"M" PROPORTIONS

The new Golden Rules in dentistry

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Abstract

Since the beginning Cosmetic Dentistry has been using the principles of Golden Proportion (1: 0.618) as a guideline for smile design... It has been taught that the dental team must develop an artistic view for smile creation which is based on Scientific guidelines. The reason that we must use our Artistic eye so much, has been because in most cases, the Golden Proportion guidelines do not give a realistic view for tooth proportion.[1]

The standard Golden Rule works well for the determination of the central incisor ratio, but in the majority of cases, fails to provide a pleasing smile when used to develop the proportion of central to lateral to cuspid. This article shows that by using new Modified Golden Proportions which are individually determined for each patient by using mathematical formulae invented by a Canadian Dr. Alain Méthot, we are able to create a pleasing smile design proportion for our patients. The modified Golden Proportion formula provides the Cosmetic Dentist with the ability to reduce the Artistic Element, in preference to a Scientific one resulting in a more accurate approach to the creation of smile design and proportion.

History

From the days of Greek antiquity, the theory of proportion has served as reference to create harmony. A link has been established between numbers and the nature first described by Fibonacci in the early 1200's. His discovery of the mathematic formula which he called the Golden Number was expressed as a function of Phi and 1.

To obtain the formula we add the 2 preceding numbers together in order to achieve the next value.[2]

$$u_1 = 1$$

$$u_2 = 1$$

$$u_k = u_{k-1} + u_{k-2}\ ,\quad k \geq 3$$

$$u_1 + u_2 + u_3 + \ldots\ldots\ldots + u_n = u_{n+2} - 1$$

This is the formula Fibonacci used to determine the Golden Number of: 1.618

$$\lim_{n \to \infty} \frac{u_n}{u_{n-1}} = \phi$$

Many forms have been created using the golden proportion such as the rectangle and many other forms used as the most pleasing to the eye forms in all aspects of our lives.

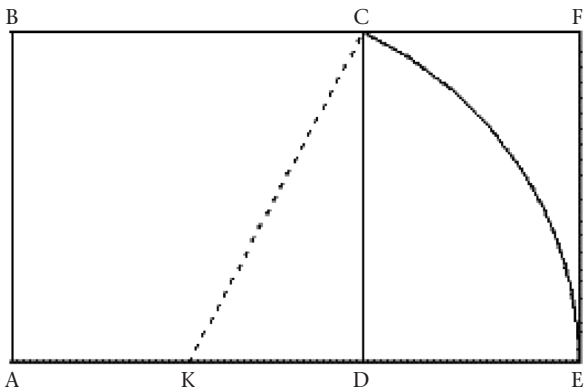

Figure 1

All these Figures and proportions are found in nature[3] as you can see in these photos.

As well as many other figures such as the triangle and the spiral... Figure 2, 3

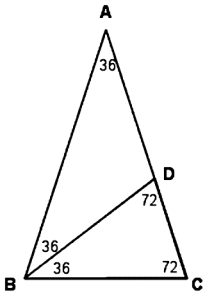

Figure 2

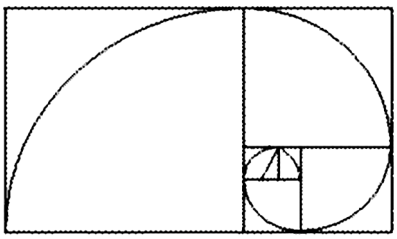

Figure 3

Correlation with Teeth

The Golden Rectangle has been used to determine the proportion of the centrals by placing the two centrals in the Rectangle representing the length of 1.618 by the width of 1 for the purpose of that example as shown in Figure 4. By then dividing the length of that Rectangle by 2 one is able to determine the width of .809 for one central. The .809/1 equation give a value of 81%. This 81% ratio for the width/length measurement of the centrals is the ideal proportion for the two predominant teeth of the smile, and we can say that a variation of +/- 5%[4] is normal and it is what we see in the majority of natural mouth.

