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Conclusion

Given the enamel-like properties of the glass-ceramic material, the minimally invasive methods used for this case provide a long-lasting approach to restoring the function, esthetics and biomechanics of the dentition while minimizing the damage to the biological structures (Figs 8a to f) [4, 6]. Beneficial clinical long-term results have been described and confirmed in several studies [3, 8]. Parafunctions, endodontically treated teeth and an adequate amount of enamel have, among others, been flagged as risk factors influencing the success of these restorations [3, 22]. Against such a background, the additive wax-up technique used here proved to be beneficial. Together with a diagnostic matrix, this technique enables a conservative approach to tooth preparation and helps preserve the remaining enamel during preparation. In addition, an in-vitro investigation has shown encouraging data regarding the stress distribution in ceramic onlay restorations [13]. It is, however, important to note that preparations should have soft and rounded transitions to prevent stress peaks from occurring [1]. In recent years, the authors of this report have mainly used glass-ceramic onlays based on lithium disilicate in conjunction with the staining technique [5, 7]. Given its increased strength, this material allows the minimum thickness to be reduced by one third to just over one millimetre, further increasing the amount of tooth structure that can be preserved during preparation.

Given their extremely high strength and optimal marginal integrity, glass-ceramic onlays appear to be ideally suited for restoring the function, esthetics and biomechanical properties of abraded and eroded posterior teeth. They offer an opportunity to circumvent traditional prosthetic measures that are more invasive and involve higher biological costs [6].

Figs 8a to f: Portrait pictures taken more than eleven years after the placement of the restorations. The esthetic and functional requirements of the patient have been and continue to be fully satisfied.

Literature available from the editors on request DT

Prof. Dr Daniel Edelhoff
Director Department of Prosthodontics Ludwig-Maximilians-University
Goethestrasse 70
80336 Munich, DE

daniel.edelhoff@med.uni-muenchen.de

Oliver Brix
Innovative Dental Design Oliver Brix
Kisseleffstrasse 1a
61348 Bad Hombur, DE
Oliver-Brix@t-online.de

Dental Photography. Part II Protocol for shade taking and communication with the lab

By Dr. Eduardo Mahn, Chile

Abstract

Part I of this article discussed the basic equipment that is necessary for dental photography. In addition, a few examples of pictures taken that were better than others for the same situation were also shown. In part II, a protocol of taking digital photographs will be presented which has been of great help to the author, specifically in achieving the right shade and value.

It is based on standardized pictures that should be taken in order to show certain individual characteristics of the patient to be treated and standardized comparisons of the shade tabs and the natural tooth structures in order to give the technician more information than the usual A2 or A1 written on a piece of paper.

Shade taking

The evolution in digital photography and the possibility of taking pictures and evaluating them immediately as well as almost instantaneous access of the information by someone located off-site in the same city or even another country, we have a great resource available that can help us achieve the right shade of our indirect restorations. Standardized high quality photographs are also an advantage when the shade is taken for a direct restoration - for example a direct veneer or a class IV .

In this case a picture can really help the clinician identify the opalescent areas and the halo effect of the adjacent tooth, before re-doing the restoration (Figure 1).

Dental shade taking at the dental lab or in the dental practice can be frustrating as most dentists do not really know how to use the shade guide when they finish their undergraduate studies. In particular, if work has to be redone, because the clinician does not know what was done incorrectly wrong or how to obtain the right shade.

Dental shade guides are used by dentists, dental assistants and dental laboratory technicians to communicate proper tooth color, translucency, and brightness.

However, many variables come into play no matter what system you decide to use. Before even starting to think about shade taking; you need to answer an extremely simple and obvious question: are you using exactly the same shade system as the lab? There are many shade taking systems available, with variations in the shades between different manufacturers, even though the concept may be the same.

They are also manufactured from different materials with different optical properties. For example, some labs are familiar with the Chromascope system, most of the dentists with the A-D shade guide, while the younger generation of dentists learned with the 3D master shade guide. (Figure 2) The role of a shade guide is to help standardize the perception and so facilitate the communication in order to match the shade of the natural teeth with the required restoration.

Shade guides are not a perfect representation of what is actually seen but are close enough to identify a range of tooth colors. Eyes are still the best tool for identifying and communicating the correct dental shade. Tooth color can be referred to as being an A1 or A2, or between a B2 and B3 when describing the respective tooth closest to the one being restored. It is always best to get the patient to the dental lab and have a custom shade taken, if possible, particularly for the more difficult cases. However, in most of the cases this is not possible, due to unwillingness of the patient to spend time going to the lab, or the location of the lab not being in close proximity.

