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Non-ablative melanin depigmentation of gingiva

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Dear Colleagues,

Every 2 years, the world of dentistry prepares for its own Oscar Ceremony—the International Dental Show (IDS) in Cologne. Companies from all over the world present their best and most innovative products.

In the world of innovation, diversity feels at home and everybody is welcomed. Bright ideas and brilliant minds are pushing forward the world of dentistry.

At IDS, gala dresses and sharp suits are replaced by architect-signed booths, innovative products and world class manufacturers compete to become the attraction of the exhibition. The Show shapes the future of dentistry for the following 2 years.

Dental media prepares its best as well, and the proof of it is now in your hands—the latest cosmetic dentistry issue. Prominent authors share their knowledge in this 64-page magazine. Innovation and diversity are also present in the articles’ subject matter, covering everything from general aspects, such as illumination in dental surgeries or practice management, to specialised topics, such as new composite materials or advanced periodontal treatment.

Scientific aspects and innovations presented at the IDS will be debated in the months to follow at the most important scientific events, organised all over the world.

As President of the European Society of Cosmetic Dentistry (ESCD) I would like to kindly invite you to another important event in dentistry—‘Heart of Esthetics’—our annual congress, which will take place from 21 to 23 September in Zagreb, Croatia. I have invited the world’s top speakers in dentistry to Zagreb, who will provide a review of the scientific literature and present clinical concepts for practitioners during two sessions. Parallel to the scientific sessions, a wide selection of workshops and live demonstrations will be organised; all that in an international, vibrant atmosphere of friendship. You will find more details about the meeting on our website www.heartofesthetics.eu.

I hope you will also find many innovative ideas in this issue of cosmetic dentistry!

Sincerely,

Dr Florin Lazarescu
President of the European Society of Cosmetic Dentistry
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Eleven tips for success in your dental clinic

Part II: CAPS & CLIMB

Author: Dr Anna Maria Yiannikos, Germany & Cyprus

After the last issue of *cosmetic dentistry*, we have begun a new journey with our brand new series “Eleven tips to gain desirable success in our dental clinics”. In this publication, we are going to continue exploring different parameters that can reinforce our success and professional development as dental practitioners. Today I will share with you the knowledge I have gained within the past 25 years of managing and evolving my clinic so you can always be one step ahead and avoid mistakes I have made in the past.

The third very important tip that I am going to share with you today in order to be and remain successful at your clinics is how to regain your power. We learn a lot of things during our studies in the dental schools. We learn how to make the best fillings with great contours and biocompatible materials; how to treat a tooth that needs a root canal therapy, but do we really learn anything on how to find the best employee that will make our life and daily routine easier?

Firstly we should make a job analysis by listing the CAPS of the candidate. If we do not take the time to complete this process, we will not know from the beginning exactly what we are looking at and by this we will increase the risk of making the wrong choice.
If, for example, we go to the supermarket without our shopping list, what will we end up doing? We will most probably buy unnecessary things or even forget the things that we went in the beginning there for.

My point here is that when we decide that we need to hire an employee we should know upfront what we are looking for, otherwise we might make mistakes that will cost us money and time!

Let's have a look now what does CAPS stand for:

- Capacities: The mental and physical abilities required to do the job. How smart and how strong (physically capable) must the successful applicant be?
- Attitudes: such as customer service, orientation, team player, reliability, honesty, willingness to follow rules, problem-solving, loyalty, safety-consciousness, ability to follow through—Imagine having a receptionist who, although she is doing the job without a mistake, complains about everything all the time. Is that a person that you would love to have as part of your team?
- Personality: traits such as competitiveness, assertiveness, attention to detail and sociability—Also search whether the person will manage his or her personality to get the job done, since as social scientists declare about 60 per cent of our personality traits are inherited and most of them are set by age nine. In other words: personality can’t be taught and it doesn’t change much over time.
- Skills: Expertise required to do the job—Skills are the easiest job requirements to identify. We could do that by asking the candidate to perform certain tests. For example, if we are trying to find a receptionist we could ask her to translate an article, or through role playing to check how she responds in certain scenarios.

Have always in mind the quote 'we hire them for the skills but we fire them for their attitudes'!

So finally we found our A-star employees and now what do we have to do in order to keep them? The fourth very essential tip of today’s article that I would love to share with you is the different ways that we can use to retain our A-star employees. Apply CLIMB to retain your team!

Now let's explain a little what does exactly the acronym CLIMB stands for:

- Challenge: Studies have shown that the main reason that our employees resign is that they are dissatisfied with their tasks. That’s why we should give them challenging duties to accomplish. And what will the result be? They will feel useful and they will find it difficult to leave from a job that offers them different and unique experiences.
- Loyalty: Be human with your employees and do not be afraid that you will lose your power. Show interest in their problems and lay back in times that they cannot handle any more pressure.
- Investment: Invest time and money to them so they will feel appreciated. During my lectures I get regularly the question that we reward them by giving them bonus and still they are not motivated enough, what shall we do? My answer here is that you must renew your reward system regularly. Sometimes you can give them cash (as bonuses) or maybe you can offer them other kind...
of incentives, like buying them a free trip for vacation on Christmas, for example. Research has proven that the more powerful and effective incentives are the ones that are specific, tangible and noncash. Also please remember to ‘Reward not the best in sales but the best’. A major mistake that we usually do is to only reward the ones that bring money to our clinics. Instead we should reward the best in our practices, the ones that are completing their tasks in excellence unconditionally to what this task is.

- Measurement: Conduct a fair performance appraisal every six months.
- Building: Demonstrate your commitment to them by showing them opportunities of career development.

During the next issue we will analyse two new tips that will reveal new opportunities and potential of our dental clinics. Till then, remember that not only are you the dentist in your clinic, but you are also the manager and the leader.

You can always send me your questions and request for more information and guidance at: dba@yiannikosdental.com or via our Facebook account. Looking forward to our next trip of business growth and educational development!

Editorial note: This article is the second one from the series. Part I appeared in Cosmetic Dentistry 1/2016.

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Lighting in dental surgeries—frequently neglected requirements of the standard on illumination

Author: Antonín Fuksa, Czech Republic

Proper illumination plays an important role in most of our activities, as we acquire more than 80 per cent of information by sight. Precious values such as health and wellbeing are intrinsic in health care.

Lighting in dental surgeries is governed by EN 12464-1:2011 standard1 specifying minimum lighting requirements for workplaces. National versions of this harmonised standard are made mandatory by country regulations in EC countries.2 The current standard is effective as of 2011. Some of the illumination systems designed according to the previous edition (2002) are therefore no longer compliant. The requirements of the standard should be understood as the absolute hygienic minimum, as they are a compromise between average physiological needs and average economic potential. According to ergonomic research, most people prefer their workplaces to be illuminated to 1,000 lx or more, while the standard-prescribed minimum is 500 lx. The standard prescribes the maintained illumination E_m. When the real average illumination E falls under E_m, maintenance is to be performed: luminaires to be cleaned up, lamps to be replaced, walls to be repainted etc.

Adequate illumination of the operating area is vital to perform surgical tasks. The standard3 for dental operating lights requires the operating field illumination to be in the range of 8,000 to 20,000 lx in ellipses of size 50 × 25 mm (visual task area); but only 60 mm up from the centre of the ellipse, a maximum of 1,200 lx is allowed to prevent the patient from being dazzled.

Constant re-adaptation of the eye between very bright and dark areas leads to eye fatigue, and finally to overall fatigue for the dentist. A powerful luminaire above the chair meets or exceeds the minimum prescribed illumination of the patient, which is 1,000 lx (co-responds to immediate surrounding area of the visual task: a stripe at least 0.5 m around visual task area). Lower contrast means better visual comfort for the dentist.

Cold tones of light are preferred as peripheral vision is more sensitive to the blue component of light. This leads to a decrease of perceived contrast. The standard requires light with high colour rendering index Ra ≥ 90. Patients looking directly into the luminaire prefer matt luminous surfaces.
The model surgery has dimensions 5 x 6 m and ceiling height of 2.8 m. The luminaire above the chair is suspended in the height of 2.2 m above the floor. Positions of the additional luminaires are a compromise between functionality and aesthetics.

Besides the visual task in the mouth cavity, many other facets exist in the dental surgery that need to be illuminated in order to carry out tasks: instrument trays, controls and displays of diagnostic instruments, material preparation areas, PC table, filing cabinet etc. Illumination requirements have to be fulfilled at all these places, too. A minimum overall room illumination of 500 lx has to be maintained as well.

One of the principal items in the updated standard is the background surrounding the dentist’s workspace, which is a stripe aligned to the surrounding area of the dentist’s workspace, at least 3 m wide, within the size of the room. According to the standard, this has to be illuminated 1/3 of the illumination of the surrounding area. Installations according to the older standard rarely meet this requirement. A luminance of 5,000 lx directed at the patient can be measured under a powerful luminaire. The background lighting in this case would be 1,670 lx, which is quite expensive to achieve. This requirement has not been met in any of tens of surgeries measured where a powerful directional pendant luminaire was placed above the chair. The updated standard helps us to understand the room as a whole, not just a set of task areas. Not only the illumination of the patient, but also the uniformity and acceptable contrast in the whole space is important.

The focused beam of the operating light provides illumination of about 15,000 lx that is necessary for the dentist’s task in the mouth cavity. The high-output directional/indirectional panel luminaire above the chair provides illumination of the task background area of about 3,000 lx, providing a 1:5 contrast, which is already an acceptable level. Colder tones of light further improve the perceived contrast to about 1:4. Besides illuminating the patient, the high-output directional/indirectional panel luminaire serves as an ergonomic aid to ease the visually demanding task of the dentist.

Measurements carried out in dental surgeries across some Eastern European countries clearly

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Purpose</th>
<th>Overall illumination</th>
<th>Patient illumination</th>
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<tr>
<td>$E_m$</td>
<td>Maintained Illuminance</td>
<td>Adequate level of light</td>
<td>500 lx</td>
<td>1,000 lx</td>
</tr>
<tr>
<td>UGR</td>
<td>Limit of Glare index UGR</td>
<td>Glare limitation, acceptable contrast</td>
<td>19</td>
<td>–</td>
</tr>
<tr>
<td>$U_o$</td>
<td>Minimum illuminance uniformity</td>
<td>Acceptable distribution of light</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>$R_a$</td>
<td>Minimum general colour rendering index</td>
<td>Required color discrimination</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>–</td>
<td>Special requirements</td>
<td>According to selected task or area</td>
<td>Light should not dazzle the patient</td>
<td>–</td>
</tr>
</tbody>
</table>
show that even the very basic requirement of task illumination is often neglected. Also task background and overall illumination are often far too low, which has both eye and overall fatigue implications. As little as 30 lx have been repeatedly measured on the material preparation areas and computer desks. Many surgeries installed in existing buildings kept the original (office) luminaires, not quite following the lighting project. These systems were often projected according to an old standard that required as little as 300 lx for office work. Savings on lighting tend to generate much larger expenses later. The need for light grows with age.

Other parameters of lighting like uniformity, glare, colour rendering or non-visual effects of light and lighting control will be discussed later in a dedicated article.

Lighting the surgery with office luminaires only is not sufficient to fulfil basic requirements. Lighting using a single, powerful central luminaire provides enough light in the visual task area, but may easily fail to meet additional requirements. That is why additional luminaires are needed to provide background area illumination and uniformity.