It has been argued that a more natural look is represented by a ***ratio greater than 81%*** compared to a ***ratio of less than 81%***. A longer or narrower tooth is often seen in cases where there is periodontal disease or in some full mouth rehabilitation where an increased vertical dimension of occlusion has been attained. According to Sterrett et al[5] average measurements made on normal white subjects offer significant help in defining relative tooth dimensions, the relative tooth dimension width/height ratio for the central is 85% for men compare to 86% for women. An 85% ratio does represent a more square tooth than an 80% or less ratio.

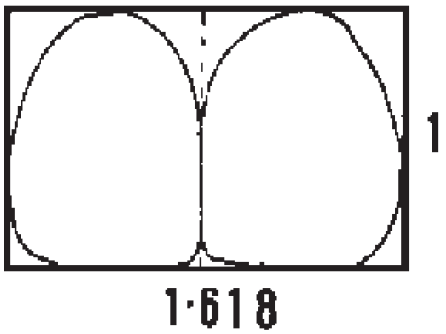

Figure 4

For a long time, the proportionality of teeth has been compared with classic elements of art and architecture. If we extend the Golden Proportion to the rest of the teeth it is shown in Figure 5 that each line should mark the distal surface of each teeth.

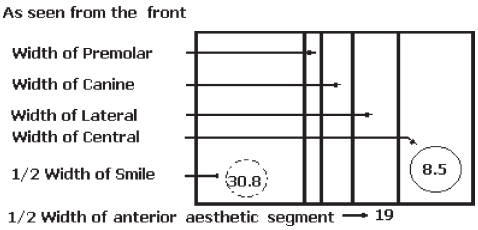

Figure 5

Many authors observe that natural teeth do not follow the Golden Proportion for the display of teeth. Lombardi was the first to discuss the golden proportion of the anterior teeth.[6] He concluded that strict application of the golden proportion has proved to be too strong in dentistry and that variations occur. According to Preston, the golden rule does not give a realistic appearance and using the golden proportion results in an excessive narrowness of the maxillary arch and compression of lateral segments.[7] Magne & Belser showed in figure 6 "Measurements have been made according to the apparent width of teeth, as viewed directly from the anterior. The original, untouched view of the central incisor to canine does not conform to the golden proportion (2–3a). The same image was digitally modified to generate golden number (2–3b)"[8]

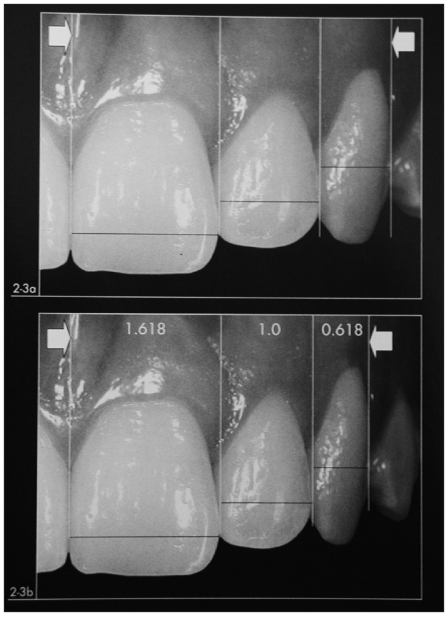

Figure 6

Visual Effect

It must be understood that "every object can be subject to apparent deformation in geometric shape whenever observed from certain positions. These deformations result from two types of phenomena: (1) the effect of perspective and (2) the effect of optical illusion. Though they seem to show specific properties, one is aesthetic, the other scientific, a precise distinction between these two phenomena is difficult to establish."[9]

When using two dimensions to study a three dimensional subject, there are two majors concerns: ***the distance*** and ***the angulations*** between the observer and the subject. It is therefore crucial to take the photograph directly in front of the subject demonstrating a full natural smile at a focal distance of 1:10. It must be understood that the photo is taken without distortion due to angulations either horizontally or vertically. See Figure 7

In order to obtain a consistent result the subject must place their hair behind the ears, in order that the ears are equally exposed and the cheeks equally exposed. The photograph must have the facial horizontal plane parallel to the lower frame of the photo usually associated with the inter papillary line following the horizontal plane.

