Using the "M" proportions to project a new smile: different clinical applications

Dr. Alain Méthot, D.M.D. M.Sc

Several options are available today to pre-design the most appropriate smile for the patient; however, it is often hard to show patient different outcome of his or her future smile and, at the same time, to transmit all the coordinates to the lab to reproduce the final work as planned. Developed on the basis of the "M" Proportions, the GPS software is a precise smile simulation software that creates a virtual 2D diagnostic wax-up on a single facial image to reproduce an identical 3D wax up of the chosen treatment plan. This concept skip physical wax-ups and mock-ups test-drive prior to case acceptance. Several clinical applications of this tool are described.

Traditional esthetic dentistry relies on professional trust, traditional wax-ups, mock-ups and/or artistic modifications of provisional in the mouth to achieve the desired final result. [1,2]

Designing a great smile can be difficult because the esthetic interpretation and judgment of the clinician is subjective and the clinician's personal idea of the final esthetic can be different from the patient's expectations. Matching treatments to patient's expectations has been shown to mark impact not only upon patient satisfaction but also upon behavioral markers of outcome. [3]

The subjective idea of the final result can be a handicap in delivering the proper appearance for each patient. Another difficulty happens in transferring all the coordinates to the lab in order to wax-up and realize the esthetic project. The ability of the restorative dentist to communicate the location and orientation of the patient's pertinent facial landmarks to the dental laboratory technician has great bearing on the esthetic success of final anterior dental restorations.[4]

Many options are available, today, to pre-design the most appropriate smile for the patient: from computer imaging, diagnostic wax-ups on models, mock-ups, to simply drawing on a patient photograph.[5] Various types of software can help the clinician to preview, predict, and plan esthetic procedures. Many of these programs lapses into obsolescence because it takes too long to develop proper diagnoses, treatment plans, clinical guides or marketing proposals.

The Dental GPS Software, described in this paper, has developed and proven over the last 8 years.[6] The system uses the parameters captured by one digital pre-operative full-face image to help clinicians with esthetic diagnosis, and automatically prepare different treatment plans that will best suit the patient. The **"M" Ruler,** the main tool of the program, helps the clinician to see all possible treatments and guide the clinician to make the most ideal treatments.

The digital facial image is calibrated with the patient's upper central incisors dimensions; the "M" Ruler is positioned over the patient's image to produce a simulation with positioning indicators attached to digital smile libraries, that generates a virtual 2D wax-up; the resulting smile

prescription is precise and can easily be transferred to laboratory technicians to create or transform the new esthetic smile with precision.

Figure 1 *An example of full arch smile design simulated in a few minutes and delivered to the patient. Gingivectomy, osteoplasty, gingival graft, gingival alterations, orthodontic, prosthodontics, dentures, implants treatments are all easily simulated by keeping a natural look.*

Transferring the clinic's esthetic idea to the patient

The first goal of the software is to anticipate the esthetic final outcome to the patient in few minutes during the first appointment or a consultation appointment, eliminating the need of complex image elaborations and esthetic calculations.
This tool helps the clinician to consider the proper treatment plan among several therapeutic proposals, generating a virtual 2D wax-up and lab smile prescription within minutes, and communicates to the patient his own esthetic project **(Figure1)**.

Formulating a complete esthetic diagnosis

As a first step, a full-face photograph is taken by placing the lens of the camera directly in line with the patient's mouth at a distance of approximately 6 feet. The facial photograph is taken with the YES and NO correctly positioned (as described in Part 1). The inter-pupillary line is not important in this process because sometimes one eye is lower than the other. The ***long axis of the face*** and the ***upper lip line*** are the ***reference planes for diagnosis, treatment planning and to align the case on an articulator*****.**
The digital smile design diagnosis is simply achieved by importing a facial photograph with patient smiling into the GPS software; the program then establishes the best smile parameters for the patient. **(Figure2).** The GPS' smile design diagnosis process starts with the **Digital Facebow** that captures the exact position of the dental and facial midline, in relation with the long axis of the face and the upper lip line to prevent canting and shifting of patient cases during the clinical realization of the treatment.

Figure 2 A picture of the patient's face is taken frontally and uploaded in the system. The area of the smile is then selected.