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4. FUKSA, Antonín. Lighting in dental surgeries. StomaTeam. 2/2014. ISSN 1214-147X.

Antonín Fuksa graduated (MSc) in 2000 at the Czech Technical University in Prague, Faculty of Electrical Engineering in the field of study Measurement and instrumentation. He currently works as a developer of intelligent luminaires, smart lighting systems and chronobiological phototherapy devices in NASLI.
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Cosmetic enamel restoration using naturomimetic layering technique—Part I

Author: Dr Sushil Koirala, Nepal

Introduction

A human face takes priority when determining physical attractiveness. If we group the facial components according to their influence on appearance, the mouth takes precedence over the others. Smiling is one of the most important facial expressions and is essential in expressing friendliness, agreement and appreciation. Whatever may be the emotion, a smile plays an important role in society, and for a variety of psychological reasons makes both giver and receiver feel good. The face, gums (gingival complex), teeth (dentition) and emotion are the four basic components of a smile. A smile requires coordination of these four components with voluntary or involuntary stimulation by various emotions; hence it is evident that every smile is different and denotes a sense of individuality.

The upper and lower lip frame displays the zone of a smile, which can be linked to the frame of a painting. Within this frame, the gums act as the canvas and the teeth become the major substance of the smile painting. As the lips separate during speech or a smile, an image of the person is revealed, which may indicate youth or age, harmony or disharmony, and beauty or a compromised aesthetic appearance.

Healthy and well-aligned teeth have been shown to have a positive effect on an individual’s confidence and psychosocial wellbeing. Among the four components of a smile, it has been found clinically that even minor defects or disharmony in alignment, brightness or contour of anterior dental components can negatively affect the overall smile aesthetic. This paper focuses on the role of the dental hard tissues, especially the enamel in smile aesthetics, and presents minimally invasive technique to rejuvenate the compromised enamel at minimal biological cost.

Understanding dental enamel

Enamel is one of the most important structures of the tooth, both from a functional and aesthetic point of view. It is a uniquely organised nano-structured material, which forms the outermost covering of teeth. It is composed of crystalline calcium phosphate, which is 96 per cent mineral with the remaining 4 per cent consisting of organic components and water. The organic content consists of breakdown...
products of major enamel protein amelogenin.8 The mature enamel is acellular and does not regenerate itself unlike other biomineralised tissues such as bone and dentine.9

**Enamel surface loss affects smile aesthetic**

Enamel, being the outermost coverage of coronal portion of teeth, has to face various challenges of maintaining its integrity with constant demineralisation and remineralisation within the oral environment, and it is susceptible to tooth surface loss (TSL) phenomenon. Tooth surface loss can be physiological, occurring as a normal aging process.10 This process, accelerated by several endogenous and exogenous factors, is termed pathologic. Depending upon the cause, four types of surface loss have been identified: attrition, abrasion, erosion and abfraction.11-19

Each type of tooth surface loss and its effects on overall health, function and smile aesthetics are described below.

**Attrition** (Fig. 1) is the loss of the tooth substance occurring as a result of mechanical wear between the opposing surfaces of teeth during masticatory and parafunctional activities.20-23 It is most often seen on the occlusal surfaces of posterior teeth and the incisal edges of the anterior teeth.

**Abfraction** (Fig. 4) is the pathologic process of tooth surface loss in which repeated compression and flexure of teeth under occlusal loading will lead to fracture of thin enamel rods. It is mostly seen in the cervical region of teeth.29-32

Other than these four causes, developmental anomalies (Fig. 5a-c), especially amelogenesis imperfecta and dentinogenesis imperfecta, predispose teeth to rapid wear.33-35 This is because the enamel is very thin and/or friable in amelogenesis imperfect, while in dentinogenesis imperfect, the attachment of the enamel and dentine is weak, which results in easy separation.36 Tooth surface loss affects tooth anatomy, and various kinds of complications may arise if it is left untreated. Loss of the mineralised tooth substance results in a higher risk of tooth sensitivity, pulpal complications, and discoloration.37, 38 Loss of the vertical occlusal dimension (VOD) may result in dentoalveolar compensation or an increased interocclusal rest space.39

This will affect the neuromusculature, efficiency of masticatory function, and aesthetics, as the position of the smile line, the horizontal occlusal plane changes.38-40

Loss of canine guidance and canine protection may increase horizontal stresses in the posterior occlusal surface and thereby cause loss and fracture of restorations.38 Moreover, instability of the occlusion will decrease masticatory function and increase the incidence of cheek and tongue biting.37, 41

The overall effects of tooth substance loss influence not only teeth anatomy and masticatory system, but also quality of life.42

Figs. 3a & b: Erosion. Fig. 4: Abfraction.

Figs. 3a & b: Erosion. Fig. 4: Abfraction.

Figs. 5a-c: Teeth with developmental defect: enamel hypoplasia (a), amelogenesis imperfecta (b), dental fluorosis (c).
Optical characteristics of anterior teeth

As mentioned previously, teeth suffer modifications over the years that directly interfere with their appearance and colour. Due to an increase in thickness of dentine and a decrease in thickness of enamel and its surface texture bring changes in translucency and opacity of dentine and enamel.

Understating optical properties of dental structures is immensely important as enamel and dentine interact with natural light differently due to their variations in composition and mineralisation. Enamel allows 70.1 per cent average light passage, whereas 52.6 per cent of light can be transmitted through the dentine structure.43, 44 It can be said that dentine is the colour and enamel is the colour modifier.45-47

Optical properties natural enamel

While dealing with enamel, clinicians need to keep in mind the orientation of the rods that comprise the basic structure of the enamel. Generally, these rods rise at right angles from the dentinal surface. In cervical areas, the rods divert from their horizontal orientation and lean apically. Near the incisal or cusp tip, the rods change direction gradually, becoming oblique and nearly vertical over the edges.48 Because of this orientation change, less light is transmitted, which decreases the translucency of the enamel.49 Enamel also modifies the chromatic aspects of the teeth because of phenomena such as reflection, transmission, refraction, thickness and surface texture.

Moreover, enamel has the ability to attenuate underling colours, which can affect the chromatic aspect of teeth.50 Hence the properties of light reflection, or transmission of enamel depend upon its texture, orientation of enamel rods, and its ability to refract light, in addition to histological character-istics. Enamel translucency may also be attributed to variations in calcification levels, because the more porous and less mineralised the enamel, the larger the dispersion index.51, 52

Optical properties of dentine

Dentine can be considered as the dental tissue of higher relevance when concerned with color.46, 53 From an optical point of view, dentine is a low-translucency structure with various chroma and saturation variations. Dentine has a special property of producing relative opacity, this is because the dentinal tubule arrangement enables the dentine to demonstrate selective light diffraction, as certain rays are reflected, whereas others are absorbed.51 As age increases, primary dentine begins to evolve or change, originating secondary and tertiary denticines, which have different structure and compositions, and affect optical properties of tissues.14 In elderly patients, the reduction in the diameter of the dentinal tubules causes progressive dentine sclerosis and high saturation.

Basic characteristics of teeth

The visual characteristics of teeth modify with age and can be studied under four categories: childhood, adolescent, middle-aged and aged teeth.

Childhood teeth (Figs. 6a–c)

At about the age of 10 years, enamel presents an almost milk-white hue, the superficial enamel layers are the most opaque and frequently appear as though they have a white frost. Enamel generally shows a clear opalescent effect, the prominent enamel surface with micro- and macro-texture has a very low surface lustre; the incisal edges of the dentinal lobes are completely covered by enamel.
Adolescent teeth (Figs. 7a–c)

At about the age of 20 years, the enamel is less white, enamel translucency becomes visible due to gradual wearing off of the opaque top layers of the young enamel. There is a presence of enamel surface micro-texture and low gloss; dentinal lobes are still covered by enamel but slightly blue and orange hues become visible.

Middle-aged teeth (Figs. 8a–c)

There is reduced enamel surface micro- and mac-roture, and an increased surface lustre. There

is also increased enamel translucency; blue and or-ange hues become more prominent and dentine is normally exposed in the region of the incisal edges.

Aged teeth (Figs. 9a–c)

There is an increased enamel translucency, changes in hue to lilac and grey, a lack of enamel surface micro-texture, with considerably reduced macro-texture. There is a high surface lustre, dentin is relatively darker and less opaque than of midde-aged teeth, and on the incisal edges, the under-lying dentine structure appears as a flat wall.

Restoration strategy

After having a better understanding of the inherent characteristics of dental tissues to light incidence, it allows a more artistic restorative approach where the light can be manipulated in each increment of the resin, thus resulting in vivid and extremely natural restorations.55, 56

Cosmetic enamel restorations can be successfully utilised to correct minor tooth misalignments, changes in brightness, and enhance the contour of a tooth.

As described earlier, enamel surface loss generally affects visual alignment, brightness and contour of the teeth, which negatively affects the overall smile aesthetic. With enamel being a thin outer layer of a tooth, the loss of enamel surface is generally asso­ciated with the exposure or loss of dentine sub­stance. Hence restoring natural enamel requires careful analysis of its dentinal substrate loss in terms of its depth, colour and type.

Selection of restorative materials based on optical properties

Natural dentine and enamel have a rich composi­tion and details. Where dentine confers the basic colour to the dental element, or the hue, this colour is not entirely perceived by the observer, because the enamel modulates the chroma and the value of hue according to its greater or smaller thickness and surface texture and level of polishing. Enamel does not actually change the hue (colour), but only con­fers a greater or lesser saturation or chroma accord­ing to its thickness.56, 57

Placing the correct thickness of enamel layer over dentine can positively increase or decrease the value (brightness) giving the restoration its vivacity. If the restoring tooth has lost both the enamel and dentinal tissue, then proper colour selection of dentine and enamel resin is paramount. It is because the percentage of light transmission on enamel is approximately 70.1 per cent, which gives this tissue translucent characteristics. On the other hand, the percentage of the dentine is 52.5 per cent, which makes it more opaque.58 Hence, in order to obtain natural lifelike restorations, more transparent res­ins should be used for the fabrication of the artificial
There are varieties of composite resin materials available in the global market, and dental manufacturers are now developing resin with different shades and opacities to mimic colour, translucencies and visual appearance of the natural tooth structure and have come up with different grouping systems.

Regardless of the method of restorative materials grouping that is employed by manufacturers, all the direct aesthetic restorative materials can be categorised into four groups based on its optical properties (Table 1).

**Table 1: Materials category.**

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<th>Material category</th>
<th>Objective</th>
<th>Example</th>
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<tr>
<td>Opaque group</td>
<td>To mask discoloration</td>
<td>Beautifil Opaquer</td>
</tr>
<tr>
<td>Dentine group</td>
<td>To replace deeper dentine</td>
<td>Beautifil II A20 (Opacious dentine)</td>
</tr>
<tr>
<td>Normal dentine</td>
<td>To replace outer dentine</td>
<td>Beautifil II A2 (Universal dentine)</td>
</tr>
<tr>
<td>Enamel group</td>
<td>To replace enamel</td>
<td>Beautifil II Enamel HVT</td>
</tr>
<tr>
<td>Effect group (stain)</td>
<td>To create special effect</td>
<td>Beautifil II Gum shade</td>
</tr>
</tbody>
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While discovering a patient's personality (temperament), the author used the concept of ‘DISC’, which was introduced by the psychologist Dr William Moulton Marston in his publication Emotion of Normal People in 1928. Marston theorised that people are motivated by four intrinsic drives that direct his/her personality patterns. He used four descriptive behavioural tendencies, which are represented by four letters of the alphabet: D (dominance), I (influence), S (steadiness) and C (compliance). Based on the DISC personality traits, the author has categorised smiles into four categories (Tables 2 & 3).