Figure 7

By using this photograph we can apply the needed lines to analyse the dento-facial aspects of the subject. For the purposes of the present article we will use 3 sets of lines:

- one horizontal line: to verify the inter papillary line
- one vertical line: to verify the midline
- set of "Golden Proportion lines" or "modified Golden Proportions lines"

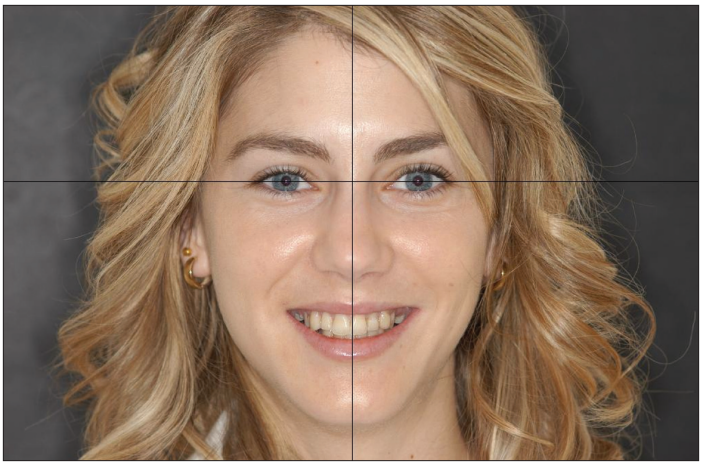

Figure 8

In Figure 8 horizontal and vertical lines are applied in order to verify the position of the 2D image from the 3D subject. Once the correlation is confirmed, the image can be enlarged and the Golden Proportion lines as generated by the computer software are applied. See Figure 9.

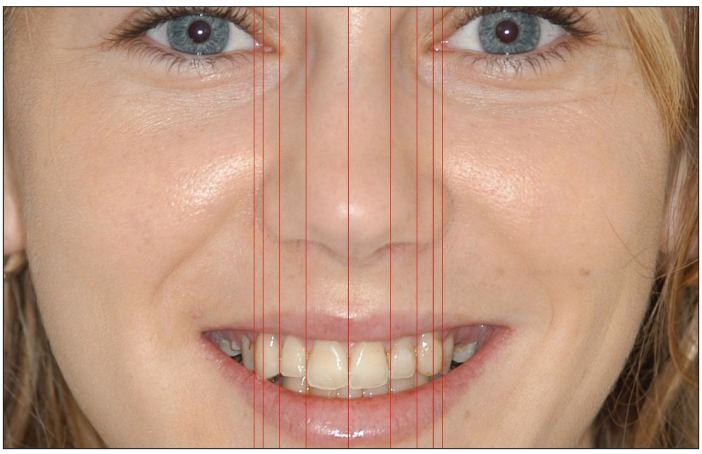

Figure 9

GUIDED POSITIONING

GPS

SYSTEM

for smile design

M

Proportions

www.mydentalgps.com

As seen in Figure 9 the usual Golden Proportion does not correlate to the natural visual tooth display. The actual lines should display the first premolar between the line 4 and 5. By placing 7 lines on each side of the midline as in the Figure 10. It is showing that the first molar should be between line 6 and 7, in this Figure the 1.618 ratio of the lines give an inter molar distance narrower than that which is naturally displayed by the subject.

