 were selected with 30 female and 30 male sets for each malocclusion (Class I, Class II division1, Class II division 2, and Class III). Digital models were produced, and the mesial and distal contact points were digitized to calculate overall and anterior tooth size ratios. No differences existed in the prevalence of overall between the male and female groups or among the malocclusion groups . For the mean anterior tooth size ratios in the male group, the values for Class III and Class II division 2 were higher than in Class II division 1, and the value for

Class II division 2 was higher than in Class I . There were no statistically significant differences in the prevalence of mean overall with regard to malocclusion or gender. In the male group, the mean anterior tooth size ratio was higher in Class III and in Class II division 2 malocclusion than in Class II division 1 and higher in Class II division 2 malocclusion than in Class I malocclusion.

Nie and Lin (2012), studied about Comparison of intermaxillary tooth size discrepancies among different malocclusion groups. This study consisted of 60 subjects who served as the normal occlusion group and 300 patients divided into 5 malocclusion groups (Class I with bimaxillary protrusion, Class II Division 1, Class II Division 2, Class III, and Class III surgery). The three dimension measuring machine performed tooth size measurements on the models of normal occlusion

and pre-treatment model of patients. Then these ratios were compared among different malocclusion groups. The results showed no significant difference between subcategories of malocclusion.

Aida and Othman (2012) studied about Comparison of tooth size discrepancy of three main ethnics in Malaysia with bolton's ratio. Ninety convenient samples consisting of 30 pre-orthodontic study casts from each ethnic that fits the inclusion criteria were selected. The greatest mesiodistal widths of each tooth from six to six for overall ratio and three to three for anterior ratio were measured using a digital callipers linked to Hamilton Arch Tooth System software to the nearest 0.01mm, in which its mean ratios were calculated using Bolton analysis. However, there were no significant differences when comparing Bolton values with Chinese and Indian anterior and overall ratios.

Lopatiene and Dumbravaite (2009) studied about Relationship between tooth size discrepancies and malocclusion in Lithuania. The study sample consisted of 181 pre-treatment dental casts with fully erupted and complete permanent dentitions from first molar to first molar, which selected randomly. The lowest mean value of the Bolton anterior ratio was in Angle Class II, and the highest – in Angle Class III, but this difference was not statistically significant. The lowest mean value of the Bolton overall ratio was in Angle Class II, and the highest – in Angle Class III, but this difference was not statistically significant. Moderate correlation was detected between the Bolton overall ratio and overjet .

Leung, Khambay, Wong, McGrath, and Min Gu (2018), studied about Tooth size discrepancy between male and female subjects presenting with a Class I malocclusion . The digital e-models of 100 male and 100 female 12-year old southern Chinese children with a Class I malocclusion were selected. The mesiodistal widths from permanent first molar to the contralateral side first molar of the upper and lower dentitions were measured. The conclusion of their study shows that females had statistically significant smaller teeth than males in southern Chinese except the upper left and lower left lateral incisor and lower left and right central incisors. There were no significant gender differences in both ratios. This study showed evidence that low level of clinical significant differences of the contralateral tooth size of maxillary canines, lateral incisors, and central incisors of southern Chinese male existed. On the other hand, low levels of clinical significant differences of contralateral tooth size of mandibular canines and lateral incisors were found in female.

Lavelle (1972) studied 160 subjects to determine anterior tooth sizes. The result showed that Bolton's discrepancy was greater in Class III subjects than other malocclusion groups.

Crosby and Alexander (1989) studied The prevalence of tooth size discrepancy among different malocclusion groups class I and class II of 20 and 30 subjects respectively . For the anterior ratio, 16.7% of Class I patients had

significant discrepancy, and 23.4% in Class II group and stated that the difference is highlighted because it might be considered potentially significant, but in fact there were no statistically significant differences in the prevalence of tooth size discrepancy among the malocclusion groups.

CHAPTER III

Research Design and Methodology

This chapter presents the research design, research locale, and procedures used during the duration of the study. This includes the discussion of the research design, describes the sources of data, instrumentation, procedures for gathering data and statistical treatment.