**Table 2: DISCover Smile Style—tooth characteristics.**

<table>
<thead>
<tr>
<th>Smile Style</th>
<th>Central incisors</th>
<th>Canine tips</th>
<th>Lateral incisors</th>
<th>IAL angle</th>
<th>Tooth axis</th>
</tr>
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<tbody>
<tr>
<td>D—Smile Style</td>
<td>Lack of dominance with square shape</td>
<td>Flat type</td>
<td>Flat and may touch incisal aesthetic line (IAL)</td>
<td>Straight or R = reverse</td>
<td>Straight or slight divergent</td>
</tr>
<tr>
<td>I—Smile Style</td>
<td>Dominant type with rectangular shape</td>
<td>Rounded with flat tips</td>
<td>Rounded and flat incisal edges and do not touch incisal aesthetic line (IAL)</td>
<td>Slightly descending to straight type</td>
<td>Straight</td>
</tr>
<tr>
<td>S—Smile Style</td>
<td>Dominant type with oval shape</td>
<td>Rounded type</td>
<td>Delicate, rounded mesial and distal incisal edges, and do not touch incisal aesthetic line (IAL)</td>
<td>Descending type</td>
<td>75–85°</td>
</tr>
<tr>
<td>C—Smile Style</td>
<td>Dominant type with triangular shape</td>
<td>Pointed type</td>
<td>Rounded distal and flat mesial incisal edges, and touch IAL</td>
<td>Descending type</td>
<td>70–80°</td>
</tr>
</tbody>
</table>

To achieve a naturomimetic enamel restoration, the clinician should understand age-related natural tooth surface texture characteristics. Generally, there is a decrease of surface texture as patients increase in age. However, surface texture should be designed on a case-by-case basis to satisfy the patient’s need and desire. The surface texture of a tooth is confirmed by three factors.

1. Surface texture or degree of surface smoothness or roughness. This can be divided into two categories.
2. Macro-texture (vertical and/or horizontal elevation and depressions, or ridges and grooves seen on the surface of a tooth).
Micro-texture (small surface irregularities related to the apposition and calcification of the enamel matrix during tooth formation, pits, vertical lines and perikymata).

3. Lustre or degree of shininess of the tooth also known as gloss (Figs. 10 & 11). Lustre will set the amount of the light reflection of the crown surface and it is as important as colour and contour in recreating the natural appearance. It is to be noted that lustre is not related to age and is genetically and congenitally determined.

**Naturomimetic layering technique (NLT)**

Natural teeth are complex in structure and hard to simulate due to the distribution of colours through the enamel and dentin. Hence, in NLT it is important to have a detailed examination of the colour, opacity, translucency, texture, surface gloss and presence of any special characterisation of the tooth to be restored. In NLT, the desired result is achieved by applying the correct thickness of clear or translucent enamel group of material over a saturated and opaque dentine group of material which produces a double effect layer and hence helps to mimic natural optical properties of the tooth. There are various clinical situations during enamel rejuvenation which are guided by the type of tooth defects (anatomy, brightness/colour and contour) and desire level of the patient. Depending on the clinical situation, the clinician should choose one of the above NLT techniques. Naturomimetic layering technique is based on new layered shading classification and is divided into the following types for clinical conveniences.

**NLT—Mono-layer**

In the mono-layer technique, the tooth defects are restored using only a single group of material. The layering procedure does not entail the use of opaque or any effect group. However multiple shades of a similar group of material may be used at different thicknesses (Fig. 12).

**NLT—Bi-layer**

The Bi-layer technique is used when both dentine and enamel are affected and two different groups of materials are used to replace dentine and enamel. Even in this layering technique, opaque and effect group materials are not used. After choosing the correct shade, opacity, and trans-
lucency materials, it is important to consider the thickness of the materials to be layered to mimic natural dentine and enamel. Perception of higher chroma and opacity is related to an increase in thickness. The handling of composite layers is crucial for obtaining the desired chromaticity, translucency, and opacity. It is to be noted that high-translucent enamel resin may create a greyish restoration with a lower value; when the thickness of translucent enamel resins increases, the value decreases and chroma increases. However, by increasing the thickness of the dentine group (opaque composite) both value and chroma of the restoration increase (Fig. 13).

NLT—Tri-layer

This is basically used to restore tooth defects where major colour modification is desired, for example, a non-vital discoloured tooth. The layering technique entails the use of opaque group of materials but does not require effect resin and the opaque layer should be covered with a suitable thickness of the correct shade of dentine and translucent enamel layer (Fig. 14).

In NLT, any restoration that demands the use of effect group of materials either singly or in combination with enamel, dentine or opaque materials is considered as a complex restoration of that particular layer technique, such as Mono-Complex layer, Bi-Complex layer or Tri-Complex layer. The use of effect resin (to create opalescence, orange or yellow hues, stain, enamel crack, white spot etc.) requires detailed colour analysis and mapping before application. This kind of restoration is basically done in the incisal third area of the tooth, where the range of translucency and opalescence is greater (Figs. 15–17).

The level of polish (smoothness) of a surface changes the chromatic perception of the composite resins and is inversely proportional to luminosity. The more polished the surface, the larger the light transmission, and consequently, the less luminosity (brightness). Conversely, the lack of polishing (matte finish or presence of more micro-texture) causes the surface to become more reflective, making the restoration appear more luminous.

Conclusion

Cosmetic dentistry is one of the fastest growing trends in oral healthcare today. This has been fuelled by increased public awareness, an increasing in patients’ affluence, as well as the desire for beautiful, stylish and healthy smiles. An aesthetic smile has recently become one of the fundamental demands of patients visiting dental practices.

Editorial note: A list of references is available from the publisher.

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For reasons of cost, patients and dentists today often find themselves obliged to use restorative materials for the treatment of large structural, functional and aesthetic defects. This case report demonstrates how an innovative, organically modified ceramic composite with extremely low shrinkage stress and volume contraction can be used to restore teeth while preserving tooth substance. Occlusal functionality is key to the longevity of the restoration.

A 71-year-old female patient presented in my practice requiring replacement of insufficient, excessively large composite resin restorations of the lower right first and second molars (46 and 47). The natural crown still retained a small amount of residual structure, and the patient did not wish any further removal of tooth substance. For cost reasons, the patient also did not wish any prosthetic treatment, e.g. in the form of ceramic restorations. The patient was recommended a direct complex resin onlay requiring functional and non-functional cusp reduction. With this unconventional approach, it was important that the occlusal design should take into consideration the strengths and weaknesses of both the restorative material and the residual tooth structure.

The patient was given a local anaesthetic with one cartridge of 4% articaine with 1:100,000 adrenaline, and the teeth were isolated with a rubber dam prior to removal of the existing restorations. In order to ensure a caries-free, hard dentine base, three successive checks were performed with a caries detector (Caries Marker, VOCO). The thickness of the remaining cusps was measured, and found to be 3 mm
at the base. The margins were strongly bevelled to maximise the amount of the planned restorative material with minimal reduction in the cusp region, and thus achieve a large contact surface. No centric contacts or other extensive functional contacts were planned for the cavity areas being treated.

The preparations were micro air abraded using 27 micron aluminium oxide. Then a selective enamel etch technique using 33% orthophosphoric acid was performed, followed by bonding with Futurabond U (VOCO). The lingual cusps of tooth 46 were created free-hand using the universal shade Admira Fusion x-tra, a purely ceramic-based bulk-fill composite. The cusps were widened towards the centroc-occlusal aspect progressively in 2 mm increments. The key factor here was not applying this bulk-fill material in bulk, and thereby ensuring maximum depth of cure at all times.

The benefit of Admira Fusion x-tra is the increased depth of cure, which is inherent to this restorative. After curing of the base of the lingual cusps, a sectional matrix system (V3, Triodent) was used. In the gingival floor area of the proximal box, a small quantity of the flowable Admira Fusion Flow (shade A3, VOCO) was used in three 0.25 mm increments (extremely thin) to ensure complete and maximum marginal hybridisation and adaptation. The marginal ridges were then incrementally completed using Admira Fusion x-tra (shade U).

The buccal lobes were layered individually with Admira Fusion x-tra before the Tam interlobe staining technique was utilised (brown, FinalTouch, VOCO) to customise the colour tone. In the next step, the lingual cusps were shaped individually, thus completing the design of the occlusal anatomy. Following complete finishing of tooth 46, the matrix system was placed on tooth 47 (Omnimatrix, Ultradent: distal marginal ridge; V3 Triodent: mesial marginal ridge). Tooth 47 was layered in a similar manner, again using a universal shade bulk-fill material (Admira Fusion x-tra).

A small amount of white shade for customisation was applied to the triangular ridges of teeth 46 and 47 (FinalTouch, VOCO) to imitate the enamel hypocalcification. A glycerine layer was then applied, and the composite was polymerised fully through the glycerine in order to avoid the oxygen inhibition layer. Only minimal occlusal adjustments were necessary. Taking the material properties of the ORMOCER into consideration (high compressive strength and low flexibility), the occlusion was ground in to establish light centric point contacts without extensive lateral contacts or interferences. The restorations were finished under water spray with a single-stage polisher (Dimanto, VOCO) to a high lustre.

**Rationale for material selection**

Geriatric dentistry is becoming an increasingly prominent part of everyday general dental practice. The main objective of treatment for this section of the population is essentially ‘to preserve function without high cost’. The majority of older individuals...
are not willing to invest a lot of money in their teeth. In view of this, it is essential to understand the physical properties of direct and indirect restorative materials in order to design the appropriate restoration.

Composite resins have high compressive strength, but only low tensile strength and flexibility. The compressive strength of enamel is 384 MPa and that of dentine is 297 MPa. In contrast, the flexural strength of dentine is 165.6 MPa. The compressive strength of Admira Fusion x-tra is 307 MPa, while its flexural strength is 132 MPa — acceptable values when compared to natural tooth substance.

The major advantage of Admira Fusion derives from its material composition, as it contains no conventional methacrylate monomers, and therefore allows a more biocompatible restoration (essentially a purely ceramic-based composite compatible with all bonding systems). At the same time, the composition gives an extremely low volumetric shrinkage (1.25 per cent), the lowest of any product currently on the market. The ability to maintain an optimal marginal seal is also critical in the Class II restorations shown, especially in the case of dentine-bound restoration margins below the cementoenamel junction (CEJ).

Arora et al investigated the role of flowable composites with regard to the marginal integrity of sub-CEJ Class II restorations and found a significant reduction in microleakage when a flowable composite liner was used instead of a purely packable composite resin. The premise of this study is that the first point of failure of Class II restorations is generally at the restoration margin, in the region of the proximal box floor, especially when located subgingivally. Thus, both volumetric shrinkage and shrinkage stress are two additional key factors with regard to high marginal precision and integrity.

The extremely low shrinkage stress (3.71 MPa) of this bulk-fill material, in combination with a high depth of cure, ensures maximum marginal integrity, especially if used in small increments like a conventional composite. In terms of avoiding gingival irritation, biocompatibility plays an important role, and ceramic-based composites are less conducive to the formation of biofilm than resin composites.