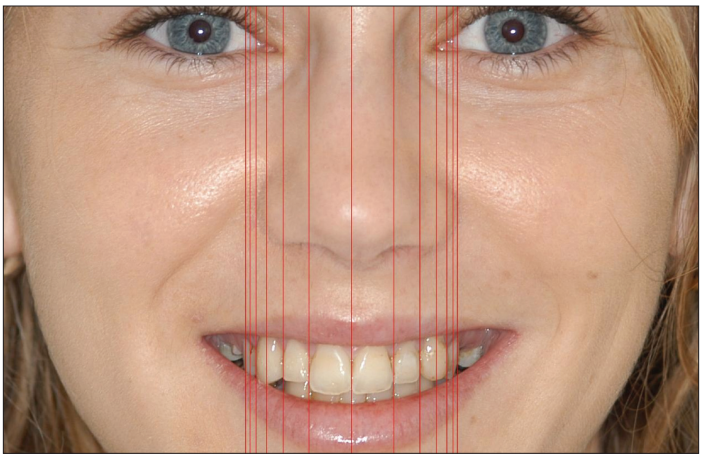

Figure 10

The remainder of the article will explain how the modified Golden Proportions are individually adapted for each patient by using the inter-molar distance and the central width to determine the appropriate ratio for that patient. This adaptation is a new innovation and a giant leap forward in the science and art of proportions.

The Discovery

The Golden Proportion Rule, or Divine Rule, represents a ratio of 1:1.618. This ratio has been used in a multitude of applications for many years and is well known in the arts and architecture dating back many centuries. Over the course of time, these Golden Proportion Rules have been applied to facial aesthetics and dentistry in order to provide mathematical guidelines for the creation of pleasing and aesthetic smiles by the determination of the appropriate proportions of central, lateral and cuspid teeth in the smile. the Golden Rule may be expressed as: (Figure 11)

$$\frac{AB}{CB} = \frac{CB}{AC} = 1.618 \quad \text{(Equation 1)}$$

A_____C_____B

Figure 11

If the distance *AB* is 10mm, then the distance *AC* will be 3.82mm and *CB* will be 6.18mm.

It has been shown that this Golden Rule cannot be universally applied to all patients, it therefore became necessary to adapt or modify this Golden Rule by individualizing the formula according to each patient. This modified Golden Rule has been achieved by application of a mathematical formula related to the inter-molar distance of each patient, representing the width of the arch, and the width of the central to determine the correct balance for the teeth displayed within that arch to create a pleasing smile.

The use of computer generated lines superimposed on the patient photograph, these lines can be altered by sliding the lines "en masse". These lines will maintain their modified Golden Proportion as they slide, these new proportions are called "**M**" Proportions. By positioning the first line (no1) on the midline and moving the end line (no 7) to the buccal cusp of the first molar, then line no 2 will have to be at the distal of the central. If the rule of the Golden Proportion was correct, then all patients will have the lines match, and we know this not to be the case. In order to achieve that result, the ratio of the Golden Rule must be changed or adapted to be individually corrected for each patient. The new mathematical formula determine a *variable ratio* in function of Phi called the "**M**" Proportions, ("**M**" for **Methot** the inventor) It can be seen that the modified ratio for this patient is 1.367 as opposed to the Golden Rule of 1.618. (Figure 12)

