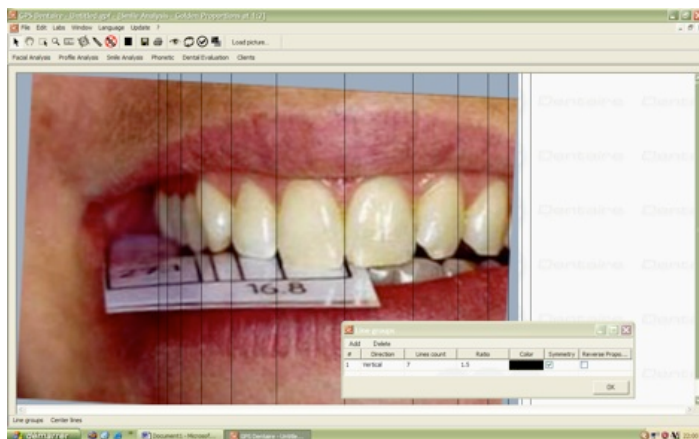


Golden proportion in Dentistry... Is it out of date!!

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When using a bi-dimensional photo to study a three-dimensional subject, like the smile, there are two major concerns: **the distance** and **the angulations** between the observer and the subject. It is crucial to take the photograph directly in front of the subject demonstrating a full natural smile at a focal distance of approximately 1:10. In order to avoid errors due to perspective and optical illusion, the photo should be taken without distortion due to angulations either horizontally or vertically. A good help could derive from positioning the hair behind the ears, keeping the ears equally exposed and the temples or cheeks equally exposed.

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. (In Figure 16, if we extend the Golden Proportion located on the paper to the remaining teeth, each line should mark the distal surface of each tooth. In this Figure the "M" Ruler with a ratio of 1.5 have been placed over the image to fit quadrant 1, each anterior teeth should arrive at the distal of each "M" lines, and the buccal contour for the posterior teeth, and tooth should be aligned with the M lines.) It is important to position analysis lines over the patient's face to make a global analysis of patient's teeth for smile design, having lines over a close up view is not significant for analysis because there is no accurate correlation between a close up picture and the facial picture. There is no possible accurate correlation between a close up picture and a facial picture. Both pictures cannot be taking at the exact same position by the same operator (**Figure 16 a**).



As seen from the front

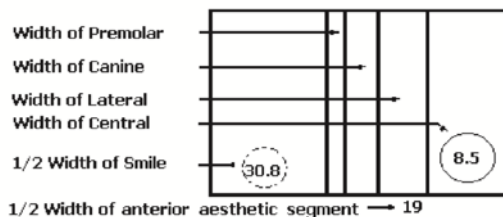


Figure 16 a,b A close up view is not significant for analysis, this picture have been taken with patient's head turned on the right side with a paper representing Golden Proportion between patient's teeth. The paper is not properly inserted in patient's mouth (twisted).

Several authors observed 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.¹ He concluded that the strict application of the golden proportion has many limitations and some variations were necessary. 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.²

Magne & Belser showed that measurements of frontal teeth made according to their apparent width (**Figure 17 a,b**), as viewed directly from the anterior do not conform to the Golden Proportion. If the same image is digitally modified to generate golden number, the entire aspect of the smile result significantly different and narrow.^{3,4}

Method applied the Golden Proportions from molars to molars over a facial picture and showed the resulting narrowness of the Golden Proportion over the dental upper arch.⁵

In the literature the Golden Proportion was most often found between the Central Incisor and Lateral Incisor.⁶ However, it was not a consistent parameter between the lateral incisor: canine relation as found by some authors.⁷ It may be due to variations in the shape of the maxillary arch or to the alignment and positioning of the anterior teeth.⁸

The standard Golden Ruler works well for the determination of the upper 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, thus forcing the practitioner to artistically tweak the case before finishing causing loss of time and often compromising the final outcome.⁵