The remarkable chameleon effect of this material, combined with optimal working properties, makes it the go-to choice for 90 per cent of posterior restorations in my practice. When combined with the easy-to-apply customisation shades in the FinalTouch range, it enables me to increase enormously the efficiency, aesthetics, predictability and marginal integrity, essentially with just a single smart material.

Reference


Contact

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‘No-prep’ interceptive rehabilitation—of tooth wear using a free-hand technique driven by a functional wax-up

Author: Dr Didier Dietschi, Switzerland

Treatment rationale

Excessive abrasion (attrition) and erosion are two common conditions affecting dental hard tissue and occur in an increasing number of patients. Both can be considered growing challenges in dentistry, because with such patients, especially in cases of severe parafunction, the etiology can rarely be successfully and permanently eliminated. Therefore, continuous monitoring to control related pathologies is required.

The most frequent causes of erosion are unbalanced dietary habits with a high consumption of acidic food or beverages (such as fruit, carbonated drinks, fruit juices and vinegar), as well as abnormal intrinsic acid production, such as in bulimia nervosa, acid reflux and hiatal hernia. Insufficient salivary flow rate or buffer capacity and, in general, salivary composition changes induced by various diseases, medications and aging are other etiological co-factors. As regards abrasion, awake and sleep bruxism are two different forms of parafunctional activities that can severely affect tooth integrity. Preventive and restorative measures are therefore mandatory to correct and limit the extent of further tissue and restoration destruction. An important clinical finding is that a large number of patients affected by hard-tissue loss present combined aetiologies, challenging the dental team to determine a multifactorial preventive and restorative approach.

The dental consequences of abrasion and erosion are manifold and involve a loss of enamel, with progressive exposure of large dentin surfaces, which significantly affects the occlusal, facial and lingual tooth anatomy and has biological consequences, too. Objective symptoms or complaints reported by patients are shortening of teeth, discoloration, tooth displac-
ment, dentin sensitivity, as well as an increased risk of decay and premature loss of marginal adaptation of the restoration. The significant impact of tooth wear on occlusion, function and aesthetics leads the patient to seek advice and intervention. The biomechanical challenge shall entail a range of treatments involving different specialties, from preventive measures to full-mouth rehabilitation. Intermediate stages (slight to moderate erosion or abrasion) require other clinical measures, such as various forms of adhesive and partial restorations. The aim of this paper is to present a sound clinical concept for addressing various forms of early restorative intervention and their potential to restrict ongoing tissue destruction.

A comprehensive treatment approach

The modern approach to the treatment of tooth wear aims to stop its progression before full prosthetic rehabilitation becomes indicated, which would require the removal of large amounts of functional tooth substance with potential biological complications and a rather inadequate biomechanical rationale. The approach involves three steps:

1. a comprehensive etiological clinical investigation, including diet analysis and identification of general/medical and local risk factors;
2. treatment planning and execution, including a proper functional and aesthetic wax-up defining the new smile line and tooth anatomy, transferred then to the mouth with a combination of direct and indirect restorations; and
3. a maintenance program, including a protective night guard and, potentially, repair or replacement of restorations over a medium- or long-term time frame.

The restorative options at hand comprise direct partial composite restorations, indirect partial composite or ceramic restorations, and indirect full-ceramic restorations. Considering the more dramatic failure patterns observed with conventional prosthetic restoration, using more conservative restorations, such as partial direct and indirect restorations, appears to have irrefutable advantages and promising outcomes in the treatment of severe abrasion and erosion.

Dahl’s concept and controlling the vertical dimension of occlusion

The idea of increasing the vertical dimension of occlusion (VDO) to treat or restore patients with abnormal tooth wear has been described and applied for a long time; one of the first clinicians to promote this technique was Dahl, who published many articles on this topic. His approach was to use a metal appliance to elevate the occlusion and allow teeth to move passively until they are again in occlusion and then create space to restore the teeth stabilised by the appliance. The dental movements are intended to occur by combined supra-eruption of occlusally free teeth together with simultaneous alveolar growth and intrusion of teeth maintaining contacts. It was shown that such phenomena would occur in a significant proportion of patients treated according to this concept and the outcomes of such treatment have been

Fig. 1: Comprehensive treatment scheme for anterior and posterior tooth wear or erosion. The length of the anterior teeth is reduced by combined wear or erosion (1). The VDO needs to be augmented (2). On the models and based on a wax-up, a new anterior guidance and smile line are established (3), from which an index is made and transferred to the mouth when proceeding with posterior restorations (4). Three different conditions are encountered in the posterior areas: (a) no or minimal tooth loss (occlusal stops are made with composite of any type); (b) moderate tooth loss and/or small to mediumsized restorations (occlusal morphology is re-established with a hybrid composite and direct technique); and (c) severe tooth loss and large metal-based restorations (occlusal morphology is re-established with indirect tooth-coloured restorations —overlay).

Figs. 2a–c: Pre-op situation showing moderate to severe tooth wear, due to combined abrasion and erosion aetiologies. However, the amount of tissue loss does not speak in favour of a conventional prosthetic solution; rather, an interceptive solution using direct composite restorations would be used in this case.
corroborated by several recent papers and review articles. Increasing the VDO is a key parameter for reversing and preventing the consequences of pathological wear and erosion. The passive eruption that accompanies the continuous tissue destruction and loss, tremendously restricts the space available for restorations, which due to their limited thickness, would be very fragile or otherwise require unnecessary removal of the residual tooth structure. Recent clinical reports have largely validated this treatment approach.

Treatment outline and restorative options

The decision regarding the optimal restorative choice is usually based on the pre-existing dental condition (presence of decay, restoration, vital or non-vital status), as well as the amount and localisation of tissue loss. This means that various restorative options have to be considered and that treatment planning is highly individual (tooth-specific). The therapeutic scheme is logically oriented toward re-establishing
first proper length of the central incisors and anterior guidance, governing thereafter the new VDO. Proper anterior tooth anatomy and function are designed according to objective aesthetic guidelines, existing and former tooth anatomy, as well as functional and phonetic components. The first step entails producing study casts in the form of a partial (in the case of moderate posterior tissue loss) or full-mouth wax-up (in the case of advanced generalised tooth wear or erosion; Fig. 1).

left quadrants, respectively. After rubber dam placement, amalgam fillings were removed and tooth surfaces prepared and cleaned with sandblasting, before applying composite. A highly filled homogenous nanohybrid material (inspiro) was used and sculpted before light curing, enabling proper anatomy and function to be established.

Figs. 2m & n: The same treatment sequence was applied to all of the lower and upper quadrants. These images show that composite serves both to fill existing cavities and to replace eroded or worn tissue, creating better function, restabilising proper anatomy and aesthetics, and finally protecting damaged tissue from further degradation. This is an ideal treatment protocol for moderate tooth wear combined with small Class I and II cavities.
The direct composite option is logically indicated for all forms of moderate to intermediate tissue loss or destruction. Among the benefits of a direct composite restoration are its highly conservative approach, the ability to replace or reshape small portions of the tooth, reparability, simplified replacement and relatively limited cost (Fig. 2). Conversely, it is more technique sensitive and might result in thin layers of material over some surfaces, placing them mechanically at risk. When using a sculpting technique, proper anatomy can be created also with a direct technique, favouring the selection of a highly filled material with a firm consistency.

In the case illustrating this treatment modality, a highly filled homogenous nanohybrid material (inspiro, Edelweiss DR) was used owing to its firm consistency, favourable for free-hand sculpting and modelling (Figs. 2f–l).

**Indirect composite option**

The indirect option is logically preferred when larger restorations or tissue destruction of a greater severity is present. It also provides greater control of the anatomy and occlusion in complex or advanced cases. Nevertheless, one should not neglect the direct option only in favour of this last parameter, as occlusion seems not to play a major role in the origin of parafunction. Since direct and indirect techniques can be used together to treat the same patient, when indirect restorations are chosen, they have to be fabricated first, at the new VDO, and then direct composites placed.

**Material selection**

Today, the debate about whether ceramics or composite is best indicated for such restorations is some-
times based on personal experience and belief, rather than on scientific or clinical evidence. The rather abundant clinical literature dealing with the clinical behaviour of composite and ceramic inlays and onlays has not shown a major advantage of either material. I clearly favour composite in the context of tooth wear. Were ceramics to be chosen, the Empress material (Ivoclar Vivadent), which has shown limited annual failure rates, and, of course, today’s new lithium disilicate pressed ceramic (IPS e.max Press, Ivoclar Vivadent), with improved flexural strength and fatigue resistance, would be considered the best choice.

Longevity of restorations placed to correct severe tooth wear and erosion

Clinical studies have demonstrated that the performance of composite in the treatment of advanced tooth wear is adequate and that partial fractures represent the most likely complication. These can be corrected by a repair or uncomplicated replacement of the restoration. The ten year survival rate of porcelain-fused-to-metal crowns has been proved to be slightly superior to that of composite restorations, but with much more severe complications: Porcelain-fused-to-metal failures led mainly to endodontic treatments or to extractions, while composite failures or fractures could be either repaired or replaced. This again demonstrates the reason the conservative and adhesive approach is favoured for treating all kinds of mild to moderate forms of tooth wear and erosion.

Conclusion

The incidence of tooth wear represents an increasing concern for the dental team and has multifactorial origins. Behavioural changes, an unbalanced diet, various medical conditions and medications inducing acid reflux or influencing salivary composition and flow rate trigger erosion. In addition, awake and sleep bruxism are widespread functional disorders that cause severe abrasion. It is then increasingly important to diagnose early signs of tooth wear so that proper preventive and, if necessary, restorative measures are taken, with the focus on biomechanics and long-term tissue preservation.

Acknowledgments

I would like to thank Serge Erpen (Oral Pro, Geneva, Switzerland) for the fabrication of the wax-ups presented in Figures 2d and f._

Figs. 2r & s: Five-year recall. The patient never did wear a night guard despite it being recommended. We can observe some additional tooth wear, mainly of an erosive nature (see, for instance, the cervical areas of the mandibular premolars). The restorations however show minimal wear or volume loss, apart from microfractures of a few margins (i.e., teeth #46 and 47).

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A complete list of references is available from the publisher.

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Aesthetic composite layering of implant-supported restorations in an edentulous jaw

A good option for the lifelike recreation of gingival tissue

Authors: Drs Patrice Margossian & Pierre Andrieu, France

Careful planning is indispensable in the treatment of an edentulous jaw with implant-supported restorations. The axes and positions of the implants must correspond to the given biological, mechanical and aesthetic conditions. In situations in which severe bone recession has occurred, the work of the dental team has to involve the reconstruction of the dental and the gingival tissue. The flawless reconstruction of gingival tissue requires sound teamwork, as well as excellent materials and exceptional skill. Layering with the light-curing laboratory composite SR Nexco (Ivoclar Vivadent) takes this procedure to a new level.

A 37-year-old female patient presented to our practice with her teeth and the surrounding bone structure in very poor condition (Figs. 1 & 2). Numerous teeth were missing from both the upper and lower jaws. In addition, the upper jaw showed considerable bone and gingival resorption. The patient wished to have her teeth restored to regain an attractive appearance. Owing to the extensive damage, complete restoration of both jaws with implants was indicated.

Surgical phase

Owing to the sufficient bone structure in the lower jaw, this part of the mouth could be restored at once with four immediately loadable implants. During the reconstructive phase, the upper jaw had to be treated with a provisional removable denture owing to the atrophied alveolar ridge. The tooth extractions from the upper and lower jaw were...
performed on one day. At the same time, four mandibular implants were placed and loaded. An immediate denture was seated in the upper jaw.