The use of shade guides should be used in conjunction with digital photography. If no direct light is projected to the mouth and the shade tabs, the main light source will be the flash of the camera, which has always the same temperature (between 5500° and 6000° K) and can be used by the dentist in the clinic and the technician in the lab. When pictures are taken under different light conditions, the variations between the same shades can be considerable. A good photo for both the dentist and the lab technician can be emailed so that they are both looking at the tooth color under the same conditions. When the technician compares the color of the restoration with the shade guide, he can take a picture that will create an image to be used as a comparison under the same light conditions as the natural teeth in the image sent by the clinician. (Figures 3 - 5)

Due to the flash of the camera, the technician can then compare, under the same light conditions as the clinician, whether the restorations look similar to the original shade tab sent by the clinician. (Figure 6, Veneers by CDT Juergen Seger, Liechtenstein)

Tooth Color Basics

Color has two basic characteristics: Hue and Chroma. Natural tooth color also displays these same characteristics. Hue can be defined as the actual color such, as yellow or gray. Chroma is the intensity of that color and is sometimes called saturation. Hue and Chroma are typically represented by a shade guide in terms of which color comes closest to the actual tooth being measured. For example, shade guides will have a range of A1 to A4 or B1 to B4, plus C and D shades. (Fig 17c)

Value is the brightness of a tooth. It is therefore given a separate classification than color when communicating shade. Teeth also exhibit translucency and can be measured by how much light can pass through different sections of a tooth. Shade taking problems arise because most natural teeth are not an exact match to a shade guide, nor do shade guides adequately express tooth translucency

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Figure 1: This picture will help the clinician to understand the challenge of reproducing the opalescent areas and the halo effect at the incisal third.

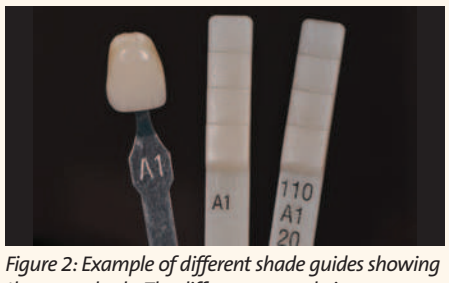
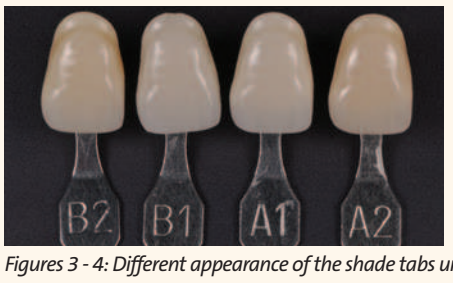
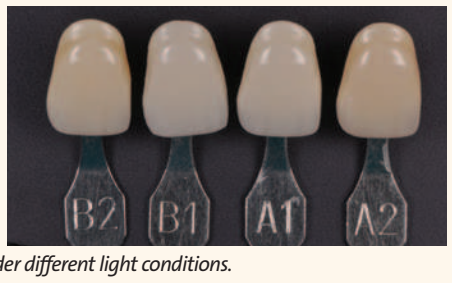
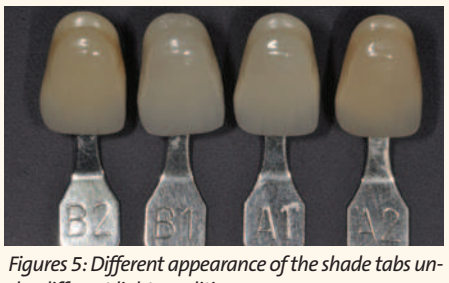


Figure 2: Example of different shade guides showing the same shade. The differences are obvious.





Figures 3 - 4: Different appearance of the shade tabs under different light conditions.



Figures 5: Different appearance of the shade tabs under different light conditions.

Figure 6: The technician should always check the final appearance of the restorations with the use of the natural die materials shade guide on order to come to the optimum result.

Figures 7 and 8: Mayor differences in the appearance of the same veneers teeth 11 and 21, due to the use or lack of lipstick. (Thanks for the pictures to CDT Juergen Seger, Liechtenstein)

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and value. In many cases, when it decided that a tooth has a certain shade, the Hue and the Chroma are communicated to the lab, but never the value and this is where the problems arise.

Very few crowns are accepted if the value is incorrect, while moderate inaccuracies in chroma and hue may go unnoticed. For this reason the shade taking protocol needs to be based on this information being communicated to the lab in the most accurate way possible.

