INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH
(ISSN: 2454-4191)
www.ijmsdh.org (2026)

Received: 28 June 2026
Revised: 27 July 2026
Accepted: 03 Aug 2026
Published: 14 Aug 2026

Volume 12 Issue 08, 2026
Page No - 95-110
DOI - 10.55640/ijmsdh-12-08-12

Article Citation: Karamitri, E. (2026). Proportions and Biometry in The Maxillary Anterior Dentition – A Review. International Journal of Medical Science and Dental Health, 12(08), 95-110. https://doi.org/10.55640/ijmsdh-12-08-12

Proportions and Biometry in The Maxillary Anterior Dentition – A Review

Edisa Karamitri, DDS, MS
Lecturer, Clinical Professor
Department of Prosthodontics, School of Dental Medicine, Tirana, Albania
Department of Stomatology, Faculty of Medical Sciences, REALD University, Vlore, Albania

Abstract

Despite a widespread variability in nature, practitioners have long been guided by the desire for predictable and reproducible means to interpret anterior teeth proportions for successful anterior dental aesthetics. Tooth biometry is an essential aspect of anterior arch restorations, where identification and correction of tooth size variations is critical to smile analysis and design.

Achieving a beautiful smile requires harmonious application of art and science.

Recent advances in electronics have made it possible to create virtual smile designs for patients with the click of a button. However, set formulas for intra-arch anterior tooth relationships, as numerous studies have shown, cannot be used as guidelines, they can only be applied and preferred by confined sets of patient populations.

Through this article the author aim to:

Give a synopsis of the psychological and scientific basis of ideal beauty and proportions in nature and the validity of contemporary guidelines.

Review the literature to investigate the suitability and limitations of various proportions proposed for the anterior dentition, like the golden proportion, the recurring aesthetic dental proportion and the golden percentage.

Highlight the relevance of tooth biometry values versus proportions in the dentofacial complex.

Draw conclusions on the more predictable and reproducible tools that clinicians can apply, for satisfying results, including in patients with missing anterior teeth, abnormal values or tooth size variations and discrepancies.

This review will assist the restorative dentist in the everyday practice with the necessary tools and knowledge in order to achieve an aesthetic result with ease and predictability in every aesthetic reconstruction case, regardless of its complexity.

Keywords: facial aesthetics, golden proportion, dental proportions, teeth dimensions, tooth biometry, anterior restorations

Introduction

During the aesthetic rehabilitation of the maxillary anterior region we face challenging tasks. Partially or completely edentulous arches where reference landmarks are missing, tooth size and shape discrepancies, as well as soft tissues procedures, are only a few of the clinical scenarios that require blending of art, biology and precise formulas to meet patient's expectations. The increased availability of treatment options, soft tissue procedures and implant dentistry in the esthetic zone entail at the same time higher esthetic demands and predictability. It becomes thus paramount the harmonious application of art and science with the adequate application of dental aesthetic principles of tooth biometry as well as face and tooth proportions. To attain the desired outcome in anterior dental esthetics, we aim to use measurable means in order to have predictable and reproducible results.

There is a great variety of articles around this topic since the beginning of the last century, nonetheless an updated knowledge on the validity of proportioning theories and biometry values becomes imperative, especially in the era of digital smile designs.

Historical Perspective

The humanity's quest to crack the code of beauty has never ceased to exist. Just like in art, science, health, in dentistry we try to apply a precise language to create beauty by expressing it mathematically, as per Galileo Galilei: "Measure what is measurable, and make measurable what is not"

Testimony of this mathematical expression is ever-present., Khesi-Ra's panels in ancient Egypt (fig.1) show the harmony rules encoded by geometry language. The panels demonstrating the rule of the "Golden Section" (the proportion of 1: square root of 5) testify that the author was familiar with the secret of harmony. [1]

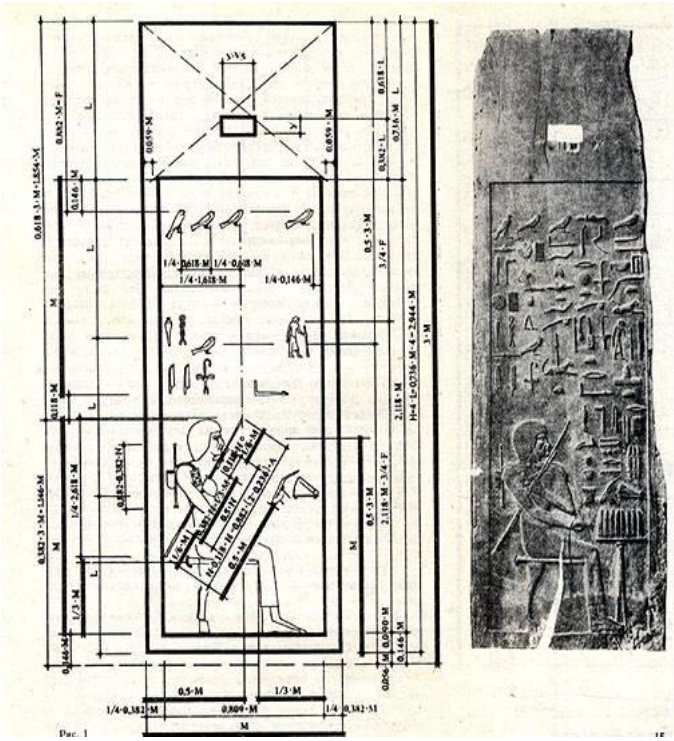

Fig.1 *Khesi-Ra's panels*

In Exodus 25:10, God commands Moses to build the Ark of the Covenant to hold the Ten Commandments, saying: "Have them make a chest of acacia wood- two and a half cubits long, a cubit and a half wide, and a cubit and a half high."