During the osseointegration period of the mandibular implants, the maxillary bone was reconstructed. The maxillary sinus and the alveolar ridge were augmented in one appointment. At a later appointment, ten implants were placed according to the treatment plan and exposed after six more months. As a result of well-planned soft-tissue management, adequate firm keratinised tissue had formed. The permanent restorations for the upper and lower jaws were fabricated two months later (Figs. 3 & 4).

The determination of the occlusal plane and the ideal incisal line allows the dental arches to be integrated more easily in terms of aesthetics and function. Open-tray impressions were taken with a special plaster (Snow White, Kerr Dental) and unsplinted impression posts. The considerable stiffness of the impression material completely immobilised the impression posts, thereby preventing any errors in the casting of the study models.

An articulator allows the kinematics of the jaw to be correctly simulated. The goal of this part of the treatment is of a functional nature. It is intended to ensure optimal occlusal integration of the restorations and the proper jaw movements during mastication, speaking and swallowing. In this particular case, the maxillary model was positioned with the help of a facebow. Four impression posts were screwed on to the implants in order to provide strong support and enhanced reliability.

Alternatively, this step can take place directly on the immediately loaded provisional restorations. For this purpose, however, the model has to be mounted in the articulator. In the present case, the masticatory model was positioned in correct relation to the hinge axis-orbital plane. Subsequently, we adjusted the bite patterns in order to record the vertical dimension of occlusion.

The centric relation is regarded as the reference position for adjusting the muscles to the centric and functional jaw relation. The mandibular model was mounted in the articulator with the help of an antagonist jaw relation record. If the centric relation and the vertical dimension of occlusion are correct, the immediately loaded provisional restorations can be used for this purpose. The restorations have to be immobilised when they are mounted in the

**Fig. 4:** Four implants were placed in the lower jaw. Bone augmentation measures were not necessary in this case.

**Figs. 5a & 5b:** Recording of the aesthetic facial axes with the Ditrax system.

**Fig. 6:** The denture was set up with prefabricated teeth (SR Phonares II).

**Fig. 7:** Try-in of the CAD/CAM-fabricated titanium framework in the upper jaw.
The Artex system (Amann Girrbach) allows the articulator of the dental practice and that of the laboratory to be synchronised. The Ditramax system was used to transfer the precise data on the aesthetic facial axes to the maxillary model (Figs. 5a & b). Two axes were marked on the plaster base of the model (vertical and horizontal). The vertical axis represents the midsagittal plane. From the front, the horizontal axis is aligned parallel to the interpupillary line and from the side to Camper’s plane. These markings, which should be very close to the working area, function as a guide for the dental technician in setting up the teeth. Therefore, the incisal line has a predictable parallel alignment with the interpupillary line. The incisal axis is aligned parallel with the midsagittal plane. The Camper’s plane markings indicate the alignment of the occlusal plane. All these elements provide a sound rationale for the tooth set-up according to aesthetic and functional principles.

We selected the tooth shade and the teeth on the basis of the SR Phonares II tooth mould chart (Ivoclar Vivadent). Holding the teeth up against the lips of the patient quickly revealed whether they were in harmony with her facial features. The set-up of the teeth according to the Ditramax markings (Fig. 6) allows the situation to be clinically validated. In this case, attention was given in particular to the aesthetic integration of the dentogingival complex when the patient was smiling. The lip dynamics were shown with video clips. The functional criteria were also checked. The vertical dimension of occlusion had to be harmonious in order to achieve a balanced lower facial third and proper phonation.

We felt that a CAD/CAM-fabricated titanium framework (NobelProcera, Nobel Biocare) would best fulfill this indication. The double-scan technique allowed the implant model to be superimposed on the tooth set-up to construct the framework. In the next step, the framework was machined and then tried on the model and in the patient’s mouth (Fig. 7). The cast impression and the high-performance processing systems significantly contributed to providing the optimal passive (tension-free) fit of the framework, which is decisive for the long-term success of the restoration.

The areas that needed to be built-up with gingival materials were blasted with aluminium oxide at 200 to 300 kPa pressure. Subsequently, the SR Link bonding agent (Ivoclar Vivadent) was applied, followed by a thin layer of the light-curing SR Nexco Gingiva Opaquer to mask the metal framework. The Opaquer was polymerised and then a second coating was applied and polymerised. The resulting inhibition layer was removed.

The conventional flask technique with a heat-curing denture base material (ProBase Hot, Ivoclar Vivadent) was used to produce the denture. After the polymerisation process, the denture base was ground and space was made for building up the Gingiva composite. The surface was conditioned by blasting it with aluminium oxide (50 µm) at 200 kPa (Fig. 8). A bonding agent was then applied and left to react for three minutes before it was light cured.

In order to achieve very lifelike results in the layering of the gingival tissue, saturated (intensive) materials (SR Nexco Paste Intensive Gingiva) were used.
first (Fig. 9). Next, translucent, light-curing gingival materials (SR Nexco Paste Gingiva and SR Nexco Paste Basic Gingiva) were used to impart the gingival areas with the desired depth (Fig. 10). The colours of the Gingiva composites range from pale pink through reddish and orange to purple. A certain amount of time and effort are necessary to master the necessary mixing techniques and achieve a harmonious interplay of the intensive and the translucent materials. Practical experience is essential. With some technical skill, the gingival areas can be naturally reproduced in terms of shape, texture and shade.

All the individual layers were pre-cured (Quick curing light, Ivoclar Vivadent) in segments. A high-performance curing light was used for the final polymerisation. Prior to this step, a coating of glycerine gel (SR Gel, Ivoclar Vivadent) was applied to the surfaces to prevent oxygen inhibition, which could lead to an unattractive result that is difficult to polish. The surfaces of the teeth were characterised with a vertical and horizontal macrostructure. Particular attention was paid to mechanical polishing. Once the glycerine gel had been removed, the restorations were finished with different polishing instruments (various grit sizes, pumice, leather buffing wheels and universal polishing paste; Fig. 11). In the present case, mechanical polishing was preferred to glazing with a light-curing composite in order to prevent premature ageing of the surface.

The dentures were seated manually with the help of multi-unit abutments from Nobel Biocare (Fig. 12). The screw channels were sealed with Teflon and light-curing composite resin. The position of maximum intercuspation was checked and the occlusal pathways were adjusted to the protrusive and laterotrusive movements. In addition, the restorations were checked in terms of the ability to clean them with interdental brushes, and the patient was given special instructions regarding her oral hygiene.

**Conclusion**

For a long time, ceramics were considered to be the aesthetic benchmark. With the introduction of state-of-the-art industrially fabricated acrylic teeth specially designed for implant applications, the bar for aesthetics has been raised in this category of materials. The teeth used in this case exhibit a true-to-nature morphology, which allows the restoration to be functionally integrated without any problems. Using the laboratory composite SR Nexco to recreate gingival tissue is an effective restorative approach. In contrast to ceramic materials, the composite resin is easy to handle and delivers exceptionally aesthetic results (Fig. 13). The light weight of the material is an added benefit. An all-ceramic restoration (zirconium dioxide framework, layering ceramic, gingival mask) weighs almost twice as much as a titanium and composite resin denture. Another advantage of the type of restoration described here is its long service life. The success of an implant-supported denture depends on the systematic coordination of all the surgical and prosthetic requirements. A strict procedure needs to be followed from the treatment plan to the final outcome. Layering gingival portions with a laboratory composite represents a genuine improvement on previous materials and methods with regard to aesthetics, handling and hygiene (Fig. 14).

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![Fig. 14: The complex restoration gave the patient a new lease on life.](image-url)
Non-ablative melanin depigmentation of gingiva

Introduction

Melanin depigmentation of gingiva using various laser wavelengths have been reported for over ten years.1–6 Layer by layer, the mucosa is ablated to the basal layer of the epithelium where the melanocytes are located. The use of lasers have been compared with the use of scalpel and diamond burrs.
By incorporating the optical properties and absorption characteristics of 810 nm together with specific power parameters, a non-ablative technique was developed (Fig. 2).\textsuperscript{10,11} Another similar non-ablative technique described as microcoagulation was also reported using a 20 W 980 nm diode laser.\textsuperscript{12} The 445 nm blue wavelength was introduced in the dental market in 2015. By using 320 μm uninitiated fiber delivering 1 W continuous wave of 445 nm, the same non-ablative procedure and result can also be realised.

**Background with non-ablative technique**

Diode laser at 810 nm is poorly absorbed in water, but it is well absorbed by pigment such as haemoglobin and melanin. The use of high power, short pulse duration concentrated the thermal energy on the surface over deep tissue thermal conduction with lower power and long pulse.\textsuperscript{13,14} The author has used the 810 nm wavelength (elexxion claros 810 nm diode laser, elexxion AG, Singen, Germany) with the power parameters of 30 W, 20 kHz, 16 μsec giving an average power of 10 W. Under local anaesthesia, a non-initiated 600 μm fiber was used. The fiber was placed at a distance of 2 mm to 5 mm from the pigmented mucosa. Coagulation can be observed with immediate effect upon irradiation.

A constant movement must be performed in order to avoid thermal damage deep into the tissue. Water irrigation can be used as coolant during the treatment. There is no surface ablation of the pigmented mucosa but rather the haemoglobin and melanin absorbing the laser energy (Fig. 2). This technique (Figs. 3–6) showed a treatment time of two minutes compared to the ablative technique time up to 30 minutes in an
The wavelength of 445 nm is much better absorbed by melanin and haemoglobin than 810 nm (Fig. 7). Hence, a much lower power density may be used to produce the same effect.

Case outline

A 26-year-old female patient of Chinese ancestry presented with melanin pigmentation in 2007. Congenital melanin pigmentation of the labial gingiva was diagnosed. Depigmentation on the upper arch using 810 nm at 30 W, 20 kHz, 16 μsec was carried out. Eight years post-op showed mild relapse of pigmentation, but the patient was satisfied with the cosmetic appearance (Figs. 3–6). She now wanted the melanin pigment on her lower anterior segment to be removed (Fig. 8).

Purpose

Pigment removal in the requested sites was discussed using 445 nm diode laser. The same technique would be used and the patient consented to the treatment.

Material and method

SIROLaser Blue (Dentsply Sirona) with an emission wavelength of 445 nm was used at 1 W, cw delivered through a 320 μm fiber.
Procedure

Depigmentation technique is the same as described with the 810 nm wavelength (above). Under local anaesthesia, a non-initiated 320 μm fiber delivers the energy at a distance of 2 mm to the pigmented area with constant movement. Immediate change to pink colour without surface ablation of the pigmented mucosa was observed. The procedure took approximately 40 seconds to complete between lower left and right canine region.

Results

In this case, the mucosa turns pink without any signs of surface mucosal ablation except one spot between teeth 31, 32 (Fig. 9). Sub-surface coagulation of blood vessels gave a pink coloured appearance. There was very mild post-op discomfort for about one hour after loss of the anaesthetic effect. No analgesics were required as the discomfort feeling disappeared fast.

Laser peeling of mucosa between 31 and 41 was noted during photograph taking at one day post-op review (Figs. 10 and 11). The three day post-op photo taken by the patient showed that the laser peel disappeared with new gingival mucosa formation (Fig. 12). Two weeks post-op showed complete recovery of the gingival mucosa without melanin pigmentation (Fig. 13).

