

## Esthetic Dental Proportions and Measurements Comprising a Natural Esthetic Smile: A Literature Review

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### Abstract

**Aim:** To review different methods determining the width and proportion of the maxillary anterior teeth. **Materials and methods:** The relevant articles were obtained from the databases of PubMed, Medline, Google scholar and Scopus index by searching keywords “Esthetic dental proportion,” “Esthetic dental measurement.” and “Esthetic dental proportion and esthetic dental measurement in smile designing” **Results:** The present review explains the different methods of esthetic dental proportion and measurements to obtain the adequate width of the maxillary incisors. These play a pivotal role in smile designing. The present review also explains various clinical studies which compared different methods under varied clinical instances and gave proper application of each proportion proposed. The present review also explains the upper smile line and the lower smile line in the smile design to obtain a more esthetically pleasing smile. **Conclusion:** The method used for determining the adequate method of proportion varies among different individuals based on the clinical aspects. The smile line is an important factor to be considered that comprises a natural esthetic smile.

**Keywords:** maxillary anterior teeth, esthetic dental proportion, the smile line, clinical aspects, Natural Esthetic Smile.

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### INTRODUCTION

Smile is an ability of an individual by which a range of emotions can be expressed. From the earliest times, beauty has been given importance in today's life and an esthetic smile is an important component of a beautiful face (Seiler *et al.*, 2018). The Esthetic dentistry has seen a vast demand to meet the requirements of the patient to achieve a perfect smile. An esthetically pleasing perfect smile can be a very subjective concept since what is pleasing to one may not be pleasing to others. However, standardized dental proportions do exist which can provide a ratio of a proportional and esthetically pleasing smile (Calamia, 2015).

The dental measurements or the esthetic dental proportions are the dimensions of the anterior teeth which can be obtained mathematically or geometrically. The esthetic dental proportion gives a mesiodistal width and length measurement of the central in proportion to the mesiodistal width and length of the lateral incisor (Khanna, 2020).

These proportions or measurements aid in obtaining an ideal and harmonious proportion of the anterior teeth which aids in placement of the esthetic restoration. These dental proportions and measurements can serve as a guideline by the dental professionals in designing ideal smiles for patients. It serves as a template that can provide more esthetically pleasing results in smile designing (Lakshmi *et al.*, 2015).

The present article is a literature review of the different tooth proportion theories. It highlights the literature comparing different theories which can be best used in designing natural looking esthetic smiles.

### MATERIALS AND METHODS

The databases of PubMed, Medline, Google scholar and Scopus index were searched using keywords “Esthetic dental proportion,” “Esthetic dental measurement.” and “Esthetic dental proportion and esthetic dental measurement in smile designing” All the search result articles were analyzed for the articles relevant to the particular topic. The data from these relevant articles were noted

## Tooth proportion theories and measurements

### Golden proportion

Golden proportion gives the relationship between the dimensional proportion of the teeth which is considered as ideal and mathematics. The history of the Golden proportion can be traced back before the 6th century B.C wherein the Egyptians have determined the Golden Number which denotes the Golden proportion today. However, the theory of Golden proportion was first described in the 6th centuries B.C. by Pythagoras. Later it was again explained by the geometrician Euclid. In 1973, Lombardi was the first one to introduce the application of golden proportion in dentistry (Rosenstein *et al.*, n.d.).

The theory of golden proportion states that the proportion of the width of the central and lateral incisors should be constant and in the progressive manner from the central incisor to the lateral incisor. When seen in the frontal plane, the width of the maxillary central incisor should be in golden proportion to the width of the lateral incisor. The proportional width of the maxillary lateral incisor is 62% width of the maxillary central incisor when viewed from the frontal plane. Similarly, the width of the maxillary canine is 62% the width of maxillary lateral incisor which is 38% width of maxillary central incisor (Laxmikanth & Raghavendra, 2014).