Before the shade is taken conventionally or a picture is taken for the same purpose, several factors need to be controlled:
1. If patient is wearing bright colored clothing, drape him or her with a neutral colored cover.
2. Have patient remove lipstick and other make-up, as well as eyewear .
3. Teeth must have been cleaned.
4. The shade taking should be done at the beginning of the appointment, so that teeth are moist (the patient must lick their teeth constantly to keep them moist) and your eyes fresh.
5. The operatory light should be turned off or pointed in another direction. It must not focus on the patient.
6. The room light conditions should have a temperature of 5500-6500° K. (when pictures are taken, these parameters are no longer relevant, because the light of the flash will prevail).
7. Obtain value levels by squinting.
8. Women are far less likely to be color blind than men, so it is a good idea to have your assistant assist in shade taking decisions (assuming that the assistant is a woman and not color blind)

In Part 1 of this article, the necessary equipment and accessories for adequate intraoral pictures was discussed.
Please refer to it for the necessary information if you are planning to purchase adequate equipment.
Once the patient is ready, place the shade tabs in front of the anterior teeth, before starting the treatment itself. The same applies for pictures with lips. It is important to repeat the same protocol intraorally, as well as extraorally, because of the large influence of the reds in shade taking. (Figures 7-8)
In addition to the points presented before, the following should be considered initially when photographs are taken: (Figures 9 - 13)
1. Avoid the large reflection areas of the metal parts of the shade guide as they reduce the detail of the pictures
2. Take pictures using two different shade tabs
3. The surface of the shade tab must be at exactly the same level of the buccal surface of the teeth, as even minor discrepancies can make a tooth look darker or brighter due to the power of the flash)
4. The incisal edge of the tabs should be at roughly 1mm distance from the natural teeth, or as close as possible, without touching each other.
5. Take pictures with and without contrasters. This is especially relevant in young teeth with opalescent areas and clear halo effects.
6. In cases where an all-ceramic restoration is planned, the shade of the stump should also be given to the lab, using a special shade guide, such as the natural die material shade guide of the IPS e.max system (Ivoclar Vivadent, Liechtenstein).
7. Consider taking some pictures in black and white. A black and white photograph will help show the value of the shade tab in relation to the patient's tooth. (Figure 14)

Clinical case

A 27-year-old female patient came to our office unsatisfied with the appearance of her 2 anterior pfm crowns (Figure 15). The value of both crowns clearly did not match the other teeth and her smile line unfortunately also showed the discolored cervical part of tooth 11 (Figure 16).
An overview picture of the stump shade was taken with a reference (Figure 17a). This reference should ideally be the natural die material A - D shade guide (Figure 17d). Both shade guides, the natural die material guide and the A-D shade guide have some similarities, for example, as a rule of thumb an ND2 looks quite similar to an A2 (Figure 17b).
Obviously, the natural die material shade guide has shades that are dark, since its purpose is to correlate to artificially discolored stumps and not to recreate natural shades as the A-D shade guide (Figures 17c and 17d).
Internal bleaching of the stump was then performed with 35% hydrogen peroxide (Figure 18) in 2 sessions of 20 minutes each. Figure 19 shows the final result after the composite build-up with Excite DSC and Multicore flow (Ivoclar Vivadent, Liechtenstein). An impression was taken and sent to the lab.

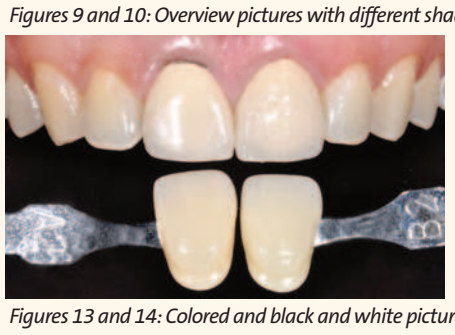
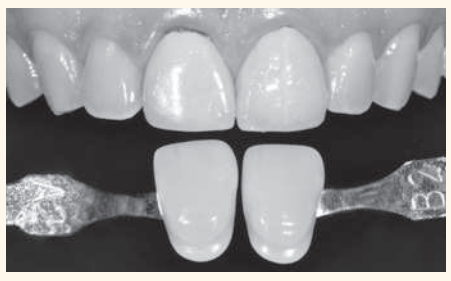
The cast was scanned and an IPS e.max Cad LT block was milled (Figure 20). The appearance of the crowns is always checked with the natural die material stumps in order to get the correct value and chroma (Figures 21 and 22). Finally, contacts and final integration of the crowns were checked in the solid cast (Figure 23, laboratory work done by CDT Volker Brosch, Germany). A retraction cord was placed prior to bonding the crowns (Figure 24). The stumps are etched with phosphoric acid (Figure 25) and Excite DSC was applied (Figure 26). Variolink N (base and catalyst, translucent shade) were mixed and applied to the crowns (Figure 27 and 28).
After 4 weeks a natural integration of the crowns with the right hue, value, chroma and effects can be seen in Figure 29.



Figures 9 and 10: Overview pictures with different shade tabs.



Figures 11 and 12: Close-up pictures with different shade tabs.



Figures 13 and 14: Colored and black and white picture.