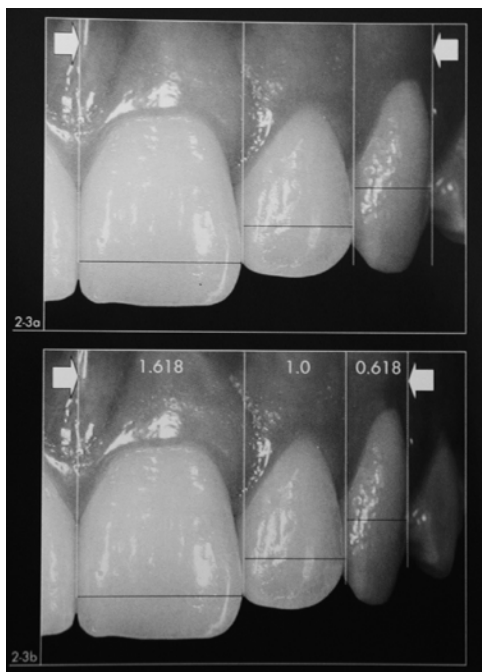
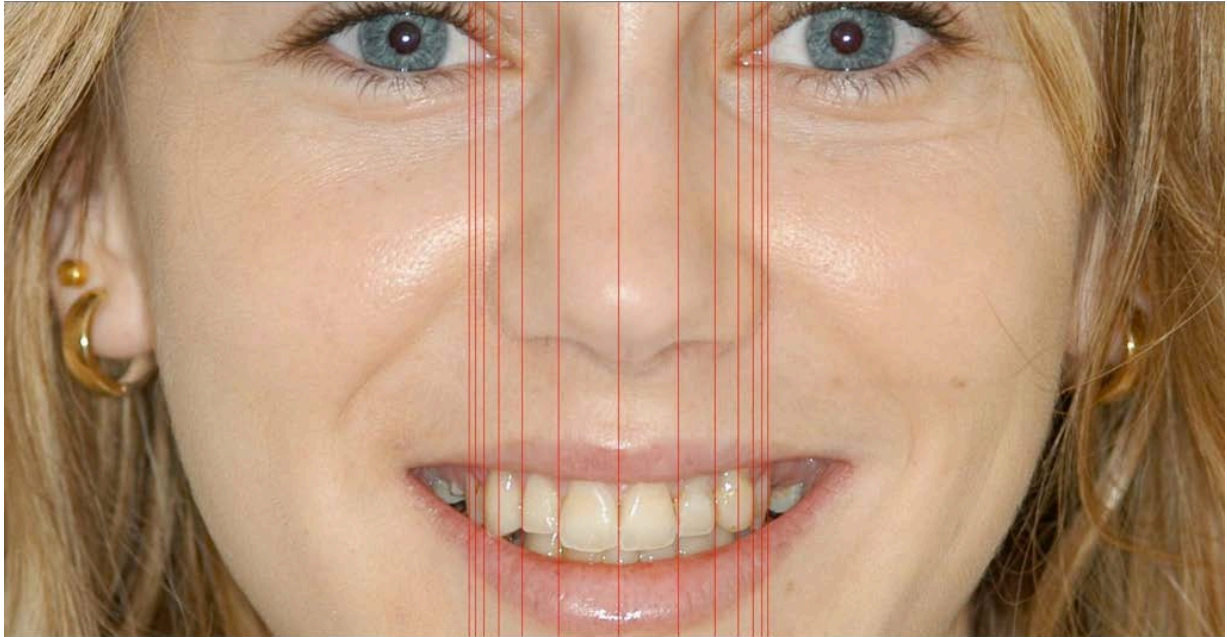