Research Design:

The research method adopts a descriptive design, which attempt to determine the significance of the relationship of Bolton's Analysis Of Filipinos With Different Malocclusion Groups.

Sources Of The Data And Sample:

Ninety (90) Dental Casts Malocclusion which were divided to:

Group A: 30 Dental Casts of Class I Malocclusion (15 males and 15 females).

Group B: 30 Dental Casts of Class II Malocclusion (15 males and 15 females).

Group C: 30 Dental Casts of Class III Malocclusion (15 males and 15 females).

Data Gathering Procedure:

The data for this study was collected from Manila Central University (MCU) Orthodontic Department and Orthodontic Clinics in Metro Manila area.

Methodology:

Ninety (90) Dental Casts were collected based on the following groups:

- Group A: 30 Dental Casts of Class I Malocclusion (15 males and 15 females).
- Group B: 30 Dental Casts of Class II Malocclusion (15 males and 15 females).
- Group C: 30 Dental Casts of Class III Malocclusion (15 males and 15 females).

The dental casts were collected from the Orthodontic Clinic of (MCU) and different Orthodontic Clinics in Metro Manila, following the inclusion and exclusion criteria. Measurements done by using digital caliper.

The following procedures were done using the digital caliper. First to check the caliper metric reading set in millimeter. Second the reading should be Zero when the caliper jaw is closed. Finally, measure the mesio-distal width of 12 teeth both Maxillary and Mandibular jaw then fill in the Bolton sheet. The Bolton Analysis for both overall and anterior ratio will follow these procedures:

1- The overall ratio of the sum of mesiodistal widths of the 12 mandibular teeth to the 12 maxillary teeth should be 91.3 percent. This ratio is calculated using the following formula:
 Overall ratio = $\frac{\text{sum of mand. 12}}{\text{sum of max. 12}} \times 100$

The sum of the 12 maxillary and 12 mandibular teeth for a given patient is inserted into the formula and the overall ratio is determined. If the overall ratio is greater than 91.3 percent, then the mandibular tooth material is excessive. The amount of mandibular tooth material excess is calculated by using the formula:

$$\text{Mandibular overall excess} = \text{sum of mand 12} - \frac{\text{sum of max 12} \times 91.3}{100}$$

If the overall ratio is less than 91.3 percent, then the maxillary tooth material is excessive. The amount of maxillary tooth material excess is calculated by using the formula:

$$\text{Overall maxillary excess} = \text{sum of max. 12} - \frac{\text{sum of mand 12} \times 100}{91.3}$$

(Gurkeerat Singh, 2008)

2- The anterior ratio: This ratio can be found out using the formula:

$$\text{Anterior ratio} = \frac{\text{sum of mand. 6}}{\text{sum of max. 6}} \times 100$$

The sum of the mesiodistal diameter of the 6 mandibular anterior teeth to the 6 maxillary anterior teeth should be 77.2 percent. If the anterior ratio is greater than 77.2 percent, then the mandibular anterior tooth material is excessive. The amount of mandibular tooth material excess is calculated by using the formula:

Mandibular anterior tooth material excess =
 sum of mandibular 6 - $\frac{\text{sum of max. 6} \times 77.2}{100}$

If the anterior ratio is less than 77.2 percent, then the maxillary anterior tooth material is excessive. The amount of maxillary tooth material excess is calculated by using the formula:

Maxillary anterior tooth material excess = sum of max 6 - $\frac{\text{sum of max. 6} \times 100}{77.2}$
 (Gurkeerat Singh,2008)

The Bolton analysis was done for all groups, and compare the results among these groups.

Research Instruments:

The following research instruments were used in this study:

Dental Orthodontic Casts, Digital Caliper was used to measure the mesio-distal width of 12 teeth both Maxillary and Mandibular jaw ,Bolton sheets, Ethnicity sheets and Pencil.

Statistical Instruments:

1. Descriptive statistics using SPSS Version 20.
2. Mean commonly referred to as the average or arithmetic mean and is most widely used as measure of central location

$$\mu = \frac{\sum x}{n}$$

3. Standard Deviation (SD) describes the dispersion of observation from the mean

$$\sigma = \sqrt{\frac{\sum(x - \mu)^2}{n - 1}}$$

Statistical test and formula for manual computation:

4. T-Test for two independent means

The independent-samples t-test (or independent t-test, for short) compares the means between two unrelated groups on the same continuous, dependent

variable.