The golden number is considered as 1.6. Thus, according to the theory of golden proportion, the width of the lateral incisor is taken as a factor of 1, then the width of the central incisor is considered as a factor of 1.6 and the visible part of the canine will be the factor of 0.6. All the measurements of golden proportion are done on photographs taken from the frontal view wherein the visible mesial portion of the lateral incisor and canine are considered. The golden proportion ratio can vary for the contralateral side of the upper dental arch (Mahshid *et al.*, 2004).

### Preston's Proportion

This theory was given by Preston in 1993 who considered that the rule of Golden proportion cannot be validated for all the esthetically pleasing smiles. Preston also ruled out the Golden proportion because according to his theory, the canine was never able to follow the Golden Proportion rule. Hence, he modified the mathematical values of the Golden proportion and formulated different values which are considered as Preston's proportion (Preston, 1993).

According to Preston's theory, the width of the lateral incisor is 66% of the width of the central incisor. The Width of the lateral incisor is 84% of the width of lateral incisor. The Preston's proportion was determined with the dental photographs taken in the frontal view.

### Golden Mean

The golden proportion was further elaborated in 1999 by Snow SR who gave the relationship of the maxillary central incisor, lateral incisor and canine in relation to the intercanine width of the upper arch (Snow, 1999). The golden proportion also known as the golden mean was formulated to achieve a harmonious esthetic smile which shows symmetry on either side of the maxillary arch.

The theory of the Golden mean or the Golden percentage is based on the intercanine width of the maxillary arch. The intercanine width is the distance measured from the distal surface of maxillary canine to the distal surface of the maxillary canine on the contralateral side of the arch. The theory states that the width of the maxillary central incisor is 25% the intercanine width of the maxillary arch. Similarly, the width of the maxillary lateral incisor is 15% of the intercanine width and the width of the maxillary canine is 10% of the intercanine width. All the measurements are taken on the photograph of the maxillary incisors from the frontal view. The distal surface of the maxillary canine considered is what is seen in the frontal view of the dental photograph.

### Recurring Esthetic Dental proportion

The Recurring Esthetic Dental proportion (RED) was proposed by Ward in the year 2001 (Ward, 2001). This theory includes the variability of the factors between the individuals that influence the proportion and considers other factors like the proportion of the tooth, face and body while calculating the proportion of the anterior teeth. This theory is based on the concept of linear coefficient progression. This suggests that the width of each successive tooth decreases by the same proportion when viewed from the frontal view. This can be applied on the dental structures like the width of the lateral incisor is less than the central incisor by the selected percentage. Similarly, the width of any tooth is less than the tooth present mesially by a particular selected percentage (Ward, 2015).

This theory states that the ratio between the two teeth placed next to each other should be constant as we measurements progress distally. However, these should be expressed as ratios that do not have a fixed value. For example, the Golden proportion gives a fixed value of 62% for the width of the lateral incisor as compared to the central incisor. However, in case of the RED, this value can show a variable value from 60%-80%. These values can also vary with the height of the teeth. For example, if the height of the central incisor is more, smaller ratios should be used. The use of the RED proportion can vary among individuals, however, the same RED proportion should be applied to individual smiles (Ward, 2008).

## **Other proportions that are based on the Golden proportion**

Golden proportion gives a fixed value to the relationship between the central and lateral incisor. Similar to this concept other proportions have been fabricated based on studies in different populations that give their values of correlation based on their surveys. According to the Plato Beauty proportion, the width of the lateral incisor is 57% the width of the central incisor. According to the Esthetic Norm Proportion, the width of the lateral incisor is 71% the width of the central incisor. According to Quarter 3:4 Proportion, the width of the lateral incisor is 75% the width of the central incisor. According to Human norm 5:6 Proportion, the width of the lateral incisor is 80% the width of the central incisor (Liao *et al.*, 2019).

