ORIGINAL PAPER



# A STUDY TO ESTABLISH A BIOMETRIC RELATIONSHIP BETWEEN MAXILLARY CENTRAL INCISOR AND NAIL OF LITTLE FINGER FOR PREDICTION OF MAXILLARY CENTRAL INCISOR DIMENSIONS: A PRELIMINARY STUDY

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## ABSTRACT

**Introduction:** During prosthodontic rehabilitation, achieving esthetics is one of the primary goals of prosthodontists. Most often when the patient reports with missing anterior teeth and does not have previous records, such as photographs or dental casts, it would be difficult to determine the dimensions of anterior teeth. Even though size can be determined by aesthetics and function with the help of esthetic trials, they are quite arbitrary. Also, using various dental proportions can give the clinician a subjective guideline to determine the dimensions of missing anterior teeth.

**Objectives:** This study aimed at establishing a biometric relationship between maxillary central incisor and the nail of little finger in order to predict the maxillary central incisor dimensions.

**Material and methods:** 63 participants, with age between 20 and 40 years were included in the study. Measurements of the maxillary central incisor and the nail of little finger were made using digital vernier caliper.

**Results:** There was a statistically significant correlation between the length of maxillary central incisor and the length of the nail of little finger ($p = 0.00$), and correlation between the width of central incisor and the width of the nail of little finger was found statically significant ($p = 0.01$).

**Conclusions:** The result of this study provided an equation to help to determine the length and the width of maxillary central incisor based on the dimensions of the nail of little finger.

**Key words:** measurement, central incisor, nail of little finger.

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## INTRODUCTION

A smile can be a person's best accessory. If it is not natural, a prosthodontist can help to achieve it. Smiling is a gesture displaying one's emotions, and esthetics is one of the concerns of most patients seeking prosthetic rehabilitation [1]. The correct proportion of size and shape of maxillary anterior teeth help to enhance the facial esthetics of an individual, and hence, it is of utmost importance that these teeth are in harmony with the facial esthetics [2]. Patients receiving esthetic treatment often have the expectations of having life-like restorations. Therefore, careful designing is required to achieve superior esthetic outcomes [3].

Achieving a pleasing smile requires a meticulous assimilation of both the facial and dental components.

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**FIGURE 1.** Measuring the length of central incisor from gingival zenith point to the incisal edge of the maxillary right central incisor


**FIGURE 2.** Measuring the width of right central incisor at the contact point with the adjacent teeth

Hard and soft tissues of the human face are elements of the facial composition. Dental components include the teeth and their relation to gingival tissues. During smile designing, it is important to study and assess both the facial and dental components. Maxillary central incisor is an influential element of the anterior dental composition, and needs to maintain balance with the remaining anterior teeth. Various guidelines have been mentioned in literature with regards to proportioning of anterior teeth, including the golden proportion, red proportion, and golden percentage. With the diversity that exists in nature, rarely does the natural dentition follow any of these set of proportions [3-5]. There are no verifiable guidelines for the determination of proportions of the teeth. In situations of missing maxillary central incisor, or in cases of extensive loss of tooth structure, an alternate reliable guide can help the clinician to establish better esthetics and functions. Therefore, the aim of this study was to establish a biometric relationship between maxillary central incisor and the nail of little finger for the prediction of maxillary central incisor dimensions.

## MATERIAL AND METHODS

Ethical clearance was obtained from the Institution's Ethical clearance committee, with approval number: ABSM/EC/57/2020. A pilot study was conducted, and data obtained from the study was subjected to statistical analysis. Based on the sample, correlation coefficient for length of maxillary central incisor and length of nail of little finger was 0.559 (pilot study), assuming population correlation coefficient 0.8, power 95% and α error 5%, the required sample size was 63. This was calculated using Nm Master software version 2. Therefore, the study included a total of 63 participants. Inclusion criteria were: (1) all participants between the age group of 20-40 years, with equal distribution between males and females; (2) no missing maxillary anterior teeth; (3) healthy periodontal status of the anterior teeth; (4) no inter-dental spacing or crowding; (5) no anterior restoration and no history of orthodontic treatment. Exclusion criteria were: (1) dental malocclusion; (2) supraerupted teeth; (3) developmental anomalies; (4) apparent loss of tooth structure due to attrition, fracture, caries, or restorations; (5) patients with finger pathologies, such as clubbing, syndactyly, polydactyly. A consent was obtained from all participants, and all patients who fulfilled the above-mentioned criteria were included in the study. All measurements were recorded using a digital vernier caliper (Zhart digital vernier caliper ZC102A, 150 mm), with an accuracy of 0.01 mm. The following sequences of measurements were recorded on examination of participants.

### MEASUREMENTS OF MAXILLARY CENTRAL INCISORS

Distance from the gingival zenith point to the incisal edge of the maxillary right central incisor was measured intra-orally, using digital vernier caliper (Figure 1). Mesiodistal width of the maxillary central incisor was measured intra-orally at its' greatest diameter, the contact point with the adjacent teeth. To avoid errors, care was taken to measure accurately by repeating the readings twice, and the average value was recorded for all measurements (Figure 2).