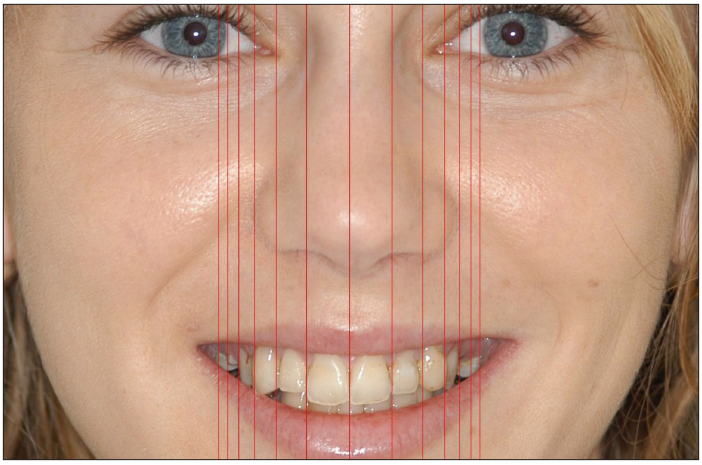

Figure 12

Computing the position of the side lines

As the central line (1) is placed in the midline between the two centrals (the smile line) and the outermost line (7) is positioned by the user, advantageously on the buccal face of the first molar, (representing the arch width) the remaining lines (2, 3, 4, 5, 6) are positioned by the computer software using the "**M**" formula.

The modified equations of the "**M**" formula allow the use of a variable "**M**" Proportions Computerized Ruler that is applied to each individual subject and is directly correlated to arch width, and the central width. During the process of the invention, subjects where analysed using the "Guided Positioning Software" program which uses this "**M**" Proportions Ruler. All the subjects studied fell within a certain ratio of 1.25 to 1.618 with the majority of the cases falling in the 1.38 area and only very few cases being found at the lower and higher ratio extremes. The **1.38** ratio has been labelled as the **Reference Ratio**.

In an alternative embodiment, shown in Figure 13, the lines (1', 2', 3', 4', 5', 6', 7') may have corresponding angles (q_1, q_2, q_3, q_4, q_5, q_6, q_7) in order to better conform to the natural positioning of the teeth. For example, angles of 0, 1.00, 2.00, 2.50, 3.75, 4.40 and 4.50 degrees may be used for angles (q_1, q_2, q_3, q_4, q_5, q_6, q_7), respectively to follow the axial inclination of teeth. It is to be understood that other angles may alternatively be used.

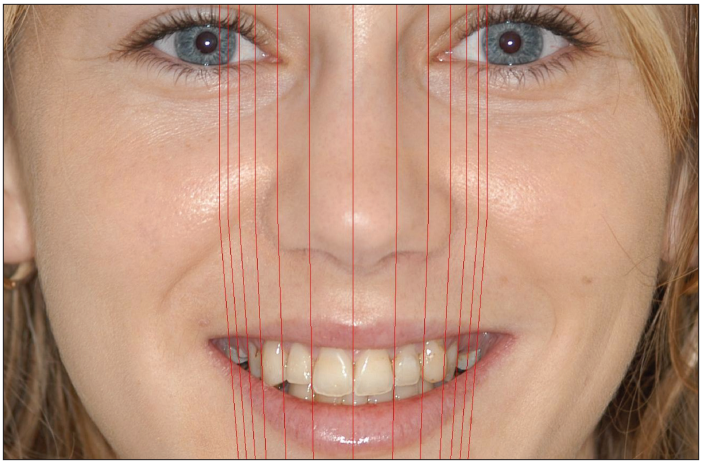

Figure 13

The "**M**" Proportions Table shows the most common ratios and may be used by the practitioner to select the appropriate ratio. Table 1 gives an example of the "**M**" Proportions ratios based on common widths of the central incisor and inter molar distances. The inter molar distance is the distance between the buccal sides of the left and right first upper molars in a transverse aspect. It may be observed that the greater the inter-molar distance, the smaller the "**M**" Proportion ratio becomes.

"M" PROPORTIONS RATIO	WIDTH OF THE CENTRAL INCISOR	INTER MOLAR DISTANCE
1:1.36	8.0mm	50.8mm
	8.5mm	54.0mm
	9.0mm	57.2mm
	9.5mm	60.4mm
	10.0mm	63.6mm
1:1.38	8.0mm	49.7mm
	8.5mm	52.8mm
	9.0mm	55.9mm
	9.5mm	59.0mm
	10.0mm	62.1mm
1:1.40	8.0mm	48.6mm
	8.5mm	51.6mm
	9.0mm	54.6mm
	9.5mm	57.7mm
	10.0mm	60.7mm

*Table 1 – Example of a **M** Proportions ratio guide*

The "**M**" Proportions ratio guide may be expanded to include other ratios as previously disclosed as well as other central incisor width and inter molar distances.