In Genesis 6:15, God commands Noah to build an ark saying: "And this is the fashion which thou shalt make it of: The length of the ark shall be three hundred cubits, the breadth of it fifty cubits, and the height of it thirty cubits."

In the scripts of the Old Testament appear the ratio of 2.5 to 1.5 - that of the golden proportion and 5 to 3 - numbers from the Fibonacci series. [3]

GOLDEN SECTION/GOLDEN MEAN/DIVINE PROPORTION, is an irregular number and cannot be expressed fully in decimal form: Φ = 1.618033… or (1 + square root 5)/2

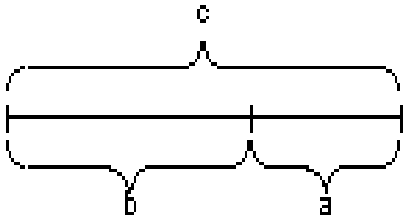

Fig.2 *"c" is to "b" as "b" is to "a"; c: b = b: a*

The Golden Proportion (or Phi) can be derived through a numerical series, such as a segment divided at the unique point where the length of the entire line segment is to the length of the larger line segment, as the length of the larger line segment is to the length of the smaller line segment (fig.2). Later, Leonardo Fibonacci discovered the Fibonacci series: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377… which is both additive, as each number is the sum of the previous two, and multiplicative, as each number (called a "Fibonacci Number") approximates the previous number multiplied by the 'Golden Section'. The ratio becomes more accurate as the numbers increase. [2]

The Story of Phi

Egyptians may have used both pi and phi in the design of the great pyramids.

Pythagoras of Samos (570-490 b.c.) – irrational Pythagoreans-Hyppasus of Metapontum

Phidias (490–430 b.c.) made the Parthenon statues that seem to embody the golden ratio.

Plato (427–347 b.c.) describes five possible regular solids (the platonic solids): the tetrahedron, cube, octahedron, dodecahedron, and icosahedron, some of which are related to the golden ratio.

Euclid (c. 325–c. 265 b.c.) in his Elements, gave the first recorded definition of the golden ratio, which he called "extreme and mean ratio"

Fibonacci (1170–1250) mentioned the numerical series now named after him in his Liber abaci (Book of calculation); the ratio of sequential elements of the Fibonacci sequence approaches the golden ratio.

Luca Pacioli (1445–1517) defines the golden ratio as the "divine proportion" in his Divina Proporzione.

Johannes Kepler (1571–1630) proves that the golden ratio is the limit of the ratio of consecutive fibonacci numbers and describes the golden ratio as a "precious jewel", combined with theorem of Pythagoras in the Kepler triangle.

Charles Bonnet (1720–1793) points out that in the spiral phyllotaxis of plants going clockwise and counter-clockwise were frequently two successive Fibonacci series.

Martin Ohm (1792–1872) is believed to be the first to use the term goldener schnitt (golden section) to describe this ratio in 1835.

Edouard Lucas (1842–1891) gives the numerical sequence now known as the Fibonacci sequence its present name.

Mark Barr (20th century) suggests the greek letter phi (φ), the initial letter of greek sculptor Phidias's name, as a symbol for the golden ratio.

Roger Penrose (b.1931) discovered a symmetrical pattern that uses the golden ratio in the field of aperiodic tiling, which led to new discoveries about quasicrystals (Al-Mn-Si, Ti-Zr-Ni).

Though not widely mentioned neither documented, the use of numbers like pi and phi dates back to the ancient cultures. Parthenon was achieved through the use of the "dynamic" and "root five rectangle" (a rectangle with an irrational side: the square root 5). The Greek sculptor Phidias confirmed the use of this proportion in the construction of the Parthenon statues, he

sculpted most of them using the Golden Ratio. [2] Designed by Ictinus and Callicrates, Parthenon's surrounding pillars were an example of "number applied". The secret, quasi-religious Pythagorean society continued this tradition with the worship "All is number" or "God is number". Although not naming it the Golden Ratio, Euclid of Alexandria defined the proportion: "A straight line is said to have been cut into extreme and mean ratio when, as the whole line is to the greater segment, so is the greater to the lesser." This "ratio" continued to be used in art and architecture for centuries in an empirical way, until Fibonacci introduced to the western world another concept involving this ratio, the Fibonacci series. Luca Pacioli (1445-1517) published "Divina Proportione"(fig.3) in Venice in 1509 which contained a detailed summary of the properties of the Golden Ratio. Up until Pacioli's time, the Divine Proportion had been known as "extreme and mean ratio" or "proportion having a mean and two extremes" and the concept appears to have only been known to mathematicians. The theological and philosophical implications and Leonardo da Vinci's drawings for the book demystified the notion to the large public of artists and intellectuals, bringing the ratio to the attention of a new audience of artists and intellectuals.

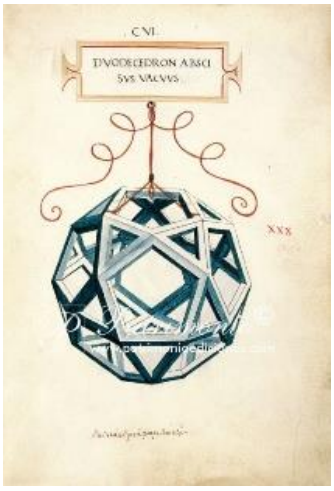

Fig.3 *Luca Pacioli's "Divina Proporzione", with models drawn by Leonardo Da Vinci, making it the only book illustrated by the artist in his lifetime.*