Manual Computation

If the variance is unknown:

- a. If $\sigma_1 \neq \sigma_2$

Computed t statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where:

$$s_1^2 = \frac{\sum(x_{1i} - \bar{x}_1)^2}{n_1 - 1} \text{ and } s_2^2 = \frac{\sum(x_{2i} - \bar{x}_2)^2}{n_2 - 1}$$

b. If $\sigma_1 = \sigma_2 = \sigma$

Computed t statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{s_p^2 \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where:

$$s_p^2 = \frac{[(n_1 - 1)s_1^2] + [(n_2 - 1)s_2^2]}{n_1 + n_2 - 2}$$

5. One-way Anova the one-way analysis of variance (ANOVA) use to determine if there is a significant difference in Bolton analysis of casts with Class I Malocclusion, Class II Malocclusion and Class III Malocclusion .Also, it is important to realize that the one-way ANOVA is an omnibus test statistic and cannot tell you which specific groups were significantly different from each other; it only tells you that at least two groups were different. Since you may have three, four, five or more groups in your study design, determining which of these groups differ from each other is important. You can do this using a post-hoc test.

Summary Table for One-way ANOVA

Source	Sum of Squares	Degrees of Freedom	Variance Estimate (Mean Square)	F Ratio
Between	SS_B	K-1	$MS_B = \frac{SS_B}{K - 1}$	$\frac{MS_B}{MS_W}$
Within	SS_W	N-K	$MS_W = \frac{SS_W}{N - K}$	
	$SS_T = SS_B + SS_W$	N-1		

Where:

N is the total number of observations,

K is the total number of groups,

SS_B =the sum of squares (deviations) of the group means from the grand mean, where $\bar{X}..$ represents the grand mean.

$$SS_B = n \sum (X_j - \bar{X})^2$$

SS_W = the sum over the sums of squared deviations of scores around their group's mean

$$SS_W = \sum (X_{ij} - \bar{X}_j)^2$$

CHAPTER IV

PRESENTATION ANALYSIS AND INTERPRETATION OF DATA

This chapter presents, analyzes, and interprets the data collected in the study based on the research questions enumerated in Chapter I.

There were three types of malocclusion, Class I, Class II and Class III that were used in this study. A total of 90 samples of Orthodontic casts. Were collected. All measurement were done by Bolton's analysis. Statistical test used Mean, Standard Deviation (SD) describes the dispersion of observation from the mean, t-test and ANOVA.

One-Way ANOVA and t-test revealed that there were no statistically significant difference in Bolton's analysis of both male and female in Class I, II and III in Anterior and Overall Ratio with both p-values greater than 0.05 level of significance.

Problem No. 1: What was the Bolton's analysis in class I malocclusion?

A) Male: Anterior and Overall ratio.

Table 1: The Mean Value and Standard Deviation of Class I Anterior and Overall Ratio in Male.

Class I Anterior and Overall Ratio in Male		
	Mean	SD
Anterior Ratio	77.72	2.94
Overall Ratio	91.37	2.06

The mean Class 1 Anterior Ratio of Male was 77.72 with SD of 2.94. The mean Class 1 Overall Ratio of Male was 91.37 with SD of 2.06.

B) Female: Anterior and Overall ratio.

Table 2: The Mean Value and Standard Deviation of Class I Anterior and Overall Ratio in Female.

Class I Anterior and Overall Ratio in Female		
	Mean	SD
Anterior Ratio	77.80	4.06
Overall Ratio	91.38	3.06

The mean Class 1 Anterior Ratio of Female was 77.80 with SD of 4.06. The mean Class 1 Overall Ratio of Female was 91.38 with SD of 3.06.

According to Guvenc, et al (2006), All the sample population were from Turkey. The result showed anterior Bolton's ratios of males and females for Class I were 79.17 and 77.58, respectively, while the overall Bolton's ratios of male and female were 87.51 and 87.24, respectively. There were no significant gender differences in both ratios.

