by Dr Davor Hribar

## Computers in Aesthetic and Cosmetic Dentistry

Can computers aid us with our aesthetic and cosmetic dentistry? Remember dentistry is becoming increasingly dependent upon computers to run various parts of our practice, but there has until now only been minimal involvement in the clinical use of computers. The area of aesthetic and cosmetic dentistry has been virtually ignored by the introduction of software packages. But before discussing the possible role of computer technology in aesthetic and cosmetic dentistry it is essential to understand the basic concepts and facts of aesthetics.

t is essential to realize that facial and dental aesthetics is not just components of parts of skin, teeth, gums and lips in isolation that are important, but it is a collection of complex visual processes and interpretation i.e. subconscious phenomenon. This collection of information is interpreted but there is a bias which is dependent upon the observer's standard of values. This then enables them to evaluate aesthetic but there are also other subconscious inferences about the person's personality, their values and standards. This is where "Siang Mien" and "Physiognomy" have been used to explain personal traits. A possible reason why aesthetic people are always the heroes in stories and are quicker considered for promotions in the business and entertainment world?

Even so professional people such as surgeons, dentists, painters and sculptors concentrate on individual facial details like facial patterns, configurations of facial components and their contours. In essence they are using the same philosophy as the ancient Greeks where their idea of aesthetics was considered a question of harmony, balance and proportion. This implies that aesthetics is a mathematical formula and it is simply a matter of physical proportions.

The well established physical proportions/ratios are:

- 1. Golden Ratio
- 2. Third Rule
- 3. Sevenths Rule

- 4. Fifth Rule
- 5. Center Rule
- 6. Symmetry Rule
- 7. Other miscellaneous canons

These canons are universal proportions/ratios but do not take into consideration any particular age, sex and racial variations. Furthermore they only consider one facial expression ie. expressionless; yet the face can be seen as a mosaic of variable expressions. The head is almost always in a set position and the teeth are in occlusion.

Furthermore these canons require the face, its components and the dentition to be referenced to the vertical and horizontal reference planes; to standardize this it means the:

- Head must be in a set position anthropological/ archeological position i.e. "Frankfort plane" and not the "Natural head position". (figures 1 and 2)
- Viewing reference is set in the frontal view and laterals view with the vertical positioning is at eye level. Note the most often researched view is the facial.
- Analysis of the entire facial is from a distance while the dental analysis is preformed at a close distance.
- 4) The primary or reference plane used in the frontal analysis is the inter-papillary plane and then the mid-facial plane is



Figures 1 (left) and 2 The Frankfort plane is arbitrarily set horizontally which then sets the head position. While the natural head position is contestant for an individual it is variable between individuals but really it is horizontal.

considered. They should be at right angles. If not, then the face will lack harmony and the clinician will have to make some hard decisions on the contemplated aesthetic or cosmetic reconstruction. (figure 3).

- 5) Once the primary reference planes are determined and set; the secondary planes are established and their relationship to the primary reference planes and then to each other (figure 4). These secondary planes to name a few are:
  - a) Occlusal plane
  - b) Maxillary and mandibular centre planes
  - c) Orientation of lips at rest
  - d) Smile line plane orientation
- 6) Dental determinants are then considered to fit into the framework that has been established by the primary and secondary reference planes:
  - a) Lips to the dental arch
    - i) Lower lip curve relative to the maxillary incisorsii) Smiling lips relative to the maxillary arch
    - transversely and vertical
    - iii) Resting upper and lower lips to their respective incisor teeth
  - b) Dental arch considerations
    - i) Incisal curve
    - ii) Maxillary central incisor proportions
    - iii) Maxillary width
    - iv) Zenith lines
  - c) Dental considerations

- i) Tooth spacing
- ii) Incisal angles
- iii) Macrotexture and microtexture of teeth
- iv) Tooth shape
- v) Tooth colour and incisal translucency
- vi) Tooth surface characteristics
- d) Gingival considerations
  - i) Gingival scalloping
  - ii) Gingival keratinization
  - iii) Papillae form

To perform all these measurements and then to inter-relate them to each other is a daunting task, if not impossible in the clinical setting. This is why all these measurements and their analysis are not routinely carried out. What becomes expedient is the assessment of the face for its visual symmetry, balance and harmony, and only a few measurements are taken. If there is a visual impression of a problem then more measurements are undertaken.

Obviously the more experienced clinician is more likely to detect these problems. But unfortunately even they do not always get it right and there is an unhappy patient. This then also means if problems do arise, it is then hard to reconstruct what actually went wrong.

Another serious problem is the less these measurements are considered, the more it becomes subjective and then there are problems with reproducibility or to apply these subtle variations in evidence based dentistry to other patients

These measurements can be critical in long term maintenance if exact records are not taken at the commencement and

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plane are the primary planes which determine the orientation of the head position to take all the reference measurements from. However the head usually is tilted to one side to varying degrees.