The German mathematician, Martin Ohm, in a footnote in the 1835 second edition of Die Reine Elementar-Mathematik first termed it the *Golden Section*: "One also customarily calls this division of an arbitrary line in two such parts the golden section [Goldene Schnitt]." Edouard Lucas names the *Fibonacci series*, while in mathematics the common symbol for the Golden Ratio is the Greek letter tau from the Greek word for "the cut" or "the section". Early in the twentieth century the American mathematician Mark Barr, gave the ratio the name of *phi*, the first Greek letter in the name of the Greek sculptor, Phidias (c. 490 BC-c. 430 BCE). This is the more common term today. Adolf Zeising (German psychologist 1810 – 1876), who found the golden ratio to be expressed in the arrangement of branches, stems of plants, veins in leaves, skeletons, veins and nerves of animals, the proportions of chemical compounds and the geometry of crystals, even in art, saw the Golden Ratio operating as a universal law. In 1854 he wrote: "The *Golden Ratio is a universal law in which is contained the ground-principle of all formative striving for beauty and completeness in the realms of both nature and art, and which permeates as a paramount spiritual ideal all structures, forms and proportions, whether cosmic or individual, organic or inorganic, acoustic or optical; and which finds its fullest realization, however, in the human form."* [4] [5]

Fig. 4 *Distant galaxy, typhoon, flower and leaf arrangements, nautilus shell, DNA helix. The equiangular spiral (logarithmic spiral), which describes a family of spirals defined as a monotonic curve that cuts all radii vectors at a constant angle. The inverse of these spirals is also the same spiral. It can be created by joining angles of golden rectangles, also tied to Fibonacci numbers and can be the geometrical pattern for that sequence.*

Proportions in Art and Nature

Art found its inspiration in nature, and the Golden ratio in nature is omnipresent. A few of the expressions of this Ratio in the world that surrounds us are found in the length and number of extremities of the human body, the EKG waves of the human heart, the solar system and galaxies, the relative distances of the planets, the spectrum of visible light, the Elliott Wave Theory in stock market; there's also an unusual energy source at the frequency of phi that is found in the universe. [6]

Classical cultures of Greece and Rome based their standards of beauty on set rules of proportion and composition. The Greek standards originated by the Pythagoreans School and its disciples over the following centuries. The famous Pythagorean Philolaus (425 B.C.E.) writes: *"Were it not for number and its nature, nothing that exists would be clear to anybody either in itself or in its relation to other things...You can observe the power of number exercising itself ... in all acts and the thoughts of men, in all handicrafts and music."* Whereas Roman standards were imposed by Vitruvius, (fig. 5) whose proportions were reproduced by Leonardo da Vinci in the classic Square of the Ancients, (fig. 6) that appeared as illustration in Luca Pacioli's book "Divina Proporzione" (1504). Leonardo da Vinci's drawing (c. 1489) of an old man proportions of the face and eye can be overlaid with a square subdivided into rectangles, some of which approximate Golden Rectangles. [2] [4]

Fig.5 *Vitruvius " De Architectura"*

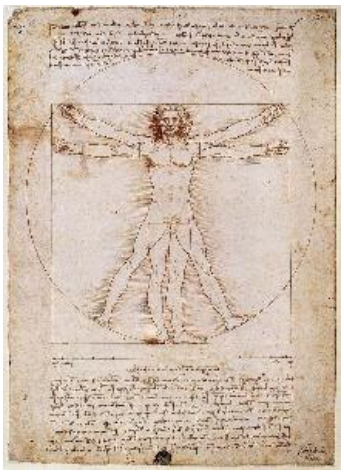

Fig. 6 *Square of the Ancients- Leonardo da Vinci*

Virgil's "Aeneid" and other great works of Classical Poetry used φ to determine metric structure of the poem. Mozart's sonatas tend to divide in parts exactly at the Golden Section of total time of the work. In Beethoven's 5th Symphony the opening motto is repeated at exactly the Φ point through the Symphony (Bar 372). Stradivarius placed the "f" holes in his violins at the Φ point of the body structure. Beauty in arts depends on "the symmetry on all parts of the body, and of the relationship between these parts, and between each of them related to the whole". As Luca Pacioli said: Without mathematics, there is no art!

Biology and Psychology of Ideal Beauty

The good is always beautiful, and the beautiful never lacks proportion. (Plato)

Fig. 7 *The Doryphorus – statue created by Polyclitus is considered to be one of the highest achievements of the classic Greek sculpture.*

What is Ideal beauty and what are the reasons for its existence?

Beauty is defined as "the quality or combination of qualities in an entity which evokes in the perceiver a combination of a sense of "strong attraction" and a sense of "strong positive emotion".

Plato (427-347 BCE) discussed his "Forms", postulating that all objects have an "ideal form" or structure. He taught that these "Forms" were perfect objects of mathematical or other conceptual knowledge and that these "pure" forms existed only in the realm of knowledge and never in the reality of human everyday existence. Individual things in the realm of appearance are beautiful only as long as they approach in structure these universal "Forms" of beauty. To him, beauty was an Ideal in a rational and unchanging world, yet more real than physical objects.

Karl Jung (1875-1961) took the concept of Plato's "Forms" further and presented his own Theory of Archetypes. In Jungian Psychology beauty is a subconscious image, an instinctual idea, an Archetype, inherited from the ancestors of the race and universally present in individual psyches, which we are born with and carry throughout our lives. This archetype helps us identify members of our own species according to their relative health and ability to successfully reproduce and provide for us. It is not strictly an image of "beauty" but actually an image of "humanness".