Working with GPS and using its **3D Digital Facebow,** avoids limitations and possible errors that sometimes occur using an anatomical facebow in transferring to lab the esthetic plane orientation. In fact, a dismetry in the disposition of the auricular duct could lead, in laboratory, to an inclinated incisal plane and an error in determining teeth axis during the wax-up. [7]

The digital smile design diagnosis and treatment planning protocol of this software uses the **"M" Ruler,** a symmetrical diagnostic device algorithm that project the best position of all maxillary teeth on a facial digital image before designing the smile. [8] Compared to the Golden Proportion [9,10] - that can only offer one ratio: 1:618 - the "M" Ruler determines the patient's own unique Y-axis pre-op ratio for smile design within the full upper arch. **(Figure 3)**

The facial guidelines are integrated with the dental composition using the "M" Ruler that highlights deviations from the ideal set up. The software thereby assists in the treatment planning process by communicating esthetic problems to the patient, laboratory personnel, and other specialists. [11]

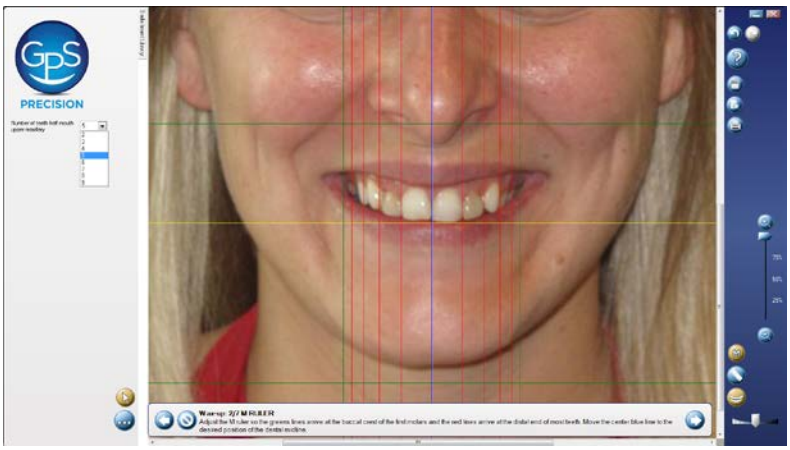

Figure 3 The diagnostic "M" Proportions are displayed as red lines that must coincide with the position of majority of the natural teeth positions. Then the image is calibrated following the natural width of the two upper central incisors.

From the diagnosis to the smile project

As second step, a picture of a smile from a preloaded library is automatically superposed on the digital facial 2D image of the patient: this leads the clinician to visualize an immediate virtual 2D wax-up over the pre-op teeth of the patient.
At this moment, the practitioner can consider all different treatments needed to achieve the ideal smile design for that subject and can visualize the final esthetic outcome of different treatments (orthodontic, veneers, crowns, implants…)**(Figure 4)**.

As a third step, the clinician can diagnose, plan, and simulate changes in the position, length, width, shape, dimension, and proportion of the teeth. As result, two simulations are compared; the ideal set up and a second set up of the project can be discussed with the patient for case acceptance before transferring the smile prescription to the lab.

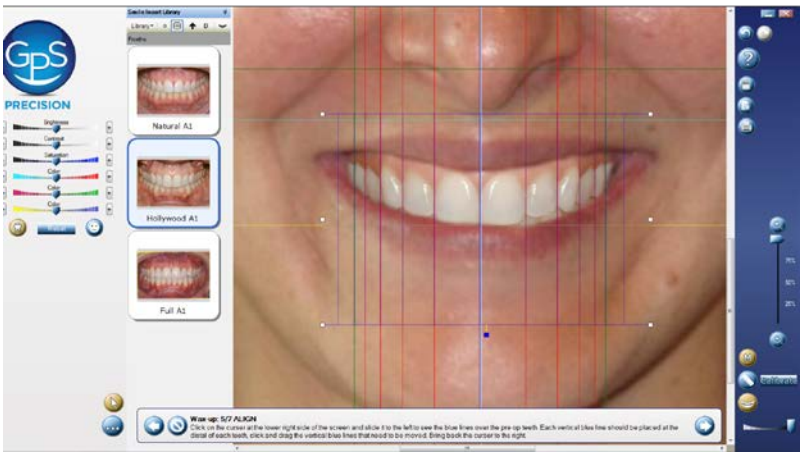

Figure 4 The preload smile libraries allow the clinician to choose the right typology of teeth to use in the simulation. The superposition of the 2D wax-up over the "M" Ruler can be switched from the original smile to the new project and the adjustment of color and brightness, shape, width, length of the virtual 2D wax-up can be done at this stage.

Transferring the 2D wax-up to the 3D model

As final step, the coordinates of the "M" Ratio are used to transfer the information from the 2D set-up to the 3D model. This could be done in two different ways;

1- With 3D software, CT Scan. The patient "M" Ratio set up of the "M" Ruler inside the 3D software with a digital connection to make surgical guides, orthodontic aligners, wax-ups, dentures…
2- Or a physical articulator with a platform on the laboratory. With this solution, the "M" Ruler is printed and apposed on a specific platform in the lab articulator aiding the technician to wax-up or mounting teeth on the 3D physic model.

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