Discussion

There has not been much information on this new wavelength. From Fig. 7, the absorption coefficient for haemoglobin is estimated at 7 x 10²/cm⁻¹ and 10³/cm⁻¹ for melanin. Penetration depth for haemoglobin is calculated at 140 μm and 10 μm for melanin. The penetration depth of haemoglobin and melanin with 810 nm are 2 mm and 0.1 mm respectively. Furthermore, scattering curve showed higher tissue scattering effect with 445 nm than 810 nm.

In comparison with the NIR diode lasers, the absorption of collagen and scattering increases in the blue light spectrum. In view of the above together with high absorption of haemoglobin and melanin to 445 nm, 1 W cw was used. Power density of 88 W/cm² (Fig. 14) delivering at 88 J/cm² fluence at 2 mm distance was calculated. Although the power density of 1,697 W/cm² (Fig. 15) delivering 543 J/cm² fluence used by 810 nm is higher than 445 nm delivered, the eight years post-op showed stable gingival contour with no recession (Fig. 6). The understanding of the optical properties of the wavelength, power parameters and laser tissue interaction are important information for the clinician to achieve the desired treatment outcome.

Conclusion

The use of 1 W cw 445 nm blue diode laser is effective in non-ablative depigmentation of oral mucosa. This non-ablative technique provide immediate aesthetic result with very short procedure time. To the author’s knowledge, this is the first case presented using 445 nm for melanin depigmentation._

Editorial note: A list of references is available from the publisher.

Dr Luk reports no potential conflicts of interest.

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New treatment protocol for periodontal pocket treatment

Combination of Er:YAG and Nd:YAG lasers

Periodontitis is the most common chronic inflammatory disease in adults of European populations. Eight out of ten over 35-year-olds suffer from some kind of gum complaint. It is associated with systemic diseases including type 2 diabetes, cardiovascular disease and stroke. Although they are so common, periodontal diseases are not very well acknowledged.1, 2

To date, mechanical therapy has been the general treatment for plaque-induced periodontal disease. A lot of studies have shown that mechanical treatment itself does not lead to a complete healing because it does not eliminate the periopathogens.3

Laser therapy may constitute an efficient alternative to surgical treatment. Based on research, data and experience of many practitioners, we can enumerate potential advantages of laser therapy, such as bactericidal, detoxification and homeostatic effects and biostimulation. It is also easy to use, provides good access to anatomically difficult areas and makes a comfortable treatment for patients. Laser treatment provides for eradication of bacteria and better wound healing.4, 5

High-energy lasers are applied in periodontal procedures as adjunctive therapy or alternative conventional procedures have become standard treatment

Figs. 1a–d: a) Initial state; b) the situation of the gingival-tooth in the jaw; c) orthopantomographic image; d) the dental-gingival situation in the mandible.
of periodontal pockets. Their effectiveness in eliminating periodontal pathogens and decreasing pocket depth is widely documented. Neodymium:Yttrium–Aluminum Garnet (Nd:YAG) laser with a wavelength of 1,064 nm can decontaminate periodontal pocket without causing necrosing or carbonisation of the underlying connective tissue. Periodontopathogens can persist within cells outside the pocket epithelium after mechanical conventional mechanical periodontal debridement, and Gianelli et al. reported that the Nd:YAG is capable of eradicating periodontopathic bacteria trapped within gingival epithelial cells.

Erbium:YAG (Er:YAG) with a wavelength of 2,940 nm has been applied for effective elimination of granulation tissue, gingival melanin pigmentation and gingival discoloration. This laser is also used for contouring and cutting of bone with minimal damage and enhances healing. In addition, irradiation with the Er:YAG laser has a bactericidal effect with reduction of lipopolysaccharide, is efficient in calculus removal, with the effect limited to a very thin layer of the surface and is effective for implant maintenance.

A case report

A 47-year-old female patient was diagnosed with advanced generalised periodontal disease, numerous missing teeth, lack of prosthetic supplements in the posterior region, periapical lesions, and an incomplete endodontic treatment. The patient required...
Figs. 3–7: Sterilisation of the periodontal pockets and decontamination.
Figs. 8–12: Removal of subgingival stone.
Figs. 13 & 14: Bleeding stop.
a comprehensive dental treatment. To create a preliminary treatment plan, it is necessary to implement initial treatment (hygienisation) to check the patient's motivation to continue the highly specialised treatment and assess the prognosis of her teeth.

Detailed clinical examination should include, among others, data on the periodontal pocket depth (PD), bleeding on probing (BOP) and plaque index (PI).

In the case of a significantly severe disease, high tooth mobility, numerous missing teeth, it is recommended...

Fig. 15: Situation immediately after surgery, subgingival plaque removal and sterilisation of the periodontal pocket.

Figs. 16a–c: Clinical view during inspection after three and six months.

Fig. 17: Comparison of the clinical condition at microbiological/molecular baseline (a) and after six months (b).

Figs. 18a–f: Clinical situation after 16 months.
to carry out a molecular-biological test to assess periopathogens quantitatively and qualitatively.

Before the treatment the patient underwent supragingival hygienic procedures done with ultrasound scaler (EMS, Piezon). After hygienisation, the clinical condition of the patient improved. Additional examination was carried out to determine the stage of the periodontal disease. Then, a Nd:YAG laser was applied for periodontal pocket sterilisation and decontamination (Figs. 3–7) and Er:YAG laser to remove subgingival calculus (Figs. 8–12). For final decontamination and stabilisation of the fibrin clot, the Nd:YAG laser was applied again (Figs. 13 & 14). Figure 15 shows the situation immediately after surgery by Er:YAG and decontamination of the periodontal pocket by Nd:YAG (LightWalker, Fotona).

Summary

Er:YAG and Nd:YAG lasers have become the tool of choice in the treatment of periodontal diseases. They effectively reduce bleeding (BOP) and a pocket depth (PD) and are less time-consuming in comparison to conventional methods. Another advantage is the increased access of laser light to anatomically difficult areas compared to conventional hand tools, such as deep narrow pockets or furcations.

Lasers broaden the range of treatments offered in the dental office, increasing precision, enabling minimally-invasive treatments and better wound healing. The introduction of laser methods to the dental practice compels us to further learning, improving professional qualifications and specialisation in the field. This in turn extends the range of non-surgical treatments of periodontal diseases.

Editorial note: A list of references is available from the publisher.

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Consider this the new era of painless teeth whitening and the end to soft tissue damage caused by hydrogen peroxide. Developments in the past five years have made a huge impact on the daily work of dentists, dental hygienists and well-trained dental nurses in the EU regarding the parameters for in-office teeth whitening and the purchase of teeth bleaching products containing hydrogen peroxide or carbamide peroxide.

Impact of EU regulations for teeth whitening professionals

In 2011, a new EU regulation called the EU directive 2011/84/EU brought about massive changes in teeth whitening across the blossoming industry in Europe. Following the new EU regulations, patients must be under constant dentist supervision and see the dentist before, during and after the teeth whitening process. Delegated, supervised and well-trained dental assistants are still allowed to perform teeth whitening procedures if supervised by a dentist on-site.

Economic effect on dental hygienists and cosmetologists

In the Netherlands and other EU countries, self-employed dental hygienists have been severely economically affected. Professional hygienists are no longer allowed to whiten teeth as they did for many years as independent business owners. To continue teeth whitening therapy and running their own local clinics, self-employed dental hygienists had to hire dentists for supervision purposes to fulfil the new EU regulations.

Cosmetologists and cosmetology studios were also required by the EU regulations to remove their teeth whitening practice. Even before the new EU regulations, some courts had already ruled that teeth whitening belonged in the dental field only and could only be performed by dentists and supervised by dental assistants and/or dental hygienists. In Germany specifically, teeth whitening in cosmetology studios where cosmeticians, dental students and dental assistants were employed, had to stop their non-regulated businesses or had to hire dentists for supervision.

Professional products banned in EU countries

Professional teeth whitening products above 6% hydrogen peroxide and 16% carbamide peroxide were banned from the market and are no longer available in all restricted EU countries. The only cosmetic products available to consumers for at-home teeth whitening contain less than 0.1% hydrogen peroxide and can only be purchased online.

Reactions have been varied in different EU countries. Most of the countries are following and monitoring EU regulations completely. Several EU countries are only allowing teeth whitening by the dentist or dentist supervised dental assistants. The same countries are no longer allowing teeth whitening products above 6% hydrogen peroxide or above 16% carbamide peroxide. The current countries following these regulations are: the Netherlands, Belgium, Luxembourg, United Kingdom, Ireland, Slovenia, Croatia, France, Romania, Sweden, Finland, Norway and Denmark.

Different guidelines in Germany

Missing from this list is Germany. Usually Germany is the first country to follow new restrictive guidelines, no matter where they come from. However, hydrogen peroxide is still being used in higher concentrations and is still available in Germany.

At the moment, the German government allows higher concentrations above 6% hydrogen peroxide.
But patients receiving the bleaching therapy should have medical purposes and not cosmetic reasons for such a special, highly concentrated teeth whitening treatment.

The state control system has not yet detected the use of higher concentrations of hydrogen peroxide in Germany and these products should also be banned from the market because of EU directive 2011/84/EU. But, we expect German regulations to follow the EU directive for this year.

Off the market in France

France had some special reactions on the EU directive and control mechanisms. All teeth whitening products—even the ones that should have only 6% hydrogen peroxide—were taken off the market for some months and went into a state control system. The Health Ministry of France wanted to be sure that all products contained the exact concentrations of the teeth whitening agents that were displayed on the packages. All teeth whitening products were analysed and double checked by a governmental state control.

After this analysis, some products failed the new restrictions; in reality they contained a higher concentration than what was printed on the packages. Of course these products were taken off the market, along with the products with officially higher concentrations of the teeth whitening agents.

Other reactions from EU countries

In countries like the Netherlands or the United Kingdom, the new rules have led to a massive change to teeth whitening treatments. Market shelves were completely empty because of all the banned products and the dentists were sending patients away from in-office teeth whitening to home teeth whitening. Products containing only 16% carbamide peroxide for home teeth whitening had a massive increase in sales.

The UK market also had an increase in home teeth whitening products. For in-office teeth whitening, UK dentists no longer saw a safe and effective alternative therapy. In general, the market appeared confused and nervous based on a lack of alternative new teeth whitening products and lack of information.

The UK’s Commonwealth States had similar reactions to the regulations and availability of products. India and Australia adapted the EU regulations to the local market and made plans to reduce hydrogen peroxide concentration down to 3% instead of 6%. By following the EU regulations like the UK, the market opportunities in these countries are growing more in the home teeth whitening business.
To put professional teeth whitening therapy back into the hands of qualified dentists, new technology had to be developed to deliver great and safe results and still comply with the EU regulations. This applied not only to whitening agents with just 6% hydrogen peroxide, but also finding new additives to increase the value and results of teeth whitening treatment, and on challenging cases with hypersensitive teeth and gums.

The regulations made it necessary to go back to studies carried out in 2010 by a Japanese University (Kawamata et al.) as well as the University of Indianapolis to find a new product. All over the world, teeth whitening scientists were waiting for the discovery—or rather, rediscovery—of the additive nHAp: nanohydroxyapatite.

Discovery of nHAp—nanohydroxyapatite

Multiple studies had previously shown several positive effects of nHAp on solid tooth structures as enamel, dentine and on gingival soft tissues leading to reduction of tooth decay and periodontitis or gum disease.