Perceived "Ideal" facial attractiveness and the agreed ideal beauty

Studies on infant perception indicate this genetic inclination towards beauty. Infants of 2-3 months old, considered still too young to be influenced by society stereotypes, are able to respond differently to previously categorize attractive faces; hence their choices have more of a genetic tendency towards perception of beauty. Other studies in the 90's and 2000 have shown that our predilection to beauty is in fact a limbic trait; it resides in the most primitive part of brain, along with the expression of our basic emotions and survival instincts. [7][8]

Collective agreements on the ideal beauty and the validity of contemporary guidelines

Different cultures have different standards for beauty that vary widely but the response to beauty is universal. Studies from Langlois and Roggman show that average faces with facial proportions that fall within the mean values of the population were considered attractive. (Averageness theory). Alley and Cunningham added to the equation secondary sexual traits (Multiple motive hypothesis of attractiveness) and found specific traits that men or women would consider attractive in the opposite sex, such as neoteny, maturity, and expressiveness. These findings suggest that: "*large eyes, a small nose and chin, high cheekbones, and a large, balanced smile are considered to be the physical attributes of a beautiful female face. Likewise, the handsome male face will have these same attributes but with the modifications of a relatively small nose, bushy eyebrows, and prominent chin".* The reasons for this have an evolutionary biological basis: averageness and symmetry being intrinsically associated with health, while attractiveness being the stimulus for sexual reproduction. Consequently, when it comes to a patient's facial appearance, the result of our treatment can be justified with the collective judgments of facial attractiveness, and be agreed upon as "attractive" when post treatment values are closer to those of the mean of that population, as a version of "averageness". One of the most valid sources of obtaining these "mean standards" is Anthropometry, however many controversies exist in the skeletal evaluation criteria of what is considered norm, or further more attractive. [6][9] [10]

Skeletal and Soft Tissue Facial Proportions Based on The Golden Proportion

The Skeletal Archial analysis (Modified Sassouni Analysis) is a skeletal classification system based on clinical, cephalometric, esthetic, biologic, physiologic characteristics common to human race and it is based on the Divine Proportion. [24][12] According to this analysis, any aberration from this proportion is due to external, environmental factors, interfering with the normal growth pattern, because genetically we are all encoded to a growth pattern based on the golden proportion. (fig.8)

Why this fascination and interest in the Golden Proportion? Because golden proportion is omnipresent in everything beautiful in nature, art and beyond, and the humanity's quest to crack the code of beauty by expressing it mathematically and applying a precise language to it has never ceased to exist. Attempts to quantify the ideal, most beautiful face have fascinated mankind for thousands of years, but though timeless beauty exists, no one has been able to delineate the perfect form of the face in a repeatable reproducible way. [11][32]

Fig. 8 *Jefferson Analysis (Modified Sassouni Analysis or Skeletal Archial Analysis) is a hard tissue analysis for evaluating lateral profiles.* [24]

In his attempts towards decoding facial attractiveness, Marquardt developed a soft tissue analysis based on the divine proportion [31], more specifically on the Golden Decagon hypothesis. In Dr Marquardt's Beauty analysis website, with the use of mathematics, computers and databases of attractive faces, facial attractiveness is quantified in a consistent mathematical computer model in repose and smile expressions in front and side views, as well as a 3D model. A special link (fig.9) allows you to superimpose facial photographs on preformed grids to assess esthetic problems. Marquardt proves his hypothesis that facial beauty is universal and timeless by showing photographs of beautiful faces belonging to different races and periods of time conform to these archetypal masks. The author suggests the mask could also be used to help with creating cosmetic makeup, surgery and dentistry for people who have suffered facial disfigurement. [31][25]

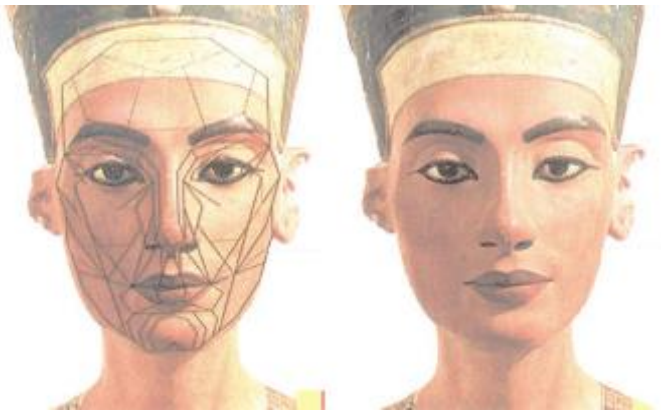

Fig. 9 *Beauty is universal and timeless.*

Despite the limited and controversial studies, golden proportion can be used as a reference or guideline in facial esthetics.

Dento-Facial Proportions

Despite the fact that a recent literature review article found that correlations between dental dimensions and facial parameters are not always present [28], attempts have been made in the past to create tools that could be used in determining anterior tooth size and position based on these proportions. Some examples are: The Golden Mean Gauge(fig.10): In the relaxed face, where the lower jaw is in the rest position with freeway space present, the lip line divides the lower third of the face (SN-M) into the Golden Proportion. This tool, applied in conjunction

with phonetics and esthetics, was used to assist in determining the incisal edge position of the incisors in denture teeth.

Trubyte tooth indicator (fig.11): It has been stated in the dental literature that the height of the maxillary central incisor should be 1/16 the height of the face from the ideal hairline trichion to menton (Tr-M) and that the width of the ideal central incisor should be 1/16 of the interzygomatic distance. The rule of the thirds and the 1/16 rule has been combined to create the Trubyte tooth indicator which can be used as a guide in selecting denture teeth.

Fig. 10 *The Golden Mean Gauge*

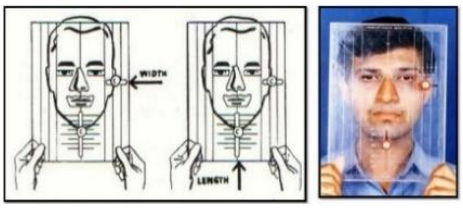

Fig. 11 *Trubyte tooth indicator*

Proportions Proposed for The Anterior Dentition

There have been numerous attempts to find the right proportion and find the formula that dentists can apply to predictably restore anterior teeth to the most attractive smile.

