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# Estimation of golden divine ratio in extracted human maxillary and mandibular premolars in Tamil population

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**Abstract**
The golden divine ratio, also known as phi (Φ), has a long history of fascinating mathematicians, artists, architects, and philosophers. It comes from the Fibonacci sequence, in which every number equals the sum of the two numbers before it (0, 1, 1, 2, 3, 5, 8, 13, etc.), and its value is around 1.6180339887(1,2). The ratio of successive numbers approaches the golden ratio as the sequence goes on. The value of being able to make use of it depends on its manifestation in nature, art and design.From total 75 premolars of both maxilla and mandibles were chosen for the Study. Crown length, root length and total length were measured using digital. Themisto TH-M61 vernier caliper. And Noted. Golden ratio for teeth was calculated as:
Root length+Crown length/Root length = Root length/Crown length = φ (1.618). The maxillary and mandibular 1st and 2nd premolars were found to follow golden divine ratio with mild deviation. Based on the findings, it is concluded that maxillary and mandibular 1st and 2nd premolar followed golden divine ratio.
**Keyword:** golden divine ratio, human, mandibular premolar,

## 1. INTRODUCTION

The golden divine ratio, also known as phi (Φ), has a long history of fascinating mathematicians, artists, architects, and philosophers. It comes from the Fibonacci sequence, in which every number equals the sum of the two numbers before it (0, 1, 1, 2, 3, 5, 8, 13, etc.), and its value is around 1.6180339887(1,2). The ratio of successive numbers approaches the golden ratio as the sequence goes on. The value of being able to make use of it depends on its manifestation in nature, art and design (3). Examples of Golden Ratio in Nature There are many examples of golden ratio in nature, the arrangement of seeds on a sunflower, the sizes of sea shells and the way trees sprout are all examples of order and harmony in the universe and grab the eye from every direction. Due to the golden ratio's prevalence in Nature, there is speculation it has been involved in biological system optimization and progress.(4,5).The golden ratio was said to be applied for aesthetics and balance in art and architecture by Leonardo da Vinci and Le Corbusier. It had to do with proportions that were both important and beautiful. It's really impressive how lasting the effect of proportion has been. (6)(7). The golden ratio has mathematically interesting properties and appears in some unexpected places like the arts. MathWorld explores its relationship with some other important mathematical numbers and constants and their uses. In doing so, MathWorld reveals many insights into number theory, fractals and geometry. (8). Some of its proponents have even linked it with a "divine proportion", suggesting that there is some kind of transcendent order to the universe. The ancient Egyptians and Greeks perceived it as a representation of their concept of perfection and harmony.(9)
In dentistry, the golden ratio serves as a tool to attain an aesthetically pleasing and balanced smile. A dentist and/or orthodontist can utilize the same concept to determine the widths and lengths of different teeth in a cosmetic or restorative dental treatment(10). The ratio is utilized to ensure proper tooth proportions regarding width and length, along with the relationship between the teeth and other features(11). The golden ratio assists dental experts in designing smiles that look harmonious and natural to people's eyes. By following these ratios, dentists can improve the balance and beauty of a patient's smile, thereby boosting their overall facial appearance and self-esteem(1). When creating dental prosthetics like crowns, veneers, or implants, or conducting orthodontic procedures, grasping the golden ratio principles helps professionals attain ideal results that align with the patient's facial structure and proportions(9,12). Additionally, the use of the golden ratio in dentistry goes beyond aesthetic factors to include functional and structural elements of dental care(13). By positioning teeth and dental restorations in line with these mathematical concepts, dentists can enhance occlusion, boost bite functionality, and improve sustainable oral health results for their patients(14). Consequently, the golden ratio acts as an important asset in contemporary dentistry, enabling both aesthetic upgrades and functional enhancements to produce smiles that are both attractive and health

## 2. MATERIALS AND METHODS

Root length+Crown length/Root length = Root length/Crown length = φ (1.618)
This in-vitro cross-sectional study was conducted in the Department of Oral Pathology, Microbiology, and Oral Biology (SDC Vivarium) at a tertiary healthcare centre, Saveetha Dental College and Hospitals, Chennai, Tamil Nadu, India.
**2.1 Inclusion criteria:** A total of 75 extracted human teeth were included, comprising 17 permanent maxillary 1st premolar, 12 permanent maxillary 2nd premolar, 16 permanent mandibular 1st premolar and 30 permanent mandibular 2nd premolar.
**2.2 Exclusion criteria:** Teeth showing attrition/erosion, fractured roots or crowns, coronal/radicular caries, and unusual anatomical variations like dilacerated roots or teeth exhibiting hypercementosis were not included.

