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Quest for the perfect restoration

_CAD/CAM dental restorations were introduced nearly 30 years ago. It is beyond doubt that this introduction marked an extremely important milestone in our endeavour to achieve the perfect restoration.

Restoring damaged or missing teeth has always been a tough challenge, since ancient Egyptians until the present time. Rapid developments in the field of CAD/CAM systems in the last decade are bringing us ever closer to our goal. Currently, a digital workflow can be implemented with great confidence. Scanners, milling units and 3-D printers are becoming precise to the extent that results can be achieved almost to within the micron.

Although our restorations offer our patients a wide range of benefits, they do not come without disadvantages. More often than not, part of the remaining healthy tooth structure must be sacrificed to accommodate and retain the restoration. Furthermore, regardless of the method of fabrication, whether direct or indirect, the dental materials used usually exhibit dimensional and structural changes during the process, leading to an array of problems.

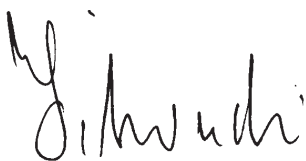
For perfect results, it is essential to standardise the procedures in fabricating a restoration. Manual fabrication involves numerous errors that are nothing but part of human nature. The human eyes and hands are not predictable in measuring and evaluating dimensions, angles, spaces, and all other calculations needed to achieve a satisfactory result. Computers are, beyond doubt, far superior to humans in determining such critical parameters.

Utilising now very advanced CAD software, we are able to come up with almost perfect restoration designs. CAM software is following suit. What we see on the screen is often what the milling unit or 3-D printer produces. It is the obligation of every one of us to join this fast-moving industry. We owe it to our patients, as well as to ourselves, to become acquainted with and put to use all available technology to offer the best possible treatment.

I believe that digital and CAD/CAM restorations are taking over in setting the standards for dental restorations. They are precise, predictable and much easier to produce. We are certainly coming closer to our goal. The perfect restoration appears to be just around the corner.

In this issue of the **CAD/CAM** magazine, you will find various clinical articles describing the use of CAD/CAM and 3-D technologies, from digital smile design to guided surgery.

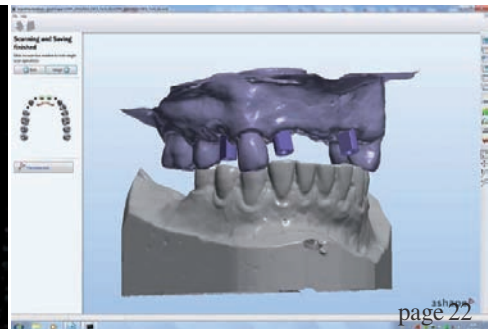
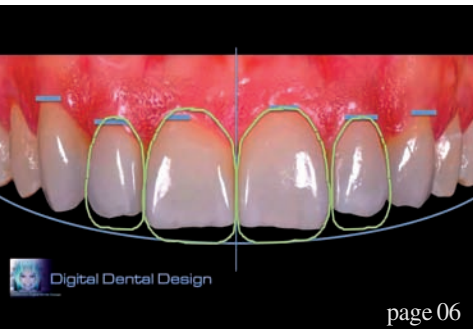
I wish you a pleasant and informative read,



Dr Munir Silwadi
Specialist in Prosthodontics, Implantology and CAD/CAM dentistry
Member of the Royal College of Dental Surgeons of Ontario, Canada



Dr Munir Silwadi



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Aesthetic Digital Smile Design: Software-aided aesthetic dentistry—Part I

Author_Dr Valerio Bini, Italy



Fig. 1



Fig. 2

Fig. 1_Facial aesthetics medical team and interdisciplinary vision.

Fig. 2_ADSD virtual planning.

Introduction

The concept of aesthetics has been explored by various authors and discussed by eminent philosophers. While their definitions are subjective, they all agree on the natural origin of the term. For this reason, I believe that the real objective of aesthetic dentistry must be imitating nature, which is so simple to perceive yet so difficult to copy, particularly as regards the aesthetics of the lower third of the face. The skill and visual perception of the dental team are

essential in pursuing this goal, and the dentist acts as architect and artisan of the oral and periodontal tissue by moulding the physiology of the smile.