## **Gauge proportion**

In 2008, Stephan Chu designed an instrument that is used to make the visual and objective evaluation of the tooth size (Chu, 2007). This instrument is known as "The Proportion Gauge." Different measurements of the Proportion Gauge are represented by different colors. The red coding represents the central incisor, the yellow coding represents the lateral incisor and the blue coding represents the canine.

The color coding represents the width and length of the individual teeth. According to Chu, the width of the teeth should not vary more than 0.5mm than the standard measurement among different individuals. According to Chu, a standard ratio of 78% is considered between the height and the coronal width of the teeth (Chu, 2007).

## **Smile line**

The level of the smile line is the soft tissue visibility factors which govern the esthetic nature of the smile. The level of the smile line can be changed and plays an important part in smile designing. The placement of the upper lip line and lower lip line is what determines the gingival exposure.

The upper lip line is one that is denoted by the lower edge of the upper lip. This line denotes the amount of exposure of the teeth during smiling. The ideal placement of the upper lip line should be at the gingival level of the maxillary central incisor or within 2mm exposure of the gingival tissue. The smile line is considered high when the upper lip line is 2mm above the marginal gingiva of the maxillary central incisor. The smile line is considered medium when the upper lip line is at the marginal gingiva and the smile line is considered low when the upper lip line is below the marginal gingiva. According to Peck and Kataja, there is a gender variation in the selection of smile lines (Peck *et al.*, 1992). A high and medium smile line is preferred for females and medium and low smile lines are preferred for males.

The lower lip line and its relationship with maxillary and mandibular incisor edge determine the esthetic nature of a smile. The lower lip line represents the upper border of the lower lip. During voluntary smiling the curvature of the incisal edge should coincide with the curvature of the lower lip which. The relationship between the incisal edge of the maxillary incisors and the tip of the maxillary canine is known as the smile arch. These factors must be considered during smile designing as the lower lip line can serve as a guide in determining the length of the maxillary incisors and canines (Sarver, 2001).

In cases of a very high placement of the upper lip line beyond the high smile line leads to the gummy smile appearance. Higher gum exposure does not produce more esthetic results under ideal settings in smile designing. Gingivectomy procedure can be opted to obtain more desirable visibility of the gums during voluntary smile. A 2mm exposure of gum is still considered acceptable in terms of designing an esthetic smile (ZACHRISSON & BU, 1998).

## **Studies comparing the proportion theories that evaluate the natural smile**

In order to evaluate the application of the theoretical proportion in dentistry, various studies have compared different proportions. A study by Murthy and Ramani has compared the Golden proportion to the Golden percentage and RED (Murthy & Ramani, 2008). This study concluded that the Golden proportion and RED cannot be applied to the entire population. However, the use of Golden percentage is more appropriate and can be applied by adjusting the percentage. Another study by Mahajan *et al* also considered golden percentage more appropriate and applicable method for achieving ideal smile designing (Mahajan *et al.*, 2019).

Rosenstiel in his study evaluated the application of Preston's proportion as compared to the RED, Golden proportion and Golden percentage when considering the length of the teeth (Rosenstiel *et al.*, 2000). According to this study, the smiles with 70% RED were preferred as compared to Preston's proportion, Golden proportion and Golden percentage when normal length of the teeth is considered. In case of tall teeth, Golden proportion was a preferred method as compared to other methods. For shorter or normal size teeth application of Golden proportion was not preferred.

A systematic review was done by Liao *et al* which showed that RED at 70% is considered as the most appropriate method to determine the width of the maxillary incisor. According to this systematic review the Golden proportion usually determines the larger width of the maxillary central incisor (Liao *et al.*, 2019).

In addition to considering the various theories in determining width of incisors and canine, the placement of the smile line should also be considered for harmonious esthetically pleasing smiles.

## CONCLUSION

The length and the width of the teeth should be considered in choosing among the different theories to be applied for smile designing. In addition to determining the appropriate visibility of the width, the placement of the upper and lower smile line is also important.

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