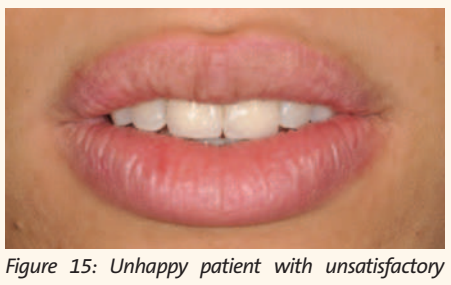
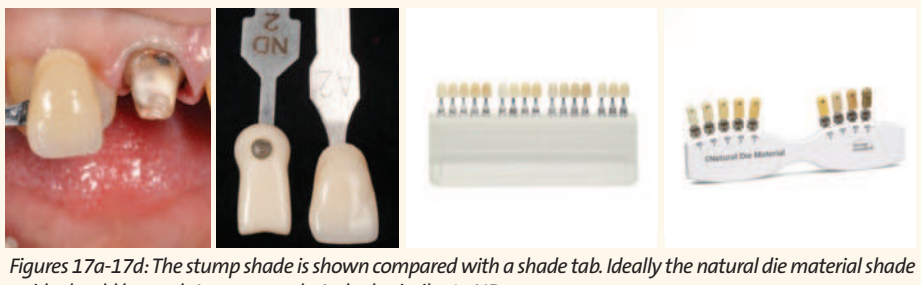


Figure 15: Unhappy patient with unsatisfactory crowns.


Figure 16: The smile is high, situation that makes the metal margin of the PFM crown obvious.



Figures 17a-17d: The stump shade is shown compared with a shade tab. Ideally the natural die material shade guide should be used. As an example A2 looks similar to ND2.

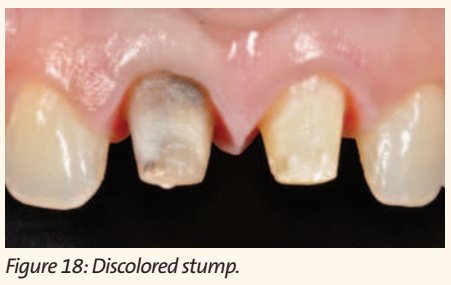


Figure 18: Discolored stump.

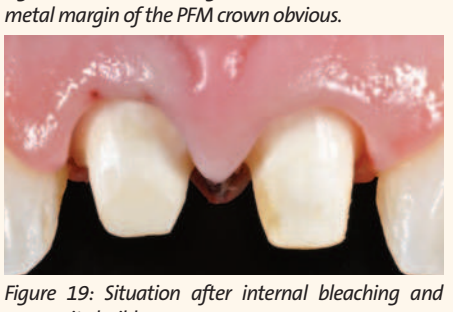


Figure 19: Situation after internal bleaching and composite build up.


Figure 20: IPS e.max CAD crowns after milling with the MC XL (Sirona) unit. The copings need to be crystalized in order to get the final shade.


Figure 21: Layering steps. The shade is compared with the natural die material stumps.


Figure 22: Final appearance of the crowns placed on top of the natural die material stumps, which has the same shade than the dentin-composite stumps in the patient's mouth.


Figure 23: Proximal contact and integration control in the model.


Figure 24: A retraction cord was placed prior etching

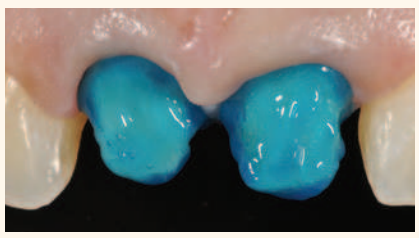


Figure 25: Etching with phosphoric acid.


Figure 26: Bonding with Excite DSC.

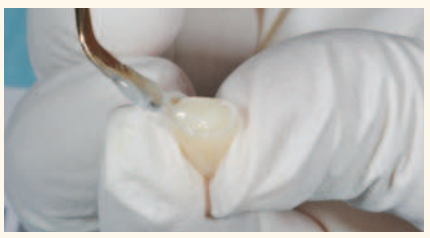


Figures 27 and 28: Mixing and application of Variolink N (Ivoclar Vivadent).


Figure 29: Final result after 2 weeks.


Figure 30: The value of the restorations match the one from the natural teeth.


Figure 31: Natural integrated crowns.

Acknowledgements

The author would like to thank CDT Juergen Seger and Volker Brosch for their valuable technical work presented in this article. DT

Dr. Eduardo Mahn, Chile, *has graduated from the University of Chile in 2004. He received the German DDS, one year later. The New York University College of Dentistry certified him as Implantologist in 2007. In 2008, he published his doctorate thesis in 2008 titled "Osseointegration of zirconia implants, an in vivo study" and got his doctorate degree in 2010 from the University of Düsseldorf, Germany.*