Repeated ratio

Golden Proportion

Golden Mean

Preston Proportion

RED

Marquardt Golden rectangle

Plato Beauty Proportion (57%)

Esthetic norm Proportion (71%)

Quarter 3:4 Proportion (75%)

Human norm 5:6 Proportion (80%)

The Repeated ratio

The first to suggest the application of a proportion in dentistry was Dr. Richard Lombardi in 1973 in the Journal of Prosthetic Dentistry in an article related to denture esthetics. [13] He described the use of a repeated ratio in the maxillary anterior teeth. This implies that in an optimized dento-facial composition the width of lateral to central incisor and canine to lateral are repeated in proportion. According to Lombardi, strict application of the golden proportion has proved to be too rigid for dentistry. It must be emphasized that these are the widths as seen, "apparent", not measured. Attempts to find the relationship between the measured widths of the incisors have all been futile.

The Golden Proportion

Levin was the one who took the golden proportion in dentistry to a different dimension. Golden proportion "grid" and "caliper" were devised and their use advocated to evaluate and develop harmonious proportions of teeth and smile, applying also the idea that the anterior esthetic segment is in golden proportion to the total width of the smile. [14]

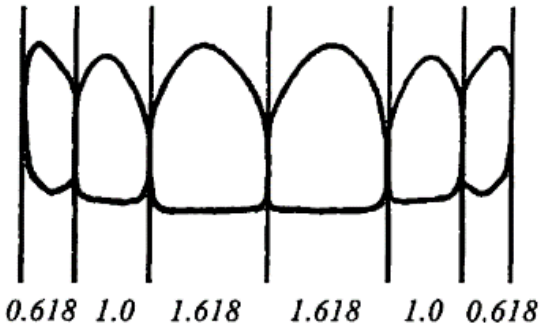

Fig. 12 *The width of the central incisor is in the golden proportion to the width of the lateral incisor The width of the lateral incisor to the width of the canine is also in the golden proportion as is the width of the canine to the first premolar.*

Fig. 13 *Rufenacht in Fundamentals of Esthetics (1990) refers to Levin's theories and illustrates the use of the grid.*

Preston Proportion

Preston revisited the golden proportion in 1993. He studied the existence of Golden proportion in natural dentition and found that only 17% of the maxillary lateral incisors' width was in Golden proportion with the width of maxillary central incisors and none of the canines' width were in Golden proportion to the width of maxillary lateral incisor. What Preston deducted from the results of his study was that "this theory is not derived from nature" and that "The results of this study not only deny the existence of such ratios in the average natural dentition, but also call for the reevaluation of the results of preceding studies that are in contrast to this investigation". Other studies have supported Preston's view concluding that the golden ratio between the perceived widths of the maxillary lateral incisors to the canines does not seem to be decisive for an attractive smile while other factors should be. He proposed Preston's proportion, that is, the width of maxillary lateral incisor should be 66% the width of central incisors and the width of maxillary canines should be 55% the width of maxillary central incisors in the frontal view. [15] (fig.14)

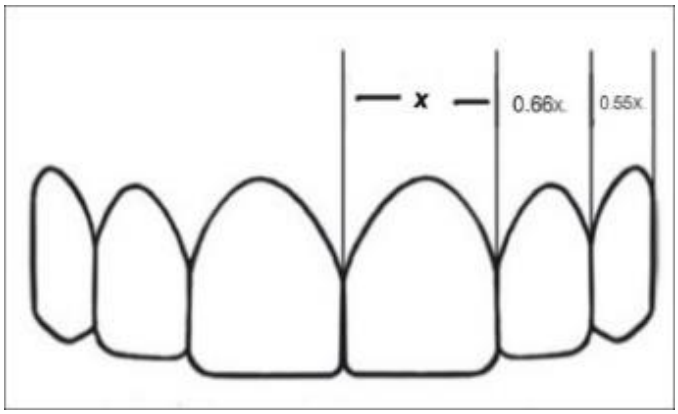

Fig. 14 *Preston's proportion*

Golden Percentage

Dr. Steven Snow in 1999 in the Journal of Aesthetic Dentistry described the golden percentage. Snow considered the apparent individual tooth width as percentage of the total apparent width of the six anterior teeth. He proposed the Golden Percentage, where if we take the measurement from the distal of the canine on one side to the distal of the canine on the other as a 100%, then our central incisors would take up the center 50% of that photo or about 25% each, each maxillary lateral incisor must be 15% and each maxillary canine 10% of the intercanine distance as viewed from the front in order to achieve an aesthetically pleasing smile.

[25][28][32]

Recurrent esthetic dental proportion (RED)

Ward in 2000 proposed Recurring Esthetic Dental (RED) proportion. A mathematical formula calculates the width of the maxillary central incisor for any RED proportion given a fixed inter-canine frontal view. RED is not limited to one particular proportion but allows the desired proportion to be selected and consistently applied throughout each individual case, giving the clinician the ability to change the proportions of the teeth to suit the individual patient's face, bone structure, or general physical type. Thus, the Golden proportion could be defined as the 62% RED value. RED values may vary between 60%-80% with apparent width proportion between two adjacent teeth moving distally remaining constant. [16]

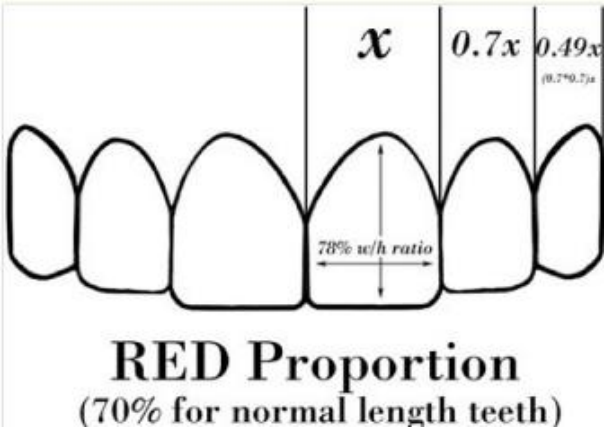

Fig. 15 *A method for designing a smile balanced with the face is 70% RED proportion for normal length teeth with a 78% width/height ratio of the maxillary central incisors.*