Figure 17 a,b

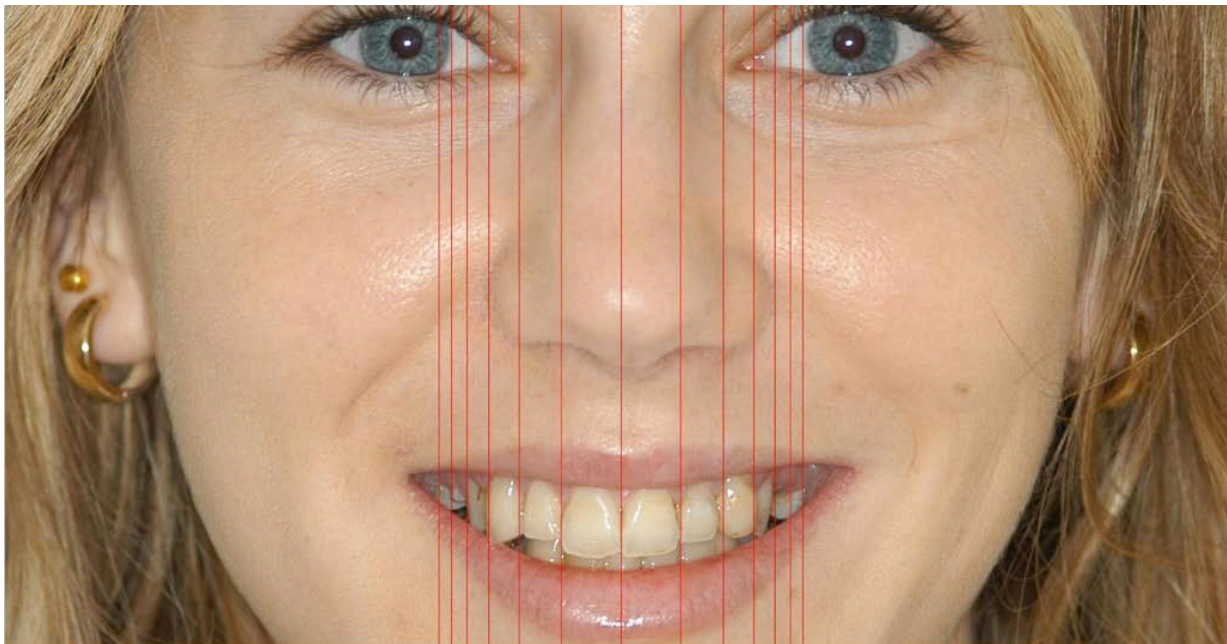
In the referred clinical example (**Figure 18**) it's evident that the usual Golden Proportion does not correlate to the natural visual tooth display. The lines related to the Golden Proportion Ratio should display the first molar between the line 6 and 7. The lines represent a ratio of 1.618; it gives an inter-molar distance narrower than what is naturally displayed by the subject.



7654 3 2 | 1 | 2 3 4567

Figure 18 The Golden Proportion does not give a realistic display of teeth.

The “M” Proportion adapts to the patient’s centrals width and molars position, it displays the best position for each tooth (**Figure 19**).



765 4 3 2 | 1 | 2 3 4 567

Figure 19 The “M” Ratio for this patient is 1.367 as opposed to the Golden Rule of 1.618

The common opinion, today, is that the Golden Rule cannot be universally applied to patients: then is therefore necessary to adapt or modify this Golden Rule by individualizing the formula according to each patient anatomy. Since 2006 ⁵, a modified symmetrical Ruler has been proposed referring to a mathematical formula related to the inter-molar distance of each patient, representing the width of the arch, and the width of the upper centrals to determine the correct balance for the teeth displayed within that arch to create a pleasing smile. The new mathematical formula determines a *variable ratio* in function of Phi called the “**M Proportions**”, (“M” for Methot the inventor). In the clinical example of **Figure 19**, the central line (1) is placed on the dental midline 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 symmetrically by the computer software using the “M” formula: these new proportions are called “M” Proportions. Software allows sliding the lines “en masse” symmetrically maintaining their proportion as they slide.

During the formula verification process, between 2004 and 2006, 154 subjects (75 females and 79 males) were analyzed using prototype software, which used the “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 “M” Proportions Table (**Figure 20**) shows the “M” Proportions ratios based on common widths of the central incisors, showing the inter-molar distances related to each central width for 3 different ratios.

“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

Figure 20 Example of 3 different “M” Proportion Ratios with different centrals width and resulting inter molar distance.

Values of the central incisor width with specific “M” Ratios were entered into the computer program and the real proportion of the subject picture has been set on the screen. The width of both the upper incisors was measured on the patient and transferred into the computer in order to calibrate the program for the individual patient. It may be observed that the greater the “M” Proportion, the smaller the inter-molar becomes.