The application of nHAp provides a remineralisation of the tooth surface and seals sensitive dentine tubules. The nHAp remineralisation is an active agent against white spots and early enamel lesions. Nanohydroxyapatite helps to effectively remineralise the erosions on teeth caused by soft drinks, for example. With a new smoother tooth surface, bacterial adhesion is decreased and fewer periodontal infections occur.

As result of the studies, the World Health Organization (WHO) announced that nHAp could become the effective and economical prevention therapy for third world countries. Thanks to the University of Indianapolis for discovering that teeth whitening with 6% hydrogen peroxide simultaneously with nHAp reduces all the well-known painful and negative side effects of teeth whitening. Currently, their studies are leading to brilliant teeth whitening results without sensitivities during and after the teeth whitening process. This is a massive breakthrough in teeth whitening over the past few decades.

Results of nHAp

From these results, the Dutch company PrevDent created patents for teeth whitening combined with nHAp, the first EU-legal teeth whitening product with an intensive simultaneous remineralisation. The new developments and changes by this technology for the sensitive patient are visible, detectable and remarkable.

In the past, hypersensitive patients with exposed dentine structures had severe challenges with teeth whitening products. To make these conditions possible to treat, patients visited the clinic several times for desensitisation therapy before the teeth whitening appointment. Multiple fluoridations of the tooth surface and multiple use of amorphic calcium phosphate (ACP) started weeks in advance of the treatment and were standard procedure.

Before, during and after the teeth whitening procedure, the patient had to consume painkillers and anti-inflammatories as a recommended therapy. Without any kind of preventive desensitisation programme, teeth whitening therapy was not possible.

Now even patients with sensitive teeth and exposed dentine can have painless teeth whitening without other side effects. The combined teeth whitening therapy is called ‘In-Office Repair Whitening’ by PrevDent.

How to achieve excellent results with only 6% hydrogen peroxide

PrevDent did their homework, used scientific research, and patented a device to arrive at the best and safest results while at the same time meeting EU regulations. The active ingredients in in-office repair whitening create an interactive reaction between 6% hydrogen peroxide combined with a...
A special stabilising molecule, which bonds with the surface of the teeth and is applied with a special mixing device and container that seals and preserves both liquids—nHAp and hydrogen peroxide.

**Technical evolution**

For each patient, the solution is mixed to freshly activate the ingredients into a foam with a solid structure that physically adheres to the tooth surface. This foam mixture is another technical evolution. Because of the way it bonds with the tooth surface, the teeth whitening process works immediately and actively.

**Time and sequence of results**

PrevDent’s standard application is six times every ten minutes. In each sequence, the foam is always mixed and freshly applied and fully concentrated. Applying the fresh foam mixture with those extremely active ingredients each time is key in reaching the predictable perfect results within the estimated time of one hour. When necessary, a few extra applications are possible.

**Therapy for sensitivities and remineralisation**

Using results based on scientific research, PrevDent also developed DeSensiDent—a tooth serum of highly concentrated nHAp. DeSensiDent has become the universal desensitising tool and is used for all kinds of treatments against dental sensitivities and for tooth surface remineralisation.

In the field of orthodontic treatment, PrevDent has opened doors for intensive preventive therapy, which is being studied and discussed by the World Health Organization (WHO). Before, during and after the orthodontist performs corrective treatments with braces, the tooth surface is treated with the highly concentrated nHAp. PrevDent’s OrthoCare products help prevent tooth decay and remineralises enamel erosion occurring at the contact points between teeth and braces.

**Medical treatment**

Preventive therapy with nHAp is a focused medical treatment and not an aesthetic, cosmetic treatment. This therapy is not based on aesthetical indications or patients’ wishes, and is therefore considered a medical treatment without additional taxes for the dental and orthodontist businesses.

In some countries like Germany, similar surface sealant therapy is paid by insurance as a preventive therapy for every single tooth before, during and after orthodontic treatment with braces (GOZ No. 2000a).

Mineral restoration and surface sealant therapy follows the GOZ No. 2000a, which is the fissure sealant and surface sealant therapy of healthy tooth surfaces. The general office of the German private insurances declares that such a treatment is medically necessary and will be covered by all German private insurance companies.

**Availability for professional treatments facilities**

The DeSensiDent product line is currently available on the market, meets EU regulations, and is the number one professional product developed by PrevDent for mineral restoration and surface sealants. PrevDent has opened a big and important scientific door for dental professionals performing orthodontic procedures and who want to include remineralising and desensitising treatments into their preventive and restorative therapy portfolios.

To summarise, based upon scientific results PrevDent’s in-office repair whitening is a combined teeth whitening and remineralisation product that is fulfilling all national and international restrictive parameters that occurred out of the EU directive 2011/84/EU. As additional complementary products, they developed new desensitising and remineralisation tools based on the usage of nHAp for intermediate short-term applications and intensive long-term applications as sealant products.

As another future perspective, this nHAp technology of PrevDent can become a successful partner for surface sealant technology in the perioprevention concept.

*Images courtesy of Dr Skander Ellouze.*

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www.prevdent.com  
www.periopreventionnetwork.com  
www.dentalspecialists.de
Evaluation of the effectiveness of the professional home whitening with the new ENA White 2.0

Analysis of results measured with spectrometer 6 months after treatment

Author: Dr Irene Franchi, Italy

Introduction

The ideal smile has always been considered as an expression of health and beauty.1, 2 The Romans congratulated the tradition of having teeth that were white in colour and perfect in shape; Patrician women used to try to bleach their teeth by rubbing them with tissues soaked in urea-based natural mixtures.

According to some recent statistics,3 about 50 per cent of the world population are not satisfied with the colour of their own teeth, and adopt all the possible methods to make them whiter and brighter, just like all advertising models suggest.

Discolouration is a very important aesthetic problem: extrinsic discolouration affects the external surface of the tooth and is of exogenous nature as it is caused by external agents (e.g. food, drinks, plaque, tartar, smoke, products with chlorhexidine) and can be easily eliminated by using a specific toothpaste and professional abrasive techniques.

Intrinsic discolouration is caused by a deposit of pigments in the organic or mineral structure of the tooth, accumulated during the development and/or the mineralisation of dental germs; specific products or appropriate techniques are required to solve them. From a chemical point of view, bleaching means the destruction of the chromophore groups in the organic and inorganic compounds.1

Through a chemical reaction of oxide reduction, the bleaching agent can discolour a substratum

Table 1: Arithmetic mean of chroma, hue and value of the treated elements of the selected study group.

<table>
<thead>
<tr>
<th>PATIENT N. 1</th>
<th>PATIENT N. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>tooth element 11</td>
<td>tooth element 11</td>
</tr>
<tr>
<td>L. before</td>
<td>L. after</td>
</tr>
<tr>
<td>incisal third</td>
<td>66,88</td>
</tr>
<tr>
<td>middle third</td>
<td>69,86</td>
</tr>
<tr>
<td>cervical third</td>
<td>64,31</td>
</tr>
<tr>
<td>incisal third</td>
<td>65,28</td>
</tr>
<tr>
<td>middle third</td>
<td>65,25</td>
</tr>
<tr>
<td>cervical third</td>
<td>64,55</td>
</tr>
</tbody>
</table>

| tooth element 12 | tooth element 12 |
| L. before | L. after | L. 6 m. later | c. before | c. after | c. 6 m. later | h. before | h. after | h. 6 m. later |
| incisal third | 68,99 | 68,23 | 69,21 | 17,56 | 17,56 | 17,56 | 79,92 | 84,06 | 84,00 |
| middle third | 68,51 | 67,98 | 68,15 | 17,56 | 17,56 | 17,56 | 83,14 | 81,94 | 82,64 |
| cervical third | 64,23 | 67,36 | 67,98 | 17,56 | 17,56 | 17,56 | 83,14 | 83,94 | 83,91 |

| tooth element 13 | tooth element 13 |
| L. before | L. after | L. 6 m. later | c. before | c. after | c. 6 m. later | h. before | h. after | h. 6 m. later |
| incisal third | 64,54 | 67,89 | 68,22 | 15,21 | 15,21 | 15,21 | 83,97 | 79,90 | 79,28 |
| middle third | 65,37 | 68,11 | 68,15 | 15,21 | 15,21 | 15,21 | 83,97 | 83,94 | 83,91 |
| cervical third | 64,04 | 64,66 | 64,81 | 15,21 | 15,21 | 15,21 | 83,97 | 86,99 | 86,76 |

| tooth element 22 | tooth element 22 |
| L. before | L. after | L. 6 m. later | c. before | c. after | c. 6 m. later | h. before | h. after | h. 6 m. later |
| incisal third | 69,19 | 70,38 | 70,40 | 15,21 | 15,21 | 15,21 | 75,22 | 75,39 | 75,36 |
| middle third | 69,80 | 71,98 | 71,67 | 15,21 | 15,21 | 15,21 | 75,22 | 75,39 | 75,36 |
| cervical third | 69,36 | 70,98 | 71,19 | 15,21 | 15,21 | 15,21 | 75,22 | 75,39 | 75,36 |

| tooth element 23 | tooth element 23 |
| L. before | L. after | L. 6 m. later | c. before | c. after | c. 6 m. later | h. before | h. after | h. 6 m. later |
| incisal third | 65,78 | 67,41 | 67,61 | 15,21 | 15,21 | 15,21 | 83,97 | 83,94 | 83,91 |
| middle third | 67,36 | 69,11 | 69,45 | 15,21 | 15,21 | 15,21 | 83,97 | 83,94 | 83,91 |
| cervical third | 65,36 | 68,33 | 68,87 | 15,21 | 15,21 | 15,21 | 83,97 | 83,94 | 83,91 |
containing double conjugated links, aromatic systems and quinolonic systems.\textsuperscript{1,3}

Many bleaching products for outpatient or home bleaching that are currently on the market are based on hydrogen peroxide and carbamide peroxide at different concentrations.\textsuperscript{1,4}

For outpatient bleaching, the professional applies the mixture on the teeth to be treated, while for at home bleaching, a special resin tray is made to be worn by the patient with the product inside during the night.

The new bleaching product ENA White 2.0 (Micerium S.p.A., Italy; Fig. 2) is an innovation in this field as the bleaching product is not applied with a tray or in office but supplied by a toothbrush with a dispenser.

The aim of this study is to verify the efficacy of the bleaching treatment ENA White 2.0 through spectrophotometer analysis, on a group of 10 patients 6 months after the clinical results, excluding possible side effects such as sensitivity.

| Table 2: Results from the clinical diary of the patients: the column on the left shows the patients, while the other columns show the hours and days passed from the application of the bleaching product. Each patient had to report the level of post-operative sensitivity at each period: value 1 indicates a very low level, value 2: low, 3: moderate, 4: heavy, 5: very heavy (implicating problems with the assumption of cold liquids or the contact with air and pain during chewing). |
|---|---|---|---|---|---|---|---|---|---|---|
| Patient | 1 h | 3 h | 6 h | 12 h | 24 h | 3 d | 4 d | 5 d | 6 d | 7 d |
| 1 | 4 | 4 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| 2 | 5 | 5 | 4 | 4 | 2 | 1 | 0 | 0 | 0 | 0 |
| 3 | 4 | 4 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| 4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 0 | 0 |
| 5 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 0 | 0 |
| 6 | 3 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 7 | 3 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 8 | 3 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |

Materials and methods

Eight patients who required the cosmetic treatment of outpatient bleaching were selected. The criteria to be included in the group of the study were: to be non-smokers, aged between 18 and 50 years old, not periodontally compromised and without any prosthetic element or aesthetic restoration on anterior teeth. Some pregnant women were excluded, as it is advisable to postpone treatment until after the birth as it is a cosmetic treatment, despite no side effects being documented for the foetus nor the mother.

