Esthetic analysis of vital teeth during treatments in the front area using computer-controlled selective anesthesia

Mirela Feraru\textsuperscript{1}, Vincenzo Musella\textsuperscript{2}

\textsuperscript{1}DMD, Bichacho Clinic, Tel Aviv, Israel  
\textsuperscript{2}DMD, MDT, Private clinic and private laboratory, Modena

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\textbf{KEYWORDS} \\
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\textbf{ABSTRACT} \\
Aim Minimally invasive preparations and aesthetic integration of restorations are the goal of all treatments, and of those in the visible area in particular. Conventional anesthesia of the anterior maxillary teeth by infiltration in the buccal fold prevents a correct dynamic evaluation of the smile and the relationship between the interfaces, since soft perioral tissues (lips, cheeks) are also anesthetized. This article describes the importance of keeping full function of the surrounding perioral tissues during functional, phonetic and aesthetic evaluation of anterior maxillary restorations. A case where porcelain laminate veneers restorations were achieved under computer-controlled selective anesthesia is reported.

Case report A case is reported of a patient with congenitally missing lateral incisor that had been treated by means of ceramic restorations transforming the shape of the canines into laterals and the premolars into canines, but with poor results; in particular the patient complained of an asymmetric smile. For the successful outcome of the new restorations, the ability to analyze the desired changes in a dynamic evaluation that requires full function of the lips, granted by selective anesthesia, proved to be invaluable. The new restorations were therefore achieved under selective anesthesia using the Wand system.

Conclusion The Wand system enables efficient, painless and ergonomic injections and allows for a precise control of the treatment and a valid esthetic evaluation during the different steps of anterior maxillary invasive treatments.

\textbf{Introduction} \\
Due to the continuing development of new adhesive systems, composite and ceramic materials in dentistry, the range of clinical indications for all types of restorations has been increasingly widened. One of the most crucial parameters for success (1) has been the amount of enamel preserved. Ceramic veneers are considered the best in terms of minimally invasive indirect restorations. The correct use of porcelain laminate veneers (PLVs) provides excellent esthetic results and is a well-established method for conservative restorations of malformed, discolored, misaligned, fractured and worn anterior teeth (2). Today the use of new adhesive systems and a correct preparation design (having the margins in enamel) facilitate restorations with minimal loss of healthy tooth structure, and provide an overall success rate of 94-97\% of cases (1). According to Magne and Belser (2), the main clinical indications for PLVs can be divided into three main categories as follows.

- Type 1, dark substrate, teeth resistant to bleaching, tetracycline discoloration etc.
- Type 2, teeth in need of morphological changes, conoid teeth, diastemas etc.
- Type 3, more extensive coronal loss of tooth structure, eroded teeth (mainly dentin) etc.

Each time aesthetic procedures are to be considered, a correct analysis of the existing relationship between face, lips and teeth is mandatory, especially when the tooth morphology is redesigned. This is generally performed with an intra-oral check (mock-up) of the preliminary wax-up produced by the technician.

Once the desired changes are checked intraorally, discussed and approved by the patient, the treatment itself becomes straightforward. Before finalizing and delivering the final restorations, one should analyze again the relationship between the different interfaces, face, and lips with the new restored teeth. In those clinical situations, where the preparation
design includes dentin and might cause sensitivity during the treatment steps and at the try-in phases, local anesthesia is necessary but the immobilization of the lips prevents a dynamic evaluation of the smile. The final aesthetic results may fail the patient’s expectations if the desired modifications are not evaluated together due to partial or full anesthesia of the perioral tissues. In the literature (1, 3) it is reported that the success rate of PLVs even with dentin exposed is high as long as there is peripheral enamel included in the preparation.

Minimally invasive preparations are the goal of all treatments, especially in the front area, together with an aesthetic integration of the restorations for a pleasing smile. The traditional way of anesthetizing the anterior maxillary teeth is infiltration in the buccal fold, where, besides the involved teeth and the periodontal tissues, the soft perioral tissues (lips, cheeks etc.) are also anesthetized. This prevents a correct dynamic evaluation of the smile and the relationship between the interfaces.