Problem No. 2: What was the Bolton's analysis in class II malocclusion?

A) Male: Anterior and Overall ratio.

	Mean	SD
Anterior Ratio	79.49	3.09
Overall Ratio	92.17	2.86

Anterior and Overall
Table 3: The Mean Value and Standard Deviation of Class II Anterior and Overall Ratio in Male.

The mean Class II Anterior Ratio of Male was 79.49 with SD of 3.09. The mean Class II Overall Ratio of Male was 92.17 with SD of 2.86.

B) Female: Anterior and Overall ratio.
Table 4: The Mean Value and Standard Deviation of Class II Anterior and Overall Ratio in Female.

Class II Anterior and Overall Ratio in Female		
	Mean	SD
Anterior Ratio	78.32	2.96
Overall Ratio	91.22	2.92

The mean Class II Anterior Ratio of Female was 78.32 with SD of 2.96.

The mean Class II Overall Ratio of Female was 91.22 with SD of 2.92.

According to Guvenc, et al (2006), All the sample population were from Turkey. The result showed anterior Bolton's ratios of males and females for Class II were 78.28 and 78.17, respectively, while the overall Bolton's ratios of male and female were 89.65 and 88.22, respectively. There were no significant gender differences in both ratios.

Problem No. 3: What was the Bolton's analysis in class III malocclusion?
A) Male: Anterior and Overall ratio.
Table 5: The Mean Value and Standard Deviation of Class III Anterior and Overall Ratio in Male.

Class III Anterior and Overall Ratio in Male		
	Mean	SD
Anterior Ratio	79.02	4.39
Overall Ratio	92.83	3.52

The mean Class III Anterior Ratio of Male was 79.02 with SD of 4.39. The mean Class III Overall Ratio of Male was 92.83 with SD of 3.52.

B) Female: Anterior and Overall ratio.
Table 6: The Mean Value and Standard Deviation of Class III Anterior and Overall Ratio in Female.

Class III Anterior and Overall Ratio in Female		
	Mean	SD
Anterior Ratio	79.19	2.62
Overall Ratio	91.72	1.42

The mean Class III Anterior Ratio of Female was 79.19 with SD of 2.62. The mean Class III Overall Ratio of Female was 91.72 with SD of 1.42.

According to Guvenc, et al (2006), All the sample population were from Turkey. The result showed anterior Bolton's ratios of males and females for Class III were 78.75 and 78.29, respectively, while the overall Bolton's ratios of male and female were 91.22 and 90.54, respectively.

The present study showed that for Class I,II and III male and female groups, the results were not for from each other's.
Problem No. 4: What was the mean Values of Bolton's analysis for both male and female in Class I,II and III?

Table 7: The Mean Value and Standard Deviation of Class I,II and III Anterior and Overall Ratio for both Male and Female.

		Mean	SD
Anterior	Class I	77.7621	3.48019
	Class II	78.9018	3.03567
	Class III	79.1035	3.55428
Overall	Class I	91.3737	2.56149
	Class II	91.6917	2.87986
	Class III	92.2751	2.69571

The mean of Anterior Ratio in Class I was 77.7621 with SD of 3.48019, Class II was 78.9018 with SD 3.03567 and Class III was 79.1035 with SD of 3.55428.

The mean of Overall Ratio in Class I was 91.3737 with SD of 2.56149, Class II was 91.6917 with SD of 2.87986 and Class III was 92.2751 with SD of 2.69571.

According to Gerard, et al (2011), The study involved Irish ethnicity groups and the results showed that anterior Bolton's ratios of both male and female for Class I was 79, Class II was 78,6 and Class III was 79,9, while the overall Bolton's ratios of both male and female for Class I was 92.3, Class II was 91.8 and Class III was 92.8. There were no statistically significant difference in in Bolton's analysis for male and female in Class I,II and III anterior and overall ratio.

Problem No. 5: Was there a significance different in Bolton's analysis for both male and female in Class I malocclusion?

A) Anterior ratio:

Table 8: The Mean Value, Standard Deviation and Independent t-test of Class I Anterior Ratio for both Male and Female.