From the RED Formula: ICW/2(1+RED+RED2) = WCI can be deducted that we can modify the RED, height, width of central incisors, or intercanine distance, depending on the clinical scenario, while maintaining the other unchanged. (fig.15)

Studies have shown that the majority of dentists prefer the 80 % proportion when viewing short or very short teeth and the golden proportion when viewing very tall teeth, with central incisors that are as close to 0.75-0.78 width/height ratio as possible. * These results reinforce the idea that when determining the width of maxillary anterior teeth, it is important to consider their length, as the latter would change the perception towards a certain proportion.

Glancing through tooth to tooth proportions used for an aesthetic smile design, it is rare to observe golden numbers in anterior teeth. In situations of strict adherence to the golden rule, excessive narrowness of the maxillary arch and compression of lateral segments can be observed.

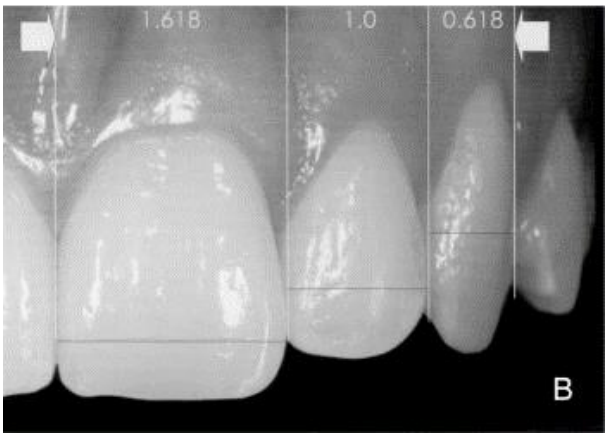

Fig. 16 *Frequently lateral incisors and canines generate the perception of narrowness, therefore providing the illusion of the golden proportion due to features like opened inter -incisal angles.*

As concepts of *perceived* proportions (*apparent* width), they can be influenced not only by proper dimensions but also by factors that can change our perception, such as: transition line angles, dominance, special effects of tooth form that influence the perception of symmetry, etc. (fig. 16)

Tooth Biometry and Proportions

Tooth Size: Width, Length

Tooth proportion: Width/length ratio

Natural tooth dimensions (mesiodistal and incisovervical) have been available through dental morphology sources since 1902, but crown width / length ratios have been considered only recently, yet, measurements of width /length ratios of normal clinical crowns seem to represent the most stable reference. According to dental morphology books, maxillary central incisors' average width is approximately 8.5 mm, average length ~1 0.2 mm and average width/length ratio ~85%).

The ratio W/L gives us the tooth proportion which can be expressed in percentage: W/L= TP %. It becomes thus important to know the variations and distributions of tooth dimensions in the general population, and their variations according to gender, ethnicity, etc.

Chu studied the "Range and mean distribution frequency of individual tooth width of the maxillary anterior dentition". This study found that as a group, a central incisor with a width of 8.5 mm, a lateral incisor with a width of 6.5 mm, and a canine with a width of 7.5 mm occur only in 34% of the population. However, 82% of the patients fell within ±0.5 mm of the mean values. (fig. 17) Therefore while restoring anterior teeth to the average dimensions of 8.5/ 6.5/ 7.5 would be correct only 34% of the time, if the range expanded within each tooth group to + - 0.5 mm of the mean value, than the percent of the population increased to 82% for maxillary anterior teeth.* Gender differences in the tooth shape have not been supported in the dental literature, this study showed gender differentiation in tooth width with ranges for males consistently 0.5 mm larger, whereas for females 0.5 mm smaller than the mean, which can be applied during aesthetic restorations with a respective 70% and 60% level of confidence.[20] [21]

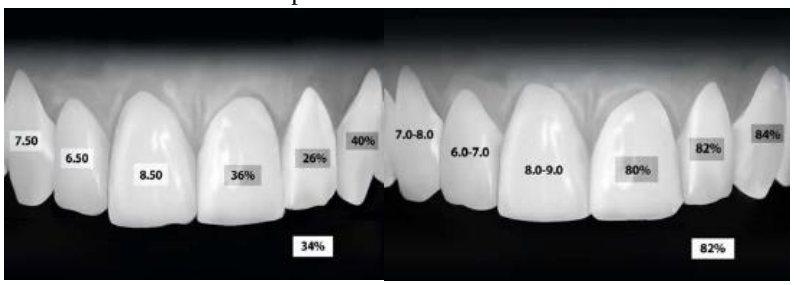

Fig. 17 *While restoring anterior teeth to the average dimensions of 8.5/ 6.5/ 7.5 would be correct only 34% of the time, if the range expanded within each tooth group to + - 0.5 mm of the mean value, the percent of the population increased to 82% for maxillary anterior teeth.*

Sterrett et al reviewed the: "Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man". The results of this study indicate that within male and female Caucasians, all width and length measured significantly greater for males than females (0.5mm greater for the width and; 1mm greater for the length), with the mean width/length ratio of the maxillary anterior teeth of 0.81. [33]

Magne et al. studied the "Anatomic crown width/length ratios of unworn and worn maxillary teeth". The width/length proportions of worn vs unworn anterior maxillary teeth were respectively 79-87% and 73-78%. As teeth get worn, the W/L ratio becomes greater due to the reduction of length, while the width of tooth does not change. [22]

Other studies have provided TP (tooth proportion) ratio ranges from 72%- 81%. [25][26][28]