The tool used to determine the table measurements was the dental "**GPS**" computer software program. Value of the central incisor width and inter molar distance entered into the computer program allowed the lines to be displayed on the computer screen as seen in Figure 14. As a test of proof the real proportion of the subject picture have been set on the screen, the inter papillary distance is measured on the patient and transferred into the computer in order to calibrate the program for the individual patient.

To attest to the precision of the calibration, a plastic ruler in millimetres was apposed on the screen of the computer to validate the measurements. The actual width of the central subject is 8.25mm and the inter molar distance is 52mm (millimetres) who give a 1.367 ratio. As seen in Figure 14 the value of the ratio 1.367 has been entered in the program and the inter molar distance of 52mm as been verified and corresponds to the value in the Table.

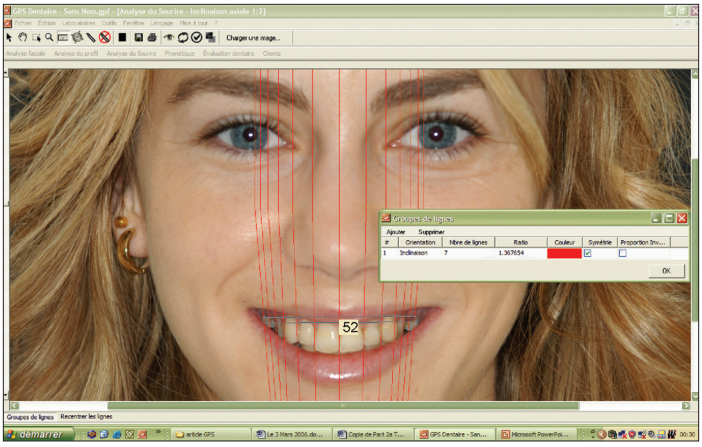

Figure 14

In Figure 15 the pre-op model of the same subject is shown before the wax up with a ratio of 1.618 on the screen, the 8.25mm central width has been verified on the computer screen with a plastic ruler in millimetres.

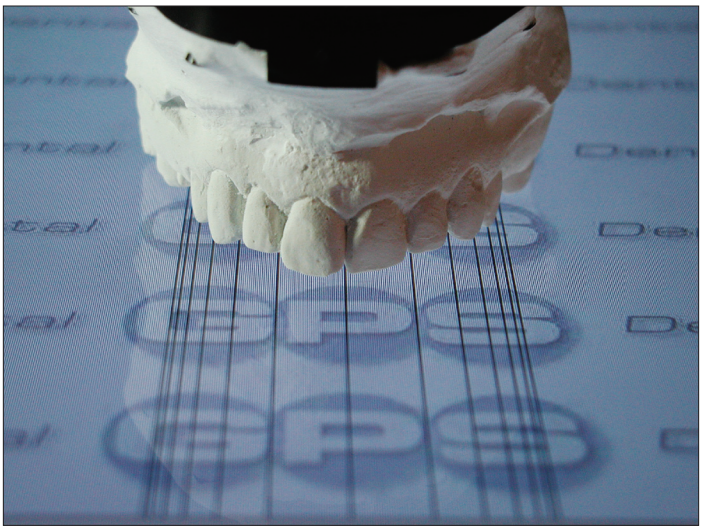

Figure 15

In Figure 16 the same pre-op model is shown before the wax up with a ratio of 1.367 on the computer screen.