Class I Anterior Ratio				
	Mean	SD	p-value	Interpretation
Male	77.72	2.94	0.952	Not Significant
Female	77.80	4.06		

Independent t-test revealed that there was no statistically significant difference in in Bolton's analysis for male and female in Class I Anterior Ratio with p-value of 0.952, which is greater than 0.05 level of significance.

B) Overall ratio:

Table 9: The Mean Value, Standard Deviation and Independent t-test of Class I Overall Ratio for both Male and Female.

Class I Overall Ratio				
	Mean	SD	p-value	Interpretation
Male	91.37	2.06	0.986	Not Significant
Female	91.38	3.06		

Independent t-test revealed that there was no statistically significant difference in Bolton's analysis for male and female in Class I Overall Ratio with p-value of 0.986, which was greater than 0.05 level of significance. Then, the null hypothesis was acceptable.

In the previous study done by Guvenc, et al (2006), for Turkish population. The anterior Bolton's ratios of males and females for Class I were 79.17 and 77.58, respectively, while The overall Bolton's ratios of male and female were 87.51 and 87.24, respectively. The results showed no significant gender differences in both ratios.

Problem No. 6: Was there a significance difference in Bolton's analysis for male and female in Class II malocclusion?

A) Anterior ratio:

Table 10: The Mean Value, Standard Deviation and

Independent t-test of Class II Anterior Ratio for both Male and Female

Class II Anterior Ratio				
	Mean	SD	p-value	Interpretation
Male	79.49	3.09	0.298	Not Significant
Female	78.32	2.96		

Independent t-test revealed that there was use to determine if there was a significant difference in Bolton analysis of casts with Class I Malocclusion, Class II Malocclusion and Class III Malocclusion

no statistically significant difference in Bolton's analysis for male and female in Class II Anterior Ratio with p-value of 0.298, which was greater than 0.05 level of significance.

Note: if p-value is less than 0.05 level of significance, Reject Ho (Significant)

If p-value is greater than or equal to 0.05 level of significance, Do not Reject Ho (Not Significant)

B) Overall ratio:

Table 11: The Mean Value, Standard Deviation and

Independent t-test of Class II Overall Ratio for both Male and Female.

Class II Overall Ratio				
	Mean	SD	p-value	Interpretation
Male	92.17	2.86	0.377	Not Significant
Female	91.22	2.92		

Independent t-test revealed that there was no statistically significant difference in Bolton's analysis for male and female in Class II Overall Ratio with p-value of 0.377, which was greater than 0.05 level of significance.

Note: if p-value is less than 0.05 level of significance, Reject Ho (Significant)

If p-value is greater than or equal to 0.05 level of significance, Do not Reject Ho (Not Significant)

According to Guvenc, et al (2006), Results revealed that. The anterior Bolton's ratios of males and females for Class II were 79.17 and 77.58, respectively, while the overall Bolton's ratios of male and female were 87.51 and 87.24, respectively. There were no significant gender differences in both ratios were observed.

Problem No. 7: Was there a significance different in Bolton's analysis for male and female in Class III malocclusion?

A) Anterior ratio:

Table 12: The Mean Value, Standard Deviation and

Independent t-test of Class III Anterior Ratio for both Male and Female.

Class III Anterior Ratio				
	Mean	SD	p-value	Interpretation
Male	79.02	4.39	0.896	Not Significant
Female	79.19	2.62		

Independent t-test revealed that there was no statistically significant difference in Bolton's analysis for male and female in Class III Anterior Ratio with p-value of 0.896, which was greater than 0.05 level of significance.

Note: if p-value is less than 0.05 level of significance, Reject Ho (Significant)

If p-value is greater than or equal to 0.05 level of significance, do not Reject Ho (Not Significant)

B) Overall ratio:

Table 13: The Mean Value, Standard Deviation and Independent t-test of Class III Overall Ratio for both Male and Female.

Class III Overall Ratio				
	Mean	SD	p-value	Interpretation
Male	92.83	3.52	0.268	Not Significant
Female	91.72	1.42		

Independent t-test revealed that there was no statistically significant difference in Bolton's analysis for male and female in Class III Overall Ratio with p-value of 0.268, which was greater than 0.05 level of significance.