To attest to the precision of the calibration of the “M” Ruler from the pictures (**Figure 18,19**) to the models (**Figure 21,22**), a plastic ruler in millimeters was apposed on the screen of the computer to validate the measurements. Verifications of the “M” Proportion were accomplished comparing the lines corresponding to the ratio of 1.618 (**Figure 21**) and the lines corresponding to the “M” Proportion (**Figure 22**).



Figure 21 The 3D patient's model with the "M" Ruler at a 1.618 ratio with "M" Lines adapted to the distal of both centrals

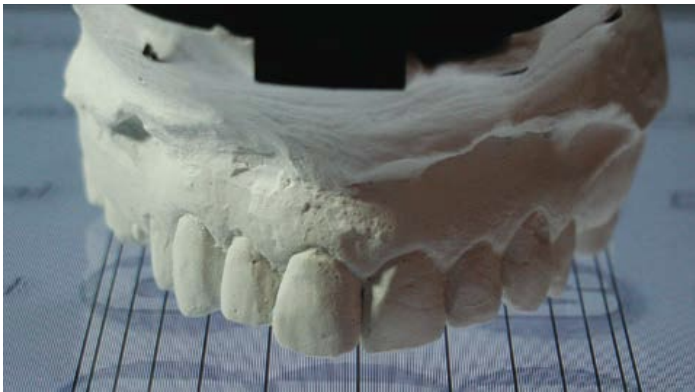


Figure 22 The 3D patient's model with the "M" Ruler at a 1.367 ratio keeping the "M" Lines at the distal of both centrals. "M" Lines better fit to the anatomy of the patient.

A new smile has been morphed over the patient teeth on the 2D project using the 1.367 "M" Ratio. The "M" Lines are then transmitted to the lab in order to wax-up the new smile respecting the proportions revealed by the GPS software (**Figure 23**).

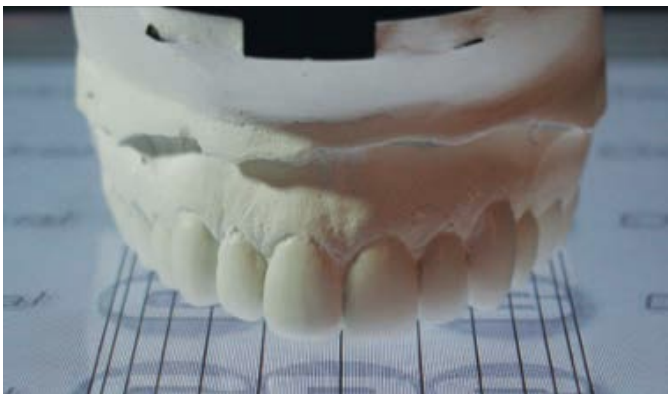


Figure 23 The wax up realized following the "M" Lines fits in to ideal smile proportions.

Conclusion

Using a full facial view of the patient's smile is the key to evaluate how the smile looks in the patients face.

Due to the limitation of Golden Proportions, the formulation of the "M" Ruler, a digital smile design diagnostic device adapted to each patient should guide the practitioner to detect asymmetries and to plan without limitations all possible treatments that will improve patient's appearance. Compared to the Golden Proportion, that can only offer one ratio: 1:618, the "M Ruler" determines the patient's own unique pre op ratio. The individualized proportion determined with the "M" Ruler uses the central width, the inter-molar distance and the number of teeth involve in the smile to display the appropriate teeth position and set up for smile design.

The procedure itself helps the patient to see and understand the possible treatments offered to him using the "M" Ruler and morphing software. The communication between the clinician and the dental laboratory is done with a precise physical and/or digital connection to create the size, shape and display of the maxillary teeth necessary to fit within the confines of the smile.

The X and Y coordinates of the projected indicators (teeth contour and/or lines) on the computer screen can easily be connected in a 3D digital system to correlate the 2D set up from the previous diagnosis and treatment plans. Projected M lines can also be printed on to correlate the set up to a physical articulator for the achievement of the best possible results in Smile Design.

This innovation is a giant leap forward in the science and art of proportions.

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