This article describes the importance of keeping the function of surrounding perioral tissues during functional, phonetic and aesthetic evaluation of anterior maxillary restorations and their integration with the surrounding tissues.
A new approach for anesthetizing teeth in the front area has been described in the literature (4-7) with the use of a computer-controlled local anesthetic device (C-CLAD) named the Wand. During its early use, it became clear that there is a fundamental change in the subjective perception of pain for patients as well as the outcome of a dental injection due to the precise control of two variables: the fluid pressure and the fluid flow rate. These variables are defined as the fluid dynamics of a dental injection. The control of fluid dynamics during the injection has led to several advantages (8) including more effective diffusion of the anesthetic into the tissues and the ability to deposit larger volumes of solution with minimum distension of the tissues. These findings led to the development of new injection techniques such as the palatal approaches for the maxillary teeth and a modified injection for the intra-ligamentary anesthesia (PDL injection, single tooth anesthesia). The main advantage of the palatal approaches, besides the low perception of pain during the injection, is anesthesia of the teeth without affecting perioral tissues and their function.

Two new approaches have been described in the literature (9,10) for the maxillary teeth using the Wand system: the palatal approach for the anterior middle superior alveolar nerve (AMSA) and the palatal approach for the anterior superior nerve (P-ASA). Both of these techniques will be explained in detail through a case presentation of anterior maxillary teeth restored with porcelain laminate veneers restorations. The importance of keeping full function of the perioral tissues while analyzing the smile will be explained along with the advantages of the Wand system.
The Wand System

The first computer-controlled local anesthetic delivery system (C-CLAD) was introduced in 1997 and was named: “the Wand”. It was designed to improve ergonomics and precision during injection and reduce the subjective pain of the patient.

In 2007, the Wand STA (single tooth anesthesia) was launched and represented a significant advancement in the C-CLAD technology. The Wand STA incorporated the dynamic pressure sensing technology (DPS) allowing for a precise monitoring and fluid pressure control at the tip of the needle, during injection (11). The fluid pressure allows identification of certain anatomic locations and different type of tissues. This pressure information is constantly available to the clinician by visual indicators and audible sounds, offering a real-time feedback on the needle location. All traditional injection techniques can be performed with this system in addition to the mentioned novel techniques.

The anterior middle superior alveolar nerve (AMSA) technique provides pulpal anesthesia to multiple maxillary teeth (incisors, canine and premolars) from a single injection. The injection site is the hard palate halfway along an imaginary line connecting the midpalatal suture to the free gingival margin.

Figure 9, 10, 11 Esthetic improvement at the first (one month after placement of the provisionals) and second re-evaluation (after further 2 weeks) showing soft tissue health

Figure 12, 13 Impression taking
between the two premolars (Figures 1, 2).

With the anterior superior alveolar nerve–palatal approach (P-ASA) it is possible to anesthetize six anterior teeth, gingiva and mucoperiosteum including one third of the anterior palate and the buccal tissues with one injection. Needle placement corresponds to the incisive papilla and penetration of the incisive canal is mandatory for an optimal effect. It is known (12) that performing an injection in the incisive papilla or at the palate area (dense tissues) is associated with considerable pain. The Wand system allows this injection with considerably reduced sensitivity and discomfort for the patient due to its dynamic control of the fluids during administration. One of the main causes of pain – especially in dense tissues – is distension of the tissues during the administration and the diffusion of the anesthetic solution. This technology enables a slow diffusion of the solution in a constant and controlled pace with minimum to no tissue distension.

Case report

A 25-year-old woman presented to the office complaining of an unpleasant smile. During the first consultation visit, among the regular data collection (case history, radiographs, periodontal charting, intra oral and extra oral examination) a series of images and video clips were taken as part of the preoperative documentation along with an impression for study models (Figures 3-6c).