Note: if p-value is less than 0.05 level of significance, Reject Ho (Significant)

If p-value is greater than or equal to 0.05 level of significance, Do not Reject Ho (Not Significant)

According to the same study done by Guvenc, et al (2006), They also found out that both anterior and overall ratios were not statistically significant wherein the anterior Bolton's ratio of males and females for Class III were 78.75 and 78.29, respectively, while the overall Bolton's ratios of male and female were 91.22 and 90.54, respectively.

Problem No. 8: Was there a significant difference in Bolton's analysis both male and female in Class I, II and III?

A) Anterior Ratio.

B) Overall ratio.

Table 14: The Mean Value, Standard Deviation and Independent t-test of Class I,II and III Anterior and Overall Ratio for both Male and Female.

		Mean	SD	p-value	Interpretation
Anterior	Class I	77.7621	3.48019	.255	Not Significant
	Class II	78.9018	3.03567		
	Class III	79.1035	3.55428		
Overall	Class I	91.3737	2.56149	.431	Not Significant
	Class II	91.6917	2.87986		
	Class III	92.2751	2.69571		

One-Way ANOVA revealed that there is no statistically significant difference in Bolton's analysis of both male and female in Class I, II and

III in Anterior and Overall Ratio with both p-values greater than 0.05 level of significance.

Note: if p-value is less than 0.05 level of significance, Reject Ho (Significant)

If p-value is greater than or equal to 0.05 level of significance, Do not Reject Ho (Not Significant)

According to the previous study by Gerard, et al (2011), For Irish population. The anterior Bolton's ratios of both male and female for Class I was 79, Class II was 78.6 and Class III was 79.9, while the overall Bolton's ratios of both male and female for Class I was 92.3, Class II was 91.8 and Class III was 92.8. There were no significant differences in malocclusion groups.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary of findings and the conclusion drawn from the data collected and analyzed as well as the recommendations offered that maybe great help to the readers and future researchers.

Summary of Findings

The results of the present study revealed that there was no significant difference in Bolton's Analysis of Filipinos with Different Malocclusion Groups.

Summary:

1. The mean anterior ratio for the male Filipinos in Class I was 77.72 with SD of 2.94 and the mean overall ratio was 91.37 with SD of 2.06.
2. The mean anterior ratio for the female 77.80 with SD of 4.06 Filipinos in Class I was and the mean overall ratio was 91.38 with SD of 3.06.
3. The mean anterior ratio for the male Filipinos in Class II was 79.49 with SD of 3.09 and the mean overall ratio was 92.17 with SD of 2.86.
4. The mean anterior ratio for the female Filipinos in Class II was 78.32 with SD of 2.96 and the mean overall ratio was 91.22 with SD of 2.92.
5. The mean anterior ratio for the male Filipinos in Class III was 79.02 with SD of 4.39 and the mean overall ratio was 92.83 with SD of 3.52.
6. The mean anterior ratio for the male Filipinos in Class III was 79.19 with SD of 2.62 and the mean overall ratio was 91.72 with SD of 1.42.
7. There is no statistically significant difference in in Bolton's analysis for male and female in Class I Anterior Ratio with p-value of 0.952, which is greater than 0.05 level of significance.
8. There is no statistically significant difference in in Bolton's analysis for male and female in Class I Overall Ratio with p-value of 0.986, which is greater than 0.05 level of significance.
9. there is no statistically significant difference in in Bolton's analysis for male and female in Class II Anterior Ratio with p-value of 0.298, which is greater than 0.05 level of significance.
10. There is no statistically significant difference in in Bolton's analysis for male and female in Class II Overall Ratio with p-value of 0.377, which is greater than 0.05 level of significance.
11. There is no statistically significant difference in in Bolton's analysis for male and female in Class II Overall Ratio with p-value of 0.377, which is greater than 0.05 level of significance.
12. There is no statistically significant difference in in Bolton's analysis for male and female in Class III Overall Ratio with p-value of 0.268, which is greater than 0.05 level of significance.
13. There is no statistically significant difference in Bolton's analysis of both male and female in Class I, II and III in Anterior and Overall Ratio with both p-values greater than 0.05 level of significance.