Figure 3 Inter-papillary plane and mid-facial



Figure 4 Secondary reference planes determine the parameters of the dental arches which in turn establish the tooth positioning within the arches and the face



Figure 5 The facial photograph and the intra-oral photograph should be aligned to each other by the use of a marker to align each digital image against

immediately upon completion of the treatment.

What has been presented is only of use to the clinician but indirectly to the patient.

The clinician has to explain the treatment, its limitations and possible variations. From a patient's perspective it can be very hard for them to know what their actual problem is as well as remembering what the clinician has said. This then has to be understood by the clinician and who then has to verify this in some manner that the patient has no misunderstandings.

Once there is agreement, then this information has to be conveyed to the laboratory. They have to have all the required information to construct the try-in prosthesis. Obviously the more the information that is quantitated, the easier it is for them to construct the prosthesis.

Once the prosthesis is constructed then the clinician can assess it; but only a few of the measurements now remain. The reason being some of these will be lost with the construction of the prosthesis. The prosthesis is still not yet related to the face, and most of the assessment of the try-in prosthesis will be undertaken when the patient is present.

Now that the aesthetic concepts and measurements have been presented in the clinical setting; how can software help? It can help by recording what has transpired and in 3 aspects:

- 1. Patient communication
- 2. Clinician's ability to analyze the aesthetics of that particular patient
- 3. Communication with the laboratory and assessment of their work

For this to have any clinical relevance the software must be easy to use and the results must be achievable by users with minimal computer skills.

The process commences with attaining the digital image with the camera and the patient in the classical position and relative to each other. The patient must be smiling. This option would be used in simple treatment situations to quickly present a minor procedure like tooth bleaching, single crown replacement etc. Even a simple graphic program could do this and the extent of its use would depend upon the clinician's computing knowledge.

Another approach is to attain the image their mouth with lips apart with both the patient and the camera in the same classical position. This information could then be used to explain the intra-oral problems and treatment close up, but it could not be related to the face. Again a reasonably powerful



Figure 6 The lip aperture can be made transparent by the use of an ellipse with handles that can maneuver the transparency and adjust its shape and size to expose the underlying intra-oral photograph



Figure 7: The facial or the intra-oral digital images then have to be calibrated. This must be by the use of fixed points that will not be altered by any reconstruction.



Figure 8 It is essential that the missing, damaged or unaesthetic crowns must be adjusted in their macrostructure and microstructure as well as their colour and translucency

graphic program would suffice but it would require much more computing knowledge of its application to create teeth and gums.

In the case of complex treatment and/or an exacting patient we should demonstrate the treatment both facially and intra-orally. This can only be accomplished by having the camera and the patient in the classical position, with the camera parameters kept constant for both images. The manipulation of these images can be achieved through a powerful graphic imaging program but would require time, patience and an extensive knowledge of the application.

The program should align the facial and oral images (figure 5) and then a process which would enable them to switch from one view to the other with ease. This would also require for the lip aperture to become transparent (figure 6). Next the images should be calibrated to each other and another calibration should include the possibility to make absolute measurements (figure 7). Naturally this must be a quick and easy process. Once this is accomplished then the program should be able to create digital images of the various tooth forms and variations of macrostructure and microstructure, colour and incisal translucency. Their position must be able to be altered as well as their orientation (figure 8).

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The gums also must be manipulated independently as well as the ability to be able to demonstrate the difference between prosthetic and surgical manipulation of the gums. The ability to do this should empower the clinician to create any correction of an aesthetic problem both quickly and efficiently. Furthermore the perceived variations should be created.

There should also be the option to create these images freehand or with a few or as many aesthetic guidelines that are currently used in cosmetic dental analysis. These guidelines should be easy to apply within the program, and the clinician should be able to review the lines from a visual perspective along with the mathematical relationships between them, as well as isolating and using the measurements that are of the most benefit. There should also be the possibility to come back at any stage and perform more measurements or adjust previous ones. A very specific software package would be required to do fulfil all this.

A software package which could easily inter-relate photographic images and aesthetic and cosmetic measurements would be a dynamic clinical tool. It could aid the clinician in determining what the patient exactly wants as well as demonstrating the realistic variations to be expected by the patient. It would also enable the clinician to assess their thoughts on the management of the case and provide accurate information to the laboratory for the construction of the try-in and final prosthesis. This approach could be very useful for the clinician running their clinic on evidence based information. It would also enable beneficial research to be conducted on cosmetic and aesthetic canons.

In conclusion cosmetic and aesthetic software packages should and can be used in every day practice and in research in quickand-easy manner.



Dr Davor Hribar is an Adelaide-based Oral and Maxillofacial surgeon. He has a special interest in software development. His clinical interests are in implants and Orthognathic surgery, with a particular emphasis towards aesthetic and cosmetic surgery.