The relationship between the different interfaces was analyzed. Gingival inflammation was noticed around all restored teeth, imprecise and leaking margins, unbalanced occlusal pattern, chipped incisal

![Figure 14](image1.png) The 27-gauge needle used to induce anesthesia, with birotational and slow advancement

![Figure 15](image2.png) Anesthesia of both sides of the palate up to the second premolar was achieved

![Figure 16, 17, 18](image3.png) Blenching on the soft tissues of the palatal and buccal area with complete function and mobility of the lips during smile
edges, asymmetry between right and left side during smile was noticeable and intra-oral analysis revealed differences in size and shape of the homologous teeth, especially between #11 and #21.

As the patient had a congenitally missing lateral incisor, she previously had undergone ceramic restorations transforming the shape of the canines into laterals and the premolars into canines.

The new treatment plan included replacing the previous defective restorations and recontouring the soft tissue for tooth #11. This would provide symmetry in the shape and size of the two central incisors for a more harmonious integration with the surrounding tissues and adjacent restored teeth.

An impression of the preoperative situation together with some clinical pictures and instructions were sent to the dental technician who provided a traditional diagnostic wax-up accordingly (Figures 7a, 7b, 7c).

The real “test drive” of the new forms of the teeth occurred during the provisional restorations phase. Together with the removal of the previous restorations, recontouring of the soft tissues around tooth #11 was performed (gingivo-plasty, i.e., no bone was removed) (Figure 8).

As a considerable amount of tooth structure had unfortunately been removed at the previous treatment, resulting in extensively exposed dentin, sensitivity during the try-in phases and re-evaluation visits was considered. The first re-evaluation took place one month after the provisionals were in place. The second followed after 2 more weeks and revealed the soft tissue health, restoration–gingiva integration and a pleasant aesthetic appearance at function and smile (Figures 9-11).

Impressions were taken next (Figures 12, 13) and definitive lithium disilicate (e.max Ivoclar) restorations were created.

A critical issue during the try-in phases, before finalizing the ceramic veneers, is the dynamic and comprehensive analysis of the teeth modifications during smile. Functionality of lips and the facial muscles is critical in this process.

Due to the considerable amount of exposed dentin, teeth sensitivity had to be addressed. In general, a traditional anesthesia (field block in the buccal fold) would address this problem but consequently it would also temporarily paralyze the perioral muscles (lips, cheeks, etc.). An important benefit in such cases is obtained by a different approach using a C-CLAD.

The anterior middle superior alveolar nerve technique was used before the removal of the provisional restorations on both sides of the palate.

A 27-gauge needle (Figure 14) with birotational and slow advancement produced deep anesthesia of both sides of the palate up to the second premolar.

Figure 19-21 Intra-oral examination, front and lateral views

Figure 22 The transitional line angles were accentuated especially on the lateral incisors
(Figure 15). Immediate bleaching can be seen on the palatal and buccal area as well as the soft tissues with complete function and mobility of the lips during smile (Figures 16-18).

In general, the AMSA technique offers deep pulpal anesthesia on the anterior teeth up to the midline, but might be less effective on the central incisors. This is likely due to the distance from the injection site. In this case, a palatal approach for the anterior superior alveolar nerve was added P-ASA.

During the intra-oral examination, the dimensions (length, shape etc.) of the new restorations were checked in relationship to the lips and intra-oral pictures were taken from the front and lateral sides during smile (Figures 19-21).

Small corrections had to be done before the final staining and polishing of the restorations.

The overall length was reduced, and the transitional line angles were accentuated especially on the lateral incisors (Figure 22) to achieve a harmonious integration between face, lips, and restorations (Figures 23-26).
Conclusion
Initial preoperative documentation and backward planning are imperative for any aesthetically oriented treatment aiming to a successful rehabilitation and aesthetic integration of the restorations. The key to a successful outcome is the ability to analyze the desired changes in a dynamic evaluation that requires full function of the lips. A different scheme in creating deep teeth anesthesia without affecting the perioral-facial muscles was achieved utilizing the C-CLAD-Wand system. This technology enables efficient, painless and ergonomic injections and allows for a precise control of the treatment and a valid esthetic evaluation during the different steps of any anterior maxillary invasive treatment.

References