## 3. RESULTS

| | CL(in mmSD) | RL(in mmSD) | TL(in mmSD) | R/C | T/R |
|---|---|---|---|---|---|
| Maxillary 1 st premolar (n=17) | Mean 8.52 | Mean: 13.70 | Mean: 21.93 | Mean: 1.6 | Mean: 1.6 |
| Mandibular 1st premolar (n=16) | Mean: 7.90 | Mean: 12.59 | Mean: 20.93 | Mean: 1.60 | Mean: 1.66 |
| Maxillary 2nd premolar cl (n=12) | Mean: 8.27 | Mean: 13.35 | Mean: 21.47 | Mean: 1.61 | Mean: 1.61 |
| Mandibular 2nd premolar (n=30) | Mean: 8.06 | Mean: 12.93 | Mean: 21 | Mean: 1.60 | Mean: 1.62 |

**Figure 1:** mean crown length, root length, total length, mean root/crown ratio and mean tooth/root ratio for maxillary and mandibular 1st and 2nd premolars; SD-standard deviation, CL- crown length, RL- root length, TL- tooth length, R/C- root to crown ratio, T/R- tooth length to root length ratio.
Crown length, root length and total length: Twenty nine extracted permanent maxillary 1st and 2nd premolar were included. The average crown length was 8.52mm and 8.27mm, root length were 21.93mm and 13.35mm and total length was found to be 21.93mm and 21.43mm. And for the rest of the forty six mandibular 1st and 2nd premolar crown length, root length and total length were recorded and found to be 7.90, 12.59mm and 20.93mm respectively for 1st premolar and 8.06mm, 12.93mm and 21 mm respectively for 2nd premolar ( Figure 2).
The maxillary 1st premolar has overall, Mean C/L ratio of 8.5 and R/L ratio of 13.7. So Golden ratio, Mean R/C ratio was 1.609 and T/R ratio was 1.605. The maxillary 2nd premolar has overall, Mean CL ratio Of 8.27, RL ratio of 13.5. The golden ratio of maxillary 2nd premolar, Mean R/C ratio was 1.61 and T/R ratio was 1.61. The mandibular 1st premolar has overall, Mean CL ratio of 7.9 and RL ratio of 12.5. So Golden ratio, Mean R/C ratio was 1.6 and T/R ratio was 1.66. The mandibular 2nd premolar has overall, Mean CL ratio of 8.06 and RL ratio of 12.9. So Golden ratio, Mean R/C ratio was 1.6 and T/R ratio was 1.62( Figure 1). As these ratios were in close approximation to the golden divine ratio corresponding to the value of 1.618 with mild deviation were found.

## 4. DISCUSSION

The golden divine ratio, a mathematical idea based in beauty and balance, has fascinating uses in the field of dentistry. Dentistry, in addition to its practical function in oral health, explores the complexities of facial aesthetics and balance, with the golden ratio serving as a foundational concept. Its use in dentistry includes multiple elements, ranging from smile creation to tooth ratios, all focused on attaining aesthetically pleasing and natural results for patients(15)
To begin with, the golden ratio acts as a key principle in aesthetic dentistry, providing a framework for designing smiles that are attractive and balanced. By following the golden ratio, dentists can attain symmetry and balance in dental restorations, making certain that the proportions of teeth and adjacent structures harmonize perfectly(16).In tooth measurements, the golden ratio defines the perfect relationship between the length and width of teeth, especially in the front area. Dentists apply this principle to establish the sizes of central incisors, lateral incisors, and canines, guaranteeing that they coordinate with one another and with the patient's facial characteristics (17).Additionally, the golden ratio goes beyond tooth proportions to include the connection between teeth, lips, and facial features. Dentists take into account both the specific measurements of teeth and their positioning in relation to the lips and adjacent facial features to design smiles that improve overall facial appearance(17,18).

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Although the golden ratio offers useful insights in aesthetic dentistry, it is important to recognize its constraints and the necessity for personalized treatment strategies. Every patient has distinct facial traits and preferences, which can differ from the ideal proportions set by the golden ratio(19). Dentists should use clinical judgment and take into account individual patient factors when implementing these principles in treatment planning.

Improvements in digital smile design and computer-assisted technology have transformed the incorporation of the golden ratio into dentistry. Digital tools allow dentists to accurately assess facial proportions, predict treatment results, and tailor smile designs based on each patient's individual anatomy and preferences(11). Besides its aesthetic aspects, the golden ratio plays a crucial role in patient contentment and mental health. Individuals frequently link a balanced smile to self-assurance and appeal, rendering the use of the golden ratio an important method for boosting self-worth and overall well-being (10).

In general, the golden divine ratio acts as a foundation in the field of aesthetic dentistry, helping practitioners design smiles that are both functional and visually attractive. By grasping the concepts of the golden ratio and thoughtfully applying them in clinical practice, dentists can attain exceptional outcomes that go beyond simple restoration, creating smiles that exude beauty and confidence.

In summary, the golden divine ratio acts as a fundamental principle in both the art and science of aesthetic dentistry, directing practitioners in designing smiles that are both functional and visually appealing. By grasping the concepts of the golden ratio and thoughtfully applying them in clinical practice, dentists can attain extraordinary outcomes that go beyond simple restoration, creating smiles that exude beauty.

## 5. CONCLUSION

From the results it is concluded that permanent maxillary and mandibular 1st and 2nd premolars followed golden divine ratio. It is essential for the reproduction of aesthetic and function of a tooth by the dentist. It also plays a significant role in veneer, crown, bridge and even for the fabrication of removable prosthesis to produce the desired aesthetics and function according to one's facial configuration.

**AUTHORS CONTRIBUTION:**

Ilammaran varshan contributed to literature survey, experimental work, data collection, analysis, and manuscript preparation.

Dr. Aparna Mohan E contributed to literature survey, experimental work, data collection, analysis, and manuscript preparation.

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