## MEASUREMENTS OF NAIL OF LITTLE FINGER

Similarly, for measuring the width of fingernail, anatomical landmarks were used to avoid any kind of discrepancies while making the measurements. The width was measured at the broadest point, which was the hyponychium (Figure 3). The length was measured between the eponychium and the hyponychium. All these landmarks are stable and do not change with the size or length of the nail of little finger (Figure 4).


**FIGURE 3.** Measuring the width of nail of little finger at the hyponychium

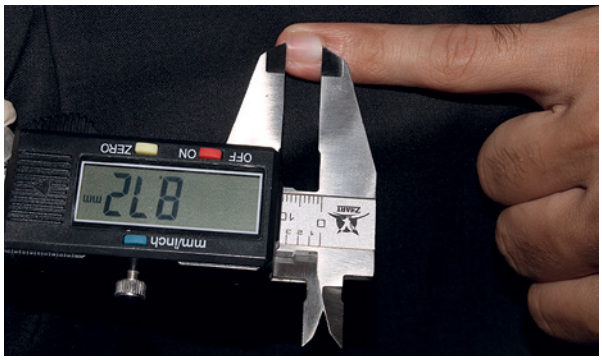


**FIGURE 4.** Measuring the length of nail of little finger between the eponychium and the hyponychium

## STATISTICAL ANALYSIS

All data recorded from the participants was tabulated. Data were then subjected to statistical analysis using Pearson's correlation test and simple linear regression test. A $p > 0.01$ was considered statistically significant.

# RESULTS

In this study, a total of 63 participants were assessed. The mean length of the maxillary central incisor was 9.21 ± 1.04 mm, and the mean length of the fingernail was 9.19 ± 1.16 mm. When these data were subjected to statistical analysis, it was found to be statistically significant ($p = 0.00$). Furthermore, the mean width of maxillary central incisor was 8.52 ± 0.70 mm, and the mean width of nail of little finger was 7.52 ± 0.68 mm. On statistical analysis, it was also highly statistically significant ($p = 0.01$) (Table 1). When simple linear regression test was performed between the length of central incisor with the length of fingernail, statistically significant results were obtained, with ($p = 0.00$) (Table 2).

Additionally, simple linear regression test was done between the width of central incisor with the width of fingernail, and also revealed statistically significant results ($p = 0.00$) (Table 3). With the input data from

**TABLE 1.** Correlation between the length and width of central incisors and the fingernail

| Parameter | Mean ± SD | *r*-value | *p*-value |
|---|---|---|---|
| Length of central incisor (mm) | 9.21 ± 1.04 | 0.50 | 0.00 |
| Length of fingernail (mm) | 9.19 ± 1.16 | | |
| Width of central incisor (mm) | 8.52 ± 0.70 | 0.42 | 0.01 |
| Width of fingernail (mm) | 7.52 ± 0.68 | | |

**Pearson's correlation, with p < 0.05 statistically significant.*

**TABLE 2.** Simple linear regression to determine the length of central incisor (dependent) with the length of fingernail (independent)

| Model | Unstandardized coefficients | | Standardized coefficients | *t*-value | Significance |
|---|---|---|---|---|---|
| | Beta | Std. error | Beta | | |
| Constant | 5.10 | 0.91 | 0.501 | 5.56 | 0.00 |
| Length of fingernail | 0.447 | 0.099 | | 4.52 | 0.00 |

*Length of central incisor (mm) = 5.10 + 0.44 [length of fingernail (mm)].*

**TABLE 3.** Simple linear regression to determine the width of central incisor (dependent) with the width of fingernail (independent)

| Model | Unstandardized coefficients | | Standardized coefficients | *t*-value | Significance |
|---|---|---|---|---|---|
| | Beta | Std. error | Beta | | |
| Constant | 5.27 | 0.900 | 0.42 | 5.86 | 0.00 |
| Width of fingernail | 0.43 | 0.119 | | 3.62 | 0.00 |

*Width of central incisor (mm) = 5.10 + 0.44 [width of fingernail (mm)].*

dimensions of existing teeth as independent variables, the following equation was achieved:

- length of the maxillary central incisor (mm) = 5.10 + 0.44 [length of fingernail (mm)];
- width of the maxillary central incisor (mm) = 5.10 + 0.44 [width of fingernail (mm)].

The length and width of the maxillary central incisor can be calculated using the above-mentioned equation.

This equation was the predictor for assessing how the width of the maxillary central incisor varies in relation to the width of nail of little finger.