While tooth width generally remains constant (in the adult population and when no orthodontic interventions are planned), tooth length is frequently the variable that has changed as a result of the aging process, need for restoration, periodontal procedures, or natural variations. Thus, applying the formula for tooth length while knowing tooth width and proportion: L=W/TP%, the clinician can determine appropriate tooth length during restorative or periodontal procedures. Proper diagnosis of tooth size for each patient is critical in treatment planning for aesthetic restorative dentistry. *Tooth biometry* is an important aspect of aesthetic dentistry in periodontal and restorative reconstruction that will allow proper arrangement of teeth in anterior maxilla and enable successful outcomes. [20]

Artificial denture teeth proportions

A simple calculation of the W/L ratios of denture teeth (IPN Dentsply mould chart) for maxillary central incisors (Square Mould randomly picked), reveals results that fall within the values agreed upon by previous research. Results are comparative with the other moulds, within a certain variability range noticeable in this table. Most proportions range from 78-87 %.

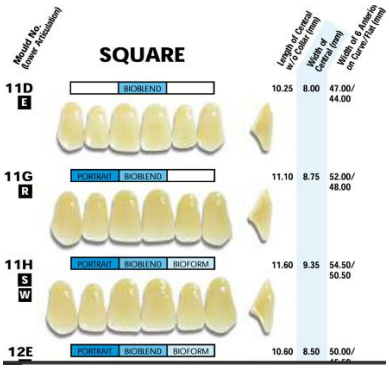

Fig. 18 *IPN Teeth Mould Chart*

L of Central mm)	W of Central (mm)	W of 6 Anteriors (mm)	Ratio WCI/LCI
9.30	**8.10**	**47.50/44.00**	**87%**
9.50	**7.75**	**46.00/44.00**	**81%**
10.25	**8.00**	**47.00/44.00**	**78%**
10.25	**8.50**	**50.50/47.00**	**82%**
10.60	**8.50**	**50.00/45.50**	**80%**
10.60	**9.15**	**53.00/49.00**	**86%**
11.10	**8.75**	**52.00/48.00**	**78%**
11.60	**9.35**	**54.50/50.50**	**84%**

Dental proportions applied in smile design software

Recent advances in electronics have made it possible to create a virtual smile for the patients with the help of some basic data like front and profile digital photographs, casts, cone beam CT images. Some digital smile design softwares are: Coachman (DSDApp LLC), Planmeca romexis smile design (PRSD), Smilecloud, ADN3D biotech, Smile designer app, Smile designer pro, 3Shape smile design, Cerec SW, Exocad smile creator, etc. They provide an effective communication between the patient-dentist-dental technicians, and can be an excellent tool for correct detection of problems, visualization of possible solutions, and thus balancing expectations and increasing mutual trust. [27][29]

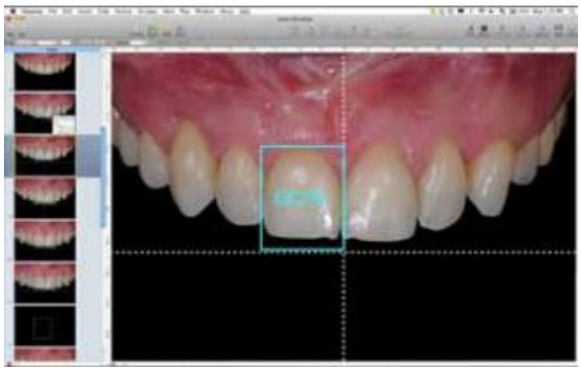

Fig. 19

The digital smile design starts with a comprehensive workflow that simulates the patient's treatment process, applying a combination of principles that make facial aesthetics compatible with the dentogingival structures [23]. With the help of the photo protocols taken with certain parameters on the face, the dentist can identify and emphasize inconsistencies in face, dento-gingival and dental morphology, and find the best solution. Most of them apply a width/ length ratio of maxillary central incisors between 75-86% [29], with 80% being the most common (fig. 19). However, details on the rationale applied by digital tools for choosing such ratio (W/L) or dimensions (W, L) and how an algorithm decides on the best tooth dimensions and proportions on a case by case basis, lack as to the specificity of each clinical scenario. More transparency and further studies may be needed in regards to the formulas used by various digital smile design software and their clinical relevance.

Conclusion

Key takeaways that could be taken into consideration for anterior teeth esthetic treatment.

Face

Golden proportion can be used as a reference in facial esthetics.

Facial esthetics goals:

Dimensions close to the mean of the population

Symmetrical face /smile

Enhancement of secondary gender characteristics

Teeth

Maintain constant ratio of maxillary anterior teeth in frontal view (apparent width) from central to canine (62% - 80% depending on tooth length).

Identify proper tooth biometry. Apply tooth proportions. Width/height ratio 0.75 - 0.81 reported as most aesthetic.

Follow structural esthetic rules of dentofacial and dentogingival complex.

Consider patient’s morpho-psychological characteristics.

When we consider the important features of the dento-facial composition, such as: unity, symmetry, proportion, repeated ratio, balance, lines, dominance, personality, teeth proportions are only one of the many elements that we need to address to achieve harmony.

Finding proper tooth dimensions for each patients remains a challenging task because there are no magic formulas and our perception is influenced by objective and subjective factors. Clinicians need to identify the biometric values and proper tooth size suitable for each patient in order to create an aesthetic smile with their restorations.