Smile designer:

A new means of communication

Dental surgery is increasingly being forced to adopt a multidisciplinary approach to treating the face and smile, in which the dentist plays an influential if not primary role. A balance between the teeth, inter-oral and perioral tissue, face, smile and person creates an aesthetic ideal, and synergises the artistic capacities and the expertise necessary to see the design in the context of the face. Today aesthetics is increasingly linked to measure, proportion and symmetry, which were all already present in ancient civilisations but today have been considerably perfected by the digital age. Modern scientific knowledge puts at the disposal of professionals various therapeutic options. This along with collaboration between different specialists (orthodontists, implantologists, periodontologists, dental technicians, maxillofacial surgeons, plastic and cosmetic surgeons) and the above-mentioned goal enable a treatment plan to be

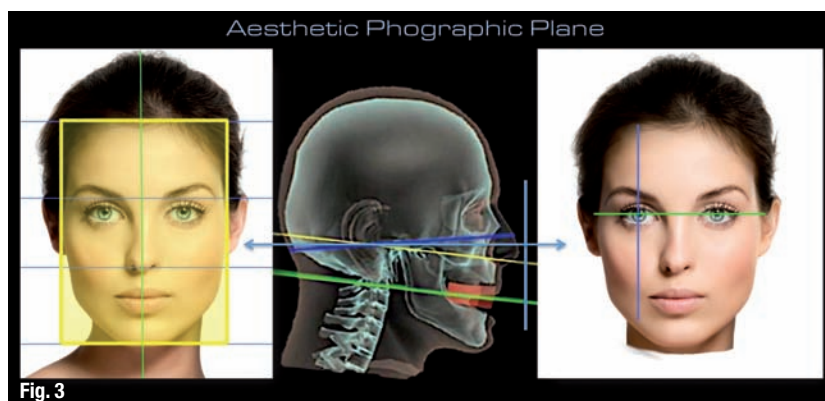


Fig. 3

Fig. 3_Photographs and aesthetic plane.



developed with ever-greater precision (Fig. 1). Furthermore, images captured at locations far away and viewed via video conferencing using Skype, for example, give the dentist the role of the conductor of an orchestra and provide him or her with a new way of working together with other professionals.

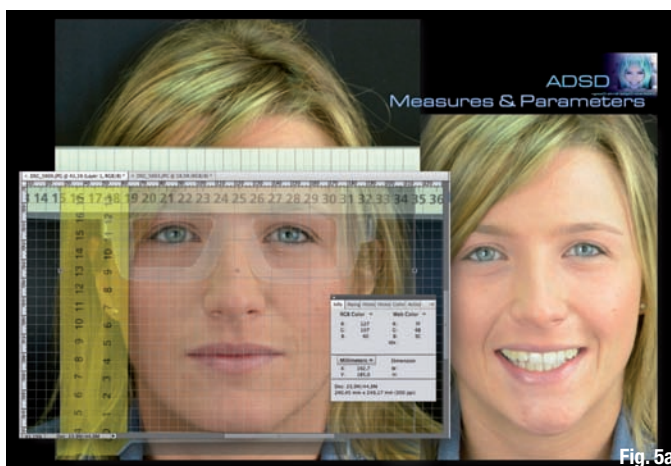
Digital dentistry requires that one follow precise protocols in order to obtain a standard, predictable result that corresponds to an optimal clinical result (virtual planning) in an ergonomic manner and with

a high level of quality. Today, the use of 2-D and 3-D software for photograph editing and digital image editing allows us to process data and customise parameters for each specific clinical and aesthetic requirement of the smile makeover. Modern digital technology along with the experience and aesthetic sensitiveness of the dentist, which are fundamental to the success of smile design, offers greater predictability for the patient, as regards both the final aesthetic results and the course of therapy agreed upon.

Figs. 4a–d Front view and lateral views at 45 and 90 degrees.

Fig. 5a Face Analogic Transfer Support.

Fig. 5b Transfer of analogue measurements to digital calliper.



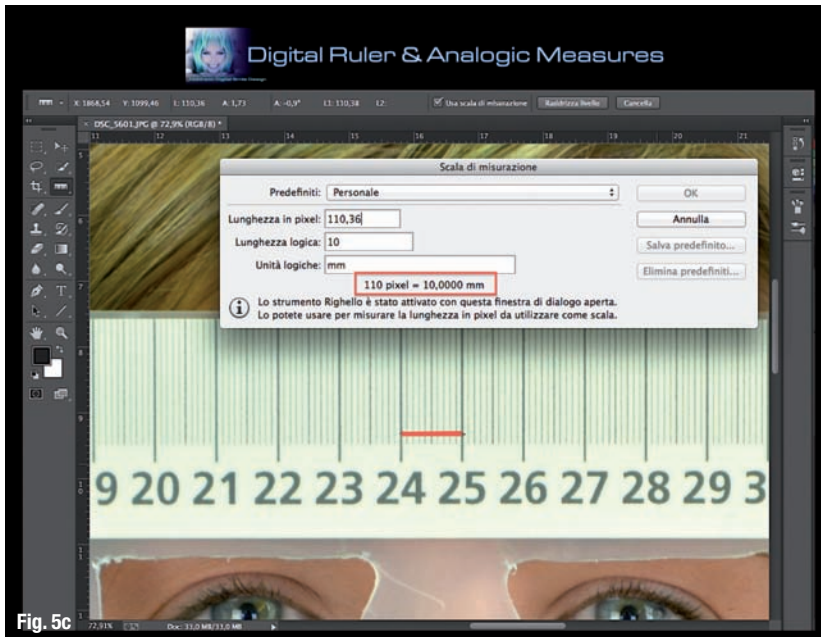


Fig. 5c

- a. MacroAesthetic (Face Extraoral Analysis)
 b. MiniAesthetic (Mouth Extraoral Analysis)
 c. MicroAesthetic (Teeth, Gum Intraoral Analysis)

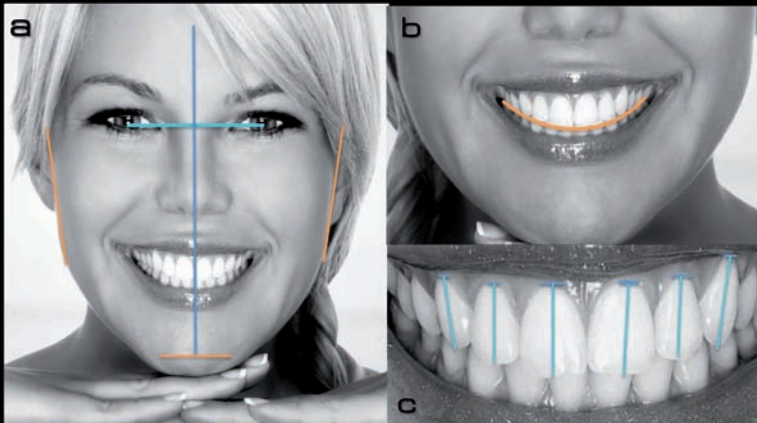


Fig. 6



Facial Analysis

- Front / Lateral
- Morphological Determinants
- Horizontal Reference Lines
- Vertical Reference Lines
- Facial Proportions
- Horizontal/Vertical Dimensions
- Profile (E-Line / Angles)
- Lips Positions e Dimensions
- Nose Position e Dimension
- Eyes Positions e Dimensions

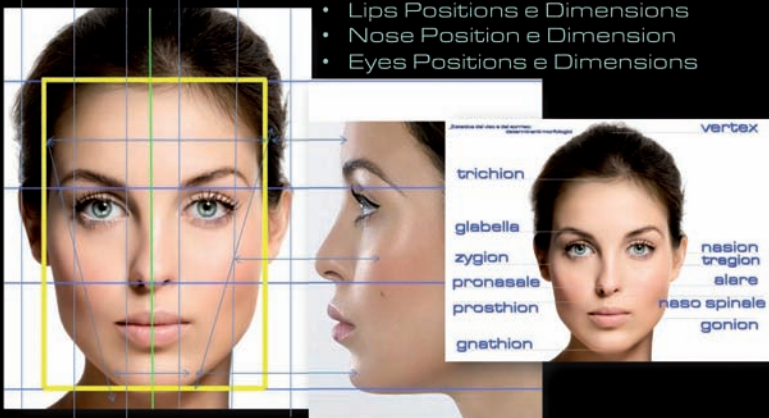


Fig. 7

The combination of terms such as "aesthetic dentistry", "interdisciplinary vision", "digital dentistry" and "predictability" led me to consider that today a new professional figure might be created: the smile designer, whose fundamental role would be communicating with the patient and the aesthetics medical team, whose members are crucial in virtual planning.

My ideal would be to have at my disposal a single instrument that would serve the purpose of the smile designer.

Using various software platforms, I have pursued the development of a protocol for Aesthetic Digital Smile Design (ADSD) to be used alongside other important diagnostic elements useful for diagnosis and prognosis, ultimately to improve the health and well-being of the patient. Furthermore, it is advisable to obtain prior consent regarding the aesthetic treatment to be undertaken using real clinical models, such a mock-up, since this is also a predictable method of simulating the aesthetic treatment plan. It is useful to recall here the forensic dentistry provides that the dentist is obliged to comply with three fundamental principles in carrying out his or her profession: prudence, diligence and technical expertise.

ADSD method and protocol

Further to what has been said above, ADSD should first be an instrument to improve communication with the patient by showing the patient detailed images. On the monitor, the before and after photographs allow an index of predictability and point of comparison with the patient himself or herself. A milestone is the innovation of aesthetic clinical planning in aesthetic dentistry and prosthetic dentistry relating to dental technical analysis and planning, which, among other things, can be integrated into diagnosis and planning for plastic and maxillo-facial surgery (Fig. 2).

The protocol first requires the acquisition of full-frame digital images and videos of the patient. Video especially is capable of capturing the dynamic phases of the smile linked to its physiology (mimicry, phonetics, relationship between the teeth and lips). Importing this vital data into the digital clinical file of the patient is complementary to the anamnesis because it is an integral part of the intra- and extra-oral objective examination, and will subsequently be the subject of aesthetic analysis according to the main guiding principles. Therefore, we could define this as the third part of the methodology, which we will call analytical processing, during which the aesthetic composition of the smile, the determining morphological features of the face and smile, including the fundamental points of reference to be

obtained from software such as face makers, will be mapped and processed.

The next phase in digital data processing is virtual planning by means of digital image editing: wax-up, digital and analogue diagnosis, mock-up, and provisional and definitive restorations. The digital methodology used for photograph and image editing is very reliable, especially in communicating through images the ongoing clinical case to dental laboratories concerning functional and morphological adjustments, which is made even easier if accompanied by explanations and verbal comments. Compatibility with other digital systems is very important, for example being able to implement ASD in digital orthodontic simulations, digitalisation of casts, CAD/CAM, etc., thus adding to the methodology.

Acquisition and import of digital images

As stated earlier, the first phase of ASD entails the acquisition and import of photographs of the patient. If possible, these photographs should be taken with a digital SLR camera with semi-professional features and with a good illumination system (nowadays there are a number of basic dental photography courses and books available dealing with this fascinating subject). We must remember that in the analytical phase the photograph is a clinical and aesthetic diagnostic element that will form part of the patient's clinical history, which can be consulted by other specialists to establish an interdisciplinary vision. In view of this, the dentist/photographer must capture the photographs with the patient's head in a position that can be replicated in the future to verify topography in relation to smile design. The

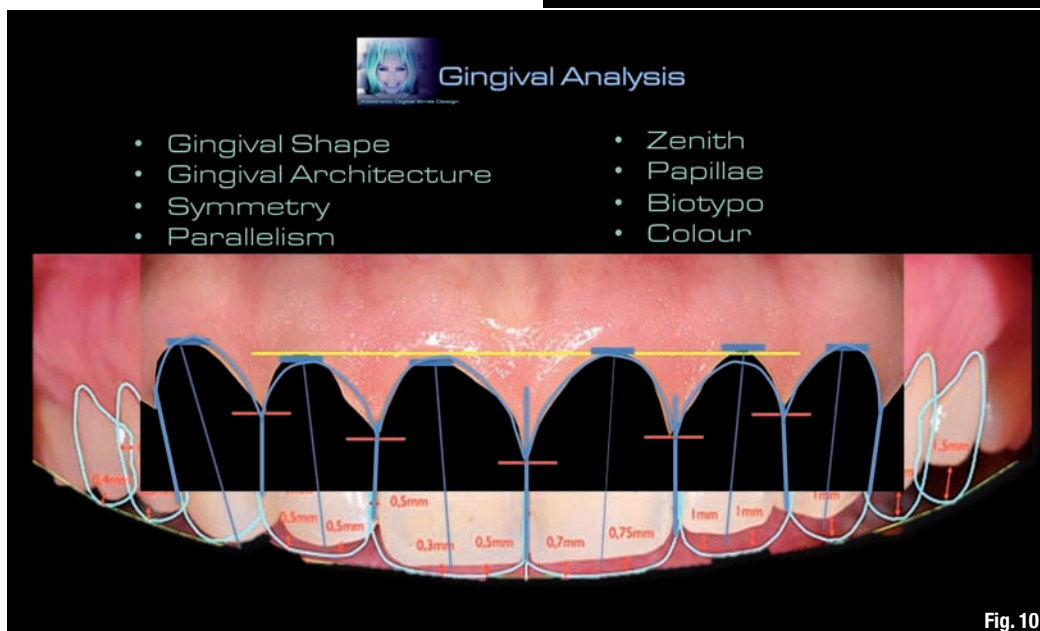
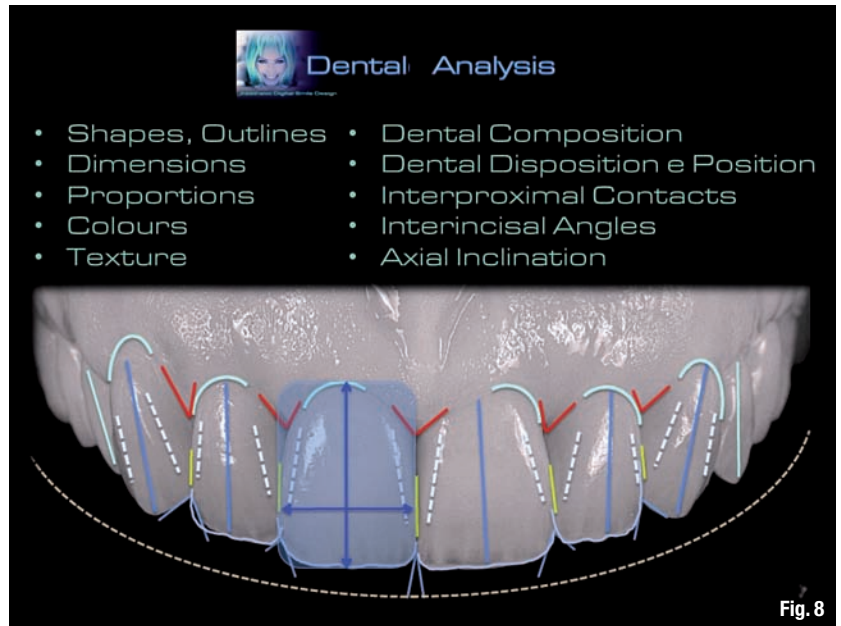


Fig. 5c Activation of analogue measurements with digital ruler.

Fig. 6 Focal length and analysis of the aesthetic component.

Fig. 7 Facial analysis.

Fig. 8 Dental analysis.

Fig. 9 Dento-labial analysis.

Fig. 10 Gingival analysis.