## DISCUSSION

In the twenty first-century, primary concern revolves around appearance of an individual. An esthetic smile can transform a person's life. Therefore, it is crucial for the dental specialist to make a comprehensive plan and fulfill the patient's desires [6]. The maxillary central incisor teeth have maximum visibility, and are the first to be visible to human eye [7]. Therefore, having appropriate width to height ratio is extremely critical. John Ray said, "Beauty is power, a smile is its' sword". Harmony and harmony in proportions are the accessories of an untarnished smile. Beauty cannot be quantified, but harmony can be with the help of various geometrical or mathematical proportions introduced by various authors. The theory of golden proportion was first introduced by Lombardi and further developed by Levin. They suggested the use of repeated ratios in the maxillary anterior teeth. Levin also formed a grid with outlines in golden proportion, and proposed the use of the grid to develop harmony within the anterior teeth [8, 9]. Ward in 2001 [10] proposed the recurrent esthetic dental proportion (RED proportion). It was the observation from his study that the proportion of successive width of the teeth remain constant, when progressing distally from the midline. Snow in 1999 [11] established the concept of golden percentage, wherein the proportional width of each tooth should be: canine 10%, lateral 15%, and central 25%, on each side of the total distance across the anterior segment, in order to achieve an esthetically pleasing smile. Various studies have been conducted to assess the prevalence of these proportions in natural dentition, but no study has conclusively found the direct application of one of these proportions to population at large. However, recent *in-vivo* studies by Varghese *et al.* [12], Mahshid *et al.* [13], and Fayyad *et al.* [14], who were evaluating the existence of golden proportion, RED proportion, and golden percentage concluded that the golden proportion and RED proportion does not exist in natural dentition. The golden percentage was found to have relatively better correlation in natural dentition in studies by Srinivasan *et al.* [15] and Fayyad *et al.* [14]. In 2019, a study was undertaken by Aldegheishem *et al.* [16], who aimed to evaluate the golden proportion in Saudi population, also concluded that there were significant differences between the subject's width-to-height ratios and the golden proportion. Golden proportion did not exist in maxillary anterior teeth. Therefore, these mathematical proportions are not reliable for deciding the dimensions of anterior teeth, and there is a need for a more definite method in rehabilitation of maxillary anterior teeth. In a study by Gomes *et al.* [17], the author proposed that in relation to dental arch perception, the maxillary central incisors are the most predominant because of their maximum visibility, as viewed from the anterior aspect. The maxillary central incisors are the teeth that set the tone of a person's smile. Therefore, the dimensions of maxillary central incisors are of paramount importance during anterior esthetic restorations. Often undesired spacing, missing teeth due to trauma, or congenital condition, all cause an unpleasing smile. Since literature suggests various proportions and not a definite guide, this study was undertaken with the aim of establishing a correlation between the dimensions of the maxillary central incisor and the nail of the little finger. Such a correlation would help to achieve size and shape of restored teeth, close to the form of naturally present. This measurement is simple to obtain without requiring the use of any expensive instrument. It can help the clinician to predict the dimensions of missing central incisors in case of extensive anterior rehabilitation or smile designing for a patient.

The findings of this study suggests that there is a very high positive correlation between the dimensions of the maxillary central incisor and the nail of little finger. This can be used as a guide to assess the dimensions of missing maxillary central incisor. The shape of the nail of little finger and the shape of the facial surface of the maxillary central incisor appear similar; therefore, this could be the reason for a positive correlation between the size of the aforementioned parameters.

Evidence suggests that teeth may preserve biological memories of the past physical stressors. These stressors most commonly include poor nutrition, trauma during development, ingestion of heavy metals, or various systemic diseases. All of these can affect the dentin and enamel cell function, the result of which is visible structural defects or alteration in chemical composition of the tooth. One such alteration is as seen the striae of Retzius, which are incremental growth lines seen on the teeth enamel. These represent successive pattern of enamel apposition during crown formation. Like enamel, nails also grow in increments, and are affected by circadian cycles. Disruption in nails can manifest as linear grooves called 'Beau's lines'. This suggest that development of human teeth and nail have etiological factors in common. Further research needs to be carried in this aspect to find a definitive correlation [18-20]. A comparison of the results of the present study cannot be done with other studies, as in our literature search

there were no other studies that determined correlation between the length and the width of the maxillary central incisor to the length and width of the nail of little finger.

From the data of this study, the length and width of the maxillary central incisor can be calculated by the following equations:

- length of the maxillary central incisor (mm) = 5.10 + 0.44 [length of fingernail (mm)];
- width of the maxillary central incisor (mm) =f 5.10 + 0.44 [width of fingernail (mm)].

However, there are a few limitations in the study. A lager sample size would help to confirm the finding. Further research can be performed with uniformity, with respect to ethnic groups and other geographical locations to ascertain the reliability of the finding of this study.

## CONCLUSIONS

Within the limitations of the study, we would like to concluded that there is significant correlation between the length and the width of the maxillary central incisor and the nail of little finger. This suggests that using the dimensions of the nail of little finger would help the clinician to restore dimensions of maxillary central incisors as close to that of natural teeth. The equation obtained in the study can help the clinician to effectively calculate dimensions of missing maxillary central incisors. This would serve as a definite guide during smile designing and extensive anterior rehabilitation of worn-down dentition.

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## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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