Bob Bosman Elst *graduated in 1991 as a dental technician. While working at his own independent dental lab in Belgium, he has continuously been working on expansion and developing innovative techniques for the dental industry. Over the years, He has participated in more than 40 master-courses including those from Brüsch, Tyszko, Calgaro, Adolfi, Galle, Hegenbarth, Sieber, Polansky and many more, either as a lecturer or as an active participant. His work has been recognized by many in the field. In 2007, Bob won the '3rd Prize worldwide' (in the category 'Young Ceramics') during the world tour of Nobel Biocare in Las Vegas. He came in as the 1st European of all participants of this highly reputable event. He set up a helpdesk for dentists covering all aspects on implant-supported restorations and porcelain. In 2017, he became a trainer of the GC Europe Campus, where he found a perfect forum to share his passion and experience.*

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Full Digital workflow with a twist

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A male 61-year-old patient was suffering from severe wear, which can be classified as attrition, abrasion and erosion depending on its cause. The entire smile line was lost and even became negative (Fig. 1). The patient was a real extravert smiling person, hence a new nice smile would impact his future social life. The destructive wear of his teeth caused already several endodontic treatments and TMJ dysfunction caused by the loss of the vertical dimension with caused tense and tired muscles.

Fig. 1: Smile before treatment.

Severe tooth wear caused morphological change of occlusal tooth, decrease of vertical dimension, pulp pathology, occlusal disharmony and change the masticatory function. In this condition, more complex therapies are needed such as endodontics, periodontics, and full coronal coverage.

A digital impression was made and the master model was printed. A digital wax-up/mock-up was made in Exocad, using the 'Digital Smile Creator' module. A standard length of 10.8 mm and width of 8.4 mm was used like described by Mauro Fradeani. This set-up was for this patient's biotype a really nice starting point. The idea was to verify the integration because the vertical dimension had to be increased with several mm and the patient wanted to rejuvenate his smile inconspicuously, so as natural as possible in addition to all the comfort of a balanced occlusion.

Fig. 2: Mock-up (GC Temp PRINT) in the mouth.

This digital wax-up/mock-up was printed with GC Temp PRINT as veneers so that it could be placed in front of the teeth (Fig. 2); a small support towards the palatal side was present so it could be placed over the natural dentition in a stable manner. This gave the possibility to evaluate the aesthetics but also the musculature response to the new occlusal height. The patient could also take this printed wax-up back home. This gave the patient the opportunity to show it to his partner but also to check it for himself in his own private space and without any pressure from time or strangers. Starting a remodulation of somebodies smile is something really drastic so the patient should be given as much time as he needs with all possible tools.

Fig. 3a: Printed temporary restorations relined with G-ænