

VIRTUAL PLANNING IN AESTHETIC AND PROSTHETIC DESIGN

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1. Introduction

The first examination of a patient who requires complete functional and esthetic rehabilitation, is one of the most challenging tasks for the dentist, thus it cannot be limited to a rapid evaluation of the patient's clinical issues. It should consist of the following three fundamental steps:

- 1-first examination, during which the dentist must understand the patient's needs and personality, and establish a reciprocal trust relationship, which is extremely important in providing successful treatment (1).
- 2-data collection to formulate correct diagnosis and develop a complete treatment plan designed to solve any underlying pathology and address the patient's functional and esthetic needs (2).
- 3-inform patient about therapeutic strategy chosen considering his/her clinical condition, psychological status and socioeconomic aspects (3-5).

Purpose of this study is to analyze which are the parameters of crucial importance in achieving correct diagnosis in treatment planning, and methods currently used for data collection.

DATA COLLECTION

The clinician, in order to design the treatment plan, has to gather as much information as possible through the following steps:

- facial and intra-oral clinical examination;
- radiographic examination;
- examination of study models mounted on a semi-individual articulator;
- a complete facial and intra-oral photographic shooting;
- diagnostic wax-up.

Clinical examination

The clinical examination of the patient is achieved in two steps:

- the first is the evaluation of the face on its esthetic and functional features;
- the second is the evaluation of dental-periodontal components and occlusal aspects.

When examining the face, the clinician must analyze peri-oral soft-tissue tonicity, particularly that of the lips, depth of the nasolabial furrows, support in the filter area, and the vertical dimension.

Moreover, he has to consider the face and the mouth with respect to the vertical and horizontal reference lines, in order to evaluate their spatial arrangement; both the bipupillary and median lines, in particular, are considered fundamental reference points for the esthetic assesment(6).

Radiographic examination

The radiological investigation plays an important role in defining the treatment plan; in complex cases, several radiological techniques must be combined: full-mouth x-ray, teleradiography and, whenever required, CT.

Examination of study models

In formulating the treatment plan in a complex clinical case, study models must be mounted on a semi-individual articulator using a transfer facial bow. Wax lateral and protrusive interocclusal records are used for setting the condylar inclination of the articulator(11).

Facial and endo-oral photographs

Obtaining a set of photographs of the face and endo-oral areas should be considered a standard procedure when diagnosing complex prosthetic cases. The photographs enable the dentist to analyze several esthetic aspects, also after the patient examination true and proper (12,13).

Thanks to the widespread availability of digital technology, the process of taking and filing pictures has been greatly simplified, moreover communication and information exchange with the dental laboratory and colleagues involved in the treatment can be achieved in real time (14,15).

A series of atypical photographs are shown in the present paper as examples that are useful in making a diagnosis and formulating the treatment plan; they include the following views:

- frontal with divaricators: taken with cheek-retractors dressed on and teeth apart, to evaluate any parallel between the bipupillary line and the occlusal plane as well as the congruence between the median and inter-incisive lines (Fig. 1).
- frontal smile: taken while asking the patient to smile in order to expose the teeth as much as possible. This picture allows the dentist to evaluate the relation between the incisal plane and the lower lip, together with the width of the buccal corridors (Fig. 2).
- rest position: taken with patient at rest, which aims to identify teeth the patient shows during phonation (Fig. 3).

The Diagnostic Wax-up

The diagnostic wax-up is the visual representation of the predicted outcome of prosthetic treatment. Despite its name, the wax-up can be carried out either by applying wax to the models or by using commercially available resin teeth.

The diagnostic wax-up allows final volumes to be determined and can be transformed into a provisional (indirect mock-up) or reproduced onto a silicone index or a heat-printed mask in order to pre-visualize it in the patient's oral cavity (direct mock-up) (16).

The drawbacks of this procedure are its production costs, due to the dental laboratory involvement, and the complexity of its use in some settings (e.g. when the wax-up is subtractive). For these reasons, the authors have long been using the "virtual wax-up", involving the digital modification of the patient's features by processing his/her face and intra-oral photographs.

Virtual wax-up

The virtual wax-up consists of processing face and dentition pictures using a digital photo-editing program to insert "new teeth" in the patient's "smile" in order to simulate an optimal esthetic outcome.

This pre-visualization of the possible treatment outcome offers several advantages in terms of communication, planning and cost minimization. In the communication with the patient, disposing of an image predicting the final outcome is extremely useful both to strengthen trust relationship (usually the patient is more inclined to accept the treatment plan), and to relay the information required by the technician to develop the diagnostic wax-up.

During treatment plan development, it is easier for the clinician to pre-determine the essential phases of the therapeutic process, the timing required for its achievement and, finally, its costs.

Moreover, it is extremely valuable to visualize in advance the different possible esthetic outcomes that can be achieved.

CLINICAL REPORT

Patient with residual dentition

A.R., 33 year-old woman, who referred to our dental office for functional and esthetic rehabilitation.

After a preliminary examination to check patient's expectations, a second appointment was scheduled to collect the above-described data.

Esthetics is the first step in determining the treatment plan, face photographs are essential: frontal view with divaricators, performed with the cheek retractors and teeth apart (Fig. 4) the frontal smile (Fig. 5) taken while asking the patient to smile and expose his teeth as much as possible.

Through simple digital-editing steps it is possible to cut from the latter picture the area between the vermilion border of the upper and lower lip, thus obtaining the "smile mask" (Fig. 6)

Once the reference esthetic parameters are chosen, a digital pre-visualization of the rehabilitation project is made by using teeth models chosen from a dedicated database.

The latter is composed by a collection of photographs depicting complete and esthetically optimal dentitions (Fig. 7).

Thanks to the picture-editing software (Adobe Photoshop CS5 Extended 2010), the therapeutic plan can also be outlined, thus allowing to directly compare the initial situation with the desired outcome. It is more straightforward for the dentist to plan treatment and to convey information to the dental technician for developing the diagnostic wax-up (Fig 8).

The overall esthetic impact of the rehabilitation is verified by overlapping onto the virtual reconstruction the "smile mask". This image is particularly useful for presenting and explaining the planned treatment to the patient (Fig. 10). During this phase, esthetic modifications can be incorporated in the pre-visualization. The conversation between clinician and patient is then followed by the realization of the diagnostic wax-up, based on the virtual picture agreed upon (Fig. 10).

Conclusions

The first examination is of crucial relevance in building up the dentist-patient relationship, the importance of which should never be underestimated. Moreover, the clinician can now use not only the traditional diagnostic tools, but also has access to state of the art tools that are a new window of opportunity in helping him formulate a treatment plan: digital cameras and picture-editing software.

The virtual wax-up is a simple and economically viable mean for showing the treatment plan to the patient, who is thus given the opportunity to visualize the functional and esthetic goals, in addition it is a powerful tool to share the information required by the entire dentistry team involved in deciding upon and providing treatment.

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