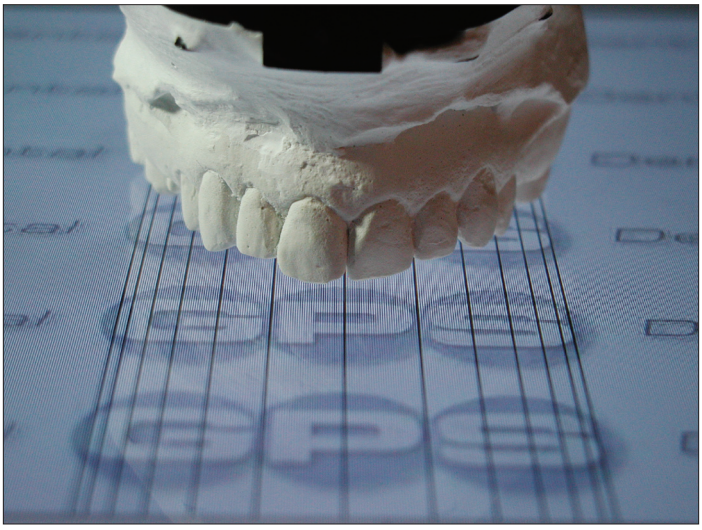

Figure 16

In Figure 17 the wax up is showed at the same 1.367 ratio on the computer screen. It is seen that the space between each lines displays a tooth mesio distally on the 2D image.

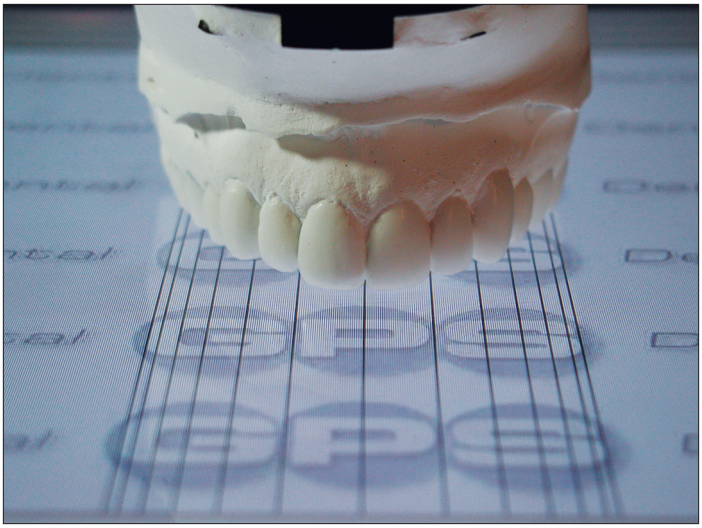

Figure 17

Conclusion

The evolution of Dentistry is dependant on the development and refinement of the principles we rely on for the understanding and application of current dental techniques.

The formulation of an individualized Golden Proportion for each patient allows the practitioner to create the perfect smile for each patient. The application of this modified golden proportion computer system determines the correct mathematical indices in order to create the size and display of the maxillary teeth necessary to fit within the confines of the smile.

Using this modified golden proportion software, a printout of the modified proportion template is used to develop the ideal diagnostic wax up for that patient.

The resulting smile will allow the practitioner to rely on mathematical and scientific formulations to get closer to the ideal smile for each patient before applying the artistic refinements to the size and shape of the anterior teeth to conform with the patients ideals and the Dentist's vision.

About the author

Dr. Méthot graduated from University of Montréal in 1981. He maintains a solo practice in complex restorative and cosmetic dentistry in Lorraine, Québec. A firm believer in continuing education, Dr. Méthot is a graduate of the L.D. Pankey Institute, LVI, and the International Dental Institute in Dentofacial Orthopaedics and Orthodontics. Dr. Méthot is currently completing his Masters Degree in TMJ Dysfunction at Donau University, Austria. A founding member of the Canadian Academy of Cosmetic Dentistry, Dr. Méthot is a respected researcher and has developed the GPS computer software system as described in this article.

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*(The "**M**" Proportions, the "**M**" Ruler as the computerized adjustable ruler, plates and tools for the "**M**" Proportions in dentistry are patent pending Internationally.)*