Conclusion

From the results obtained in this study, the researcher concludes that there is no significant difference in Bolton's Analysis of Filipinos with Different Malocclusion Groups. The comparison between Filipino male and female anterior and overall ratios no statistically significant difference. Mean for mesiodistal tooth diameters of the maxillary and mandibular permanent teeth were established for Filipinos.

Implications

This describes how the results from this study could help and provide answers to the questions of the students and future researcher as well as their implications on the practice of orthodontics.

Implication on to the Orthodontic and Dental Practitioners:

The result of this study will give a clear idea about in Bolton analysis in different malocclusion. Wherein the anterior and overall ratio of Bolton's analysis revealed that there was no difference in gender and type of malocclusion.

Implication on to the Researchers:

The result of the present study can help the researchers performing Bolton's analysis for different population group to also understand the finding of the Filipino group and compare with their own findings.

Recommendations

In view of the findings and conclusions, the researcher came up with the following recommendations:

1. It can be recommended to just use any results from the present study regarding anterior ratio and overall ratio of Bolton's analysis due to no significant difference between gender and malocclusion groups.
2. Further study can be done on different Filipino ethnicity.
3. Further study can be recommended to increase the sample size to be able to conclude for general population.

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"تحليل بولتون للفلبينيين مع مجموعات مختلفة من سوء الإطباق"

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ملخص البحث:

تُعرف مرحلة "الإنهاء" الخاصة بتقويم الأسنان تحديد التفاصيل الضرورية لتحقيق نتيجة ممتازة. في بعض الحالات، تكون مرحلة الإنهاء صعبة للغاية، وتتطلب إنتاج قوى ميكانيكية حيوية معقدة للوصول إلى حلول تقويمية مرضية. تنشأ نسبة عالية من صعوبات مرحلة الإنهاء هذه بسبب اختلاف حجم الأسنان التي كان من الممكن اكتشافها وأخذها في الاعتبار أثناء التشخيص الأولي وتخطيط العلاج. تنشأ العديد من الصعوبات التي تمت مواجهتها خلال مرحلة الإنهاء أثناء العلاج بتقويم الأسنان بسبب عدم مطابقة حجم الأسنان بين الفكين. تعتبر نسبة بولتون من أكثر الحسابات المفيدة لتشخيص تقويم الأسنان الدقيق لأنها توضح ما إذا كانت هناك نسبة صحيحة بين نسب الأسنان.

الأهداف: كان الغرض من هذه الدراسة هو تحديد ما إذا كان هناك ميل سائد لاختلاف حجم الأسنان بين الفكين بين مجموعات سوء الإطباق المختلفة من الفلبينيين.

الطرق: تتألف العينات من 90 نموذج دراسة (45 ذكرًا و 45 أنثى) مصابين بسوء الإطباق من الصنف الأول والثاني والثالث. تم إجراء قياسات حجم الأسنان بواسطة الفرجار الرقمي الإلكتروني بدقة 0.01 ملم. تم تحليل نسب حجم الأسنان كما وصفها بولتون. تم تحليل المسافة أنسي-وحشي في حجم الأسنان في مجموعات سوء الإطباق ومقارنتها بين الذكور والإناث في مجموعات سوء الإطباق المختلفة من الفلبينيين.

النتائج: أظهرت النتائج عدم وجود فرق كبير في النسب الأمامية والكلية لعينة الإطباق الطبيعي بالمقارنة مع معايير بولتون. لم يتم العثور على فروق ذات دلالة إحصائية بين الجنسين بالنسبة لاختلافات حجم الأسنان. أشار تحليل التباين (ANOVA) إلى أنه لم يتم تحديد اختلاف كبير في النسبة الأمامية والإجمالية في مجموعات سوء الإطباق المختلفة.

الاستنتاج: يقترح أنه يمكن استخدام قيم بولتون للفلبينيين حتى يتم دراسة عينة تمثيلية كبيرة.

الكلمات المفتاحية: تحليل بولتون، الفرجار الإلكتروني، الفلبينيين، سوء الإطباق، مثال الدراسة.