References

1. Stakhov, A. The golden section, secrets of the Egyptian civilization and harmony mathematics *Chaos, Solitons, Fractals* 2006 30(2) 490-505
2. Akhtaruzzaman Md., Shafie, A. Geometrical Substantiation of *Phi*, the Golden Ratio and the Baroque of Nature, Architecture, Design and Engineering *International Journal of Arts* 2011 1(1):1-22 doi:10.5923/j.arts.20110101.01
3. Gary Meisner Golden Ratio- The divine beauty of mathematics Published 2012
4. Luca Pacioli *Divina Proporzione 1509 Milan*
5. Adolf Zeising *Der goldene schnitt 1884* Leipzig
6. Edler R.J. Background considerations to facial esthetics *Journal of Orthodontics* 2001 28(2):159-168
7. Langlois *et al*. Infant preferences for attractive faces: rudiments of a stereotype? *Developmental psychology* 1987 23: 363–369
8. Samuels C., Ewy R. Aesthetic perception of faces during infancy *British Journal of Developmental Psychology* 1985 3:221-228
9. Langlois J., Roggman I.A. Attractive faces are only average *Psychological Science* 1990 1:115-121
10. Alley T.R., Cunningham M.R. Average faces are attractive but very attractive faces are not average *Psychological science* 1991 2:123-125
11. Ricketts,R.M The biologic significance of the divine proportion *Am J Orthod* 1982 81:351-370
12. Ferring. V., Pancherz. H. Divine proportions in the growing face *Am J Orthod & Dentofacial Orthop* 2008 134:472-9
13. Lombardi R. The principles of visual perception and their clinical application to dental esthetics. *J Pros Dent*; 1973 29:358-381
14. Levin. E. Dental esthetics and the golden proportion. *J Pros Dent;* 1978 Sept 40:3 244- 252
15. Preston J.D. The golden proportion revisited. *J of esthetic dentistry*; 1993 5(6):247-251
16. Ward DH. Proportional smile design using the RED proportion. *Dent Clin North Am* 2001, 45:143–54.
17. Sreenivasan M., Niketa R. Evaluation of natural smile: golden proportion, red, or golden percentage. *J Conserv Dent*, 2008 11:16-21
18. Kokich, V. Perceptions of dental professionals and laypersons to altered dental esthetics: Asymmetric and symmetric situations *Am J Orthod Dentofacial Orthop* 2006, 130:141-51
19. Rosenstiel S. F., Ward D.H., Rashid G., Dentists' preferences of anterior tooth proportion—a web-based *study J Prosthodontics*, 2000 9:3, 123-136
20. S.J., Range and mean distribution frequency of individual tooth width of the maxillary anterior dentition *Pract. Proced. Aesthet. Dent* 2007 19(4) 209-215
21. Chu S.J., Hochman M., A biometric approach to esthetic crown lengthening. *Pract Proced Aesthet Dent* 2007 19(10)
22. Magne P., Gallucci O., Belser C. Anatomic crown width/length ratios of unworn and worn maxillary teeth J Prosthet Dent 2003 89:453-61.
23. Rufenacht C., Principles of esthetic integration *Fundamentals of Esthetics* 1990 Quintessence Berlin
24. Jefferson Y. Facial beauty- establishing a universal standard *Int J of Orthodontics* 2004 15(1):9-22
25. Kazem D., Mohammad B. Maxillary anterior teeth width proportion a literature review *EC Dental Science* 2017 406159637/ECDE-16-00566
26. Shilpa S., et al To evaluate the validity of Recurring Esthetic Dental proportion in natural dentition *J Conserv Dent.* 2011 14(3):314–317
27. Davis, N. Smile design *Dent Clin N Am* 2007 51:299–318
28. Cinelli F., et al Maxillary Anterior Teeth Dimensions and Relative Width Proportions: A Narrative Literature Review *Dent. J.* 2024, 12, 3. https://doi.org/ 10.3390/dj12010003
29. Coachman, C., Calamita M. Digital Smile Design: A tool for treatment planning and communication in esthetic dentistry *Quintessence Dent Technol.* 2012, 35:103–11
30. Yeşim Ö. Digital smile design as a communication tool for predictable clinical results: An update and review *J Exp Clin Med* 2021; 38(S2): 123-128 doi: 10.52142/omujecm.38.si.dent.8
31. Marquardt S. JCO Interviews *J Clin Orthod* 2002 36:6 339-347
32. Swati S., et al Esthetic Considerations in Orthodontics: An Overview *Dent J Adv Stud.* 2021 DOI https://doi.org/ 10.1055/s-0041-1726473 ISSN 2321-1482
33. Sterrett J.D., Oliver T., Robinson F., Fortson W., Knaak B., Russell C.M. Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man *J Clin Periodontol* 1999 26:153-157

Edisa Karamitri, DDS, Msc

Edisa Karamitri is a faculty at the University of Dental Medicine, Tirana, Albania and REALD University, Vlore, Albania.

Specialized in Prosthodontics at the Manhattan VA Hospital, she brings to the students and community over twenty years of experience in the field of Restorative and Implant Dentistry.

Her prior positions include Prosthodontist and teaching Faculty at Orlando Veterans Affairs Hospital (Florida, US) and Manhattan Veterans Affairs Hospital (New York, US).

Dr. Karamitri graduated in 1999 from University of Dental Medicine, Tirana, Albania. earning the degree Master of Science in Stomatology She pursued her dream by graduating from NYU College of Dentistry in 2006, with a degree of Doctor in Dental Surgery (DDS).

From 2006 to 2010, Dr. Karamitri held various positions as a general dentist in private practice and clinical faculty at NYU College of Dentistry.

She started her training in Prosthodontics in 2010 and continued to be part of the VA Healthcare System after graduating in 2013, working as a Prosthodontist and Faculty at VA Postgraduate Residency Programs.

Over the past two decades, she has practiced and lectured both in US and in Europe.

Dr. Karamitri is a recipient of numerous academic excellence and scholarship awards. She is a member of OKU, the Dental Honor Society (USA).

Dr. Karamitri has used her experience to give patients a beautiful smile and teach students and postgraduate residents to practice evidence-based dentistry and use scientific literature in their clinical decision-making.