Before starting the clinical bleaching session, all patients were submitted to an accurate treatment of oral hygiene and spectrophotometer analysis of the six frontal superior elements (from canine to canine).

For each dental element (from 1.3 to 2.3), the variables L (value), C (chroma) and h (hue) in the cervical, medium and incisal sections were observed (Fig. 1 and Table 1).

The three above-described parameters were observed before the treatment and after 6 months, with the aim of evaluating the maintenance of the colour.

All patients used the toothbrush twice a day: once in the morning and once in the evening. The patients were given instructions on how to use the device as follows:
First remove the cap, unscrew the head of the brush from the dispenser and remove the seal at the base of the toothbrush.

Then screw the head on the dispenser again, rotate the ring on the lower part anti-clockwise towards the direction ‘UP’ until the gel comes out.

The first time you perform this operation, a couple of rotations of the ring are required as the tube that takes the gel to the bristles must be filled. (The patient must be informed that a rotation of a couple of marks is enough to make the right quantity of product come out.)

The brushing must be performed with a horizontal movement, for about 30 seconds, avoiding the gums as much as possible; then rinse the toothbrush with water and brush again for another 30 seconds.
The patients were asked to evaluate the post-operative sensitivity, indicating its extent with a number (from 5, maximum intensity, to zero) immediately after the session and 10 days after (Table 2).

Discussion

At the end of the 1980s, some home bleaching techniques were conceived, with the use of customised or not-customeised trays, adequately filled with hydrogen peroxide at a low rate, worn for some hours per day, or even all night long. The active ingredient had a concentration from 10 to 30 per cent and the time of contact (from a couple of hours to the whole night) varied accordingly.

The aesthetic result obtained is based on the variation of the colour; to define the colour from the psychosensorial point of view three parameters were used:

- Hue (h) is the base colour of the tooth, the most difficult parameter to identify, which comes from the dentine and is defined with four gradients: A (red-brown), B (orange-yellow), C (green-grey), and D (pink-grey).
- Chroma (c) represents the level of saturation, the pigmented portion of a shade. Vita Shade Guide has 4 levels of chroma: 1, 2, 3 and 4.
- Value (L) represents the level of brightness, it separates light and dark colours. Black is the minimum value, white is the maximum value.

Through the SpectroShade colorimeter, the value, hue and chroma of the upper frontal elements were measured; the main feature of this device is that it shows the value of the sample of the required shade guide, which is more similar to the colour of the examined tooth, thanks to a comparison of the delta E of the samples.

The delta E of the data is the square root of the sum of the squares of the colorimetric data of the obtained evaluation points:

\[ \Delta E = \sqrt{[L_{\text{fin}} - L_{\text{init}}]^2 + [C_{\text{fin}} - C_{\text{init}}]^2 + [h_{\text{fin}} - h_{\text{init}}]^2]} \]

After the analysis of 10 clinical cases, it was shown that the value (L) of the treated elements increased, so that the dental element acquired a lighter aspect. Analysing the literature, we can deduce that in order to have a visual perception of the difference of brightness between the two treated elements \( \Delta L \) must be at least identical or higher than 1.

The results obtained for the parameter of chroma (C) were excellent, with values that were lower than at the start of the study, meaning that a lower level of saturation was attained.

Six months after the end of the treatment, the analysis with the spectrophotometer was repeated and it was noticed that the studied parameters remained unvaried, without any significant change.

The excellent aesthetic result achieved with ENA White 2.0 bleaching is visually admirable and confirmed also by the analysis with the colorimeter.

The balance of chroma, hue and value was also maintained after 6 months.

Concerning post-operative progress, this study confirms what has been stated by the literature: sensitivity is particularly marked during the first hour after the treatment, but it disappears in 24 hours. After 3 days, only four people reported some problems of sensitivity (described as very bearable), which persisted in only one case even after 7 days. On the 10th day no problem was reported.

Conclusion

The new method with ENA White 2.0 allows excellent aesthetic results to be obtained with only 2 minutes a day of application of the bleaching product for about 20 to 30 days, a time period corresponding to less than 1/5 of the time necessary using the classic tray; the toothbrush with dispenser is easy to use, handy, it can be brought and used anywhere for 1 minute in the morning and 1 minute in the evening.

If the aesthetic result is not achieved at the end of this treatment, a second cycle can be performed without any negative effect on the dental structure.

The described treatment respects the EU regulation for the use of 6% hydrogen peroxide, clarifying that the bleaching kits can be directly delivered to the user by the dentist as a professional treatment after an accurate visit and evaluation of every single case.

The accelerator XS 151 is contained into the bleaching, it activates with brushing and allows the patient to use it easily and everywhere.

Editorial note: A complete list of references is available from the publisher.

contact

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Align extends Invisalign offering for GDPs

With its Invisalign system, Align Technology provides one of the leading solutions on the clear aligner market. The company has now introduced Invisalign Go, a new aesthetic tooth-straightening product, with which it aims to make the solution accessible to more clinicians in the UK.

Designed specifically for general dentists, Invisalign Go can treat mild crowding, spacing, orthodontic relapse and other aesthetic tooth misalignment cases. It will be available for single-arch or dual-arch treatments, ranging from £655 to £875, making it a realistic treatment option for GDPs, the manufacturer said.

Align promises that patients can achieve Invisalign smiles in as little as seven months with Invisalign Go. Users will be able to easily identify suitable patients for treatment with new case assessment software that can be fully integrated into an existing digital dental workflow and works both with polyvinyl siloxane impressions and Align Technology’s intra-oral scanner, the iTero Element, as well as 3M True Definition and CEREC Omnicam (Dentsply Sirona).

As part of the new Invisalign Go system, dentists are provided with an appointment plan that gives task-level guidance with specific and detailed processes to be performed at each appointment. Owing to a progress assessment tool, the technology furthermore allows clinicians to upload new intra-oral photographs and receive confirmation of whether the case is progressing as planned at any time during treatment.

A specially set-up website at www.invisalign-go.co.uk provides more information for those practitioners interested in signing up for the system. Invisalign also offers a training program, available to users and non-users of the system, that includes both online and live sessions that provide hands-on tips and techniques on Invisalign Go digital photography, impressions, interproximal reduction and attachments. Furthermore, the company gives clinicians access to an extensive continuing education program that is aimed at supporting them throughout their Invisalign Go treatments.

The Invisalign product family includes Invisalign, Invisalign Teen, Invisalign Lite, and Vivera Retainers. In addition to the Invisalign System, Align Technology manufactures and markets 3-D digital scanning products and services for orthodontic and restorative dentistry, including the iTero including the iTero element intraoral scanner and OrthoCAD software. For additional information, please visit www.invisalign.com.

Website pushes technology for cosmetic treatment simulation at home

Polls have shown that a significant number of Brits are considering cosmetic procedures to improve their appearance. In order to guide them in their decision-making process, patient education website Comparethetreatment.com has recently launched a new simulation tool that promises to show consumers what they would look like after treatment.

According to the website, the Visualizers are the only technology in the UK that can simulate cosmetic surgical and non-surgical treatment outcomes with or without clothes. Users simply select the treatment option, upload a current photograph and enter their contact information. They then receive a free digitally created before and after photograph by e-mail within 24 hours.

The company said that the tool was developed for prospective patients who are thinking about having procedures such as cosmetic dentistry done, but are not ready to commit to a consultation with a professional for various reasons.

“Aesthetic procedures are becoming mainstream in consumer consciousness. Yet many people who could benefit from treatment don’t because they simply can’t imagine how they’ll look afterwards, so don’t pursue it,” said the website’s founder, Tim Molony. “With our aesthetic treatment visualizers, people get a better understanding of what they could achieve before committing to the procedure. It’s simply an extension of our aim to help consumers to make confident treatment decisions.”

“We also aim to take away the fear factor in choosing cosmetic treatments and clinicians by providing people with face-to-face contact with surgeons and evidence-based web information,” he further explained.

The Visualizer tool will be available exclusively on www.comparethetreatment.com. Launched in 2015, the website claims to be a safe and informative platform for everything concerning cosmetic surgery, covering over 250 treatments, ranging from smile makeovers to all-out plastic surgery.
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The 6th IMAGINA Dental edition, Digital technologies & Aesthetic dentistry congress will be held from 13 to 15 April 2017 at the Grimaldi Forum in Monaco. IMAGINA Dental is the industry’s leading event for new digital technologies, 3-D and CAD/CAM in dentistry.

IMAGINA organizers invite dentists to a new generation of congress designed to help them better understand, learn and share experiences and clinical cases about how digital technologies could change their daily practice. From 3-D imagery and 3-D diagnostic tools to guided surgery, treatment planning, implantology, CAD/CAM, aesthetic restoration and Digital Smile Design, IMAGINA Dental brings a unique educational experience in an intimate setting, to discover and find out more how enjoyable innovative dentistry can be.

After last year’s edition (7–9 April 2016) it was apparent that IMAGINA has maintained its reputation as the leading congress for digital technology. In particular, participants emphasised the quality of the presentations and remarked that IMAGINA is more personal, giving the opportunity to engage with the presenters. More than 600 visitors from 26 countries attended the event, which received positive feedback from both the presenters and attendees.

**Highlights of 2016 meeting**

IMAGINA 2016 focused on CAD/CAM dentistry and microscopy, innovations in implantology and digital smile design.

The guest of honour at the opening session was Dr Marcus Abboud, Founding Chair of the Department of Prosthodontics and Digital Technology and Director of Continuing Education at Stony Brook University’s School of Dental Medicine in New York in the US. Abboud pointed out that digital dentistry and 3-D printing have rendered possible what could only be dreamed of just a few years ago, including individualised bone grafts and trachea replacements for cancer patients. However, it is important to realise that these technologies do not replace knowledge or conventional treatments; rather, they open up new treatment avenues, he said.

“Innovations in implantology” was the theme of the second day and started with a presentation by Drs Luc Manhès and Guillaume Fougerais titled “At the dawn of artificial intelligence, how to leverage technologies to keep hold of our dental treatments?” The speakers demonstrated that using CBCT technology, it is possible to obtain perfect treatment planning in 3-D. They pointed out that very few dentists use the technology and emphasised the value of using CBCT. Only 3 per cent of dentists use surgical guides to place implants, but Manhès and Fougerais encouraged the use of a surgical guide even for a simple case “to see the technology through”.

Dr Joseph Choukroun was the guest of honour of the second day. In his presentation, titled “A-PRF and i-PRF: the latest innovations with the use of mesenchymal stem cells in the dental office”, he explained how it is possible today to treat patients who have lost bone, cartilage and collagen by regenerating the lost tissue with stem cells. In the past, harvesting stem cells and treating them were very difficult to achieve. However, today, stem cells can be extracted directly with a blood sample, and Choukroun presented the technique for quickly extracting stem cells and injecting them where needed.

The theme of the last day of the congress was “Digital smile design”. The room was full for Prof. Angelo Putignano’s presentation, titled “Simplicity in dentistry: The Style Italiano approach”. He began by explaining the guiding foundation for his work—colour and details—and went on to demonstrate this, taking the attendees on a magical trip to see what can be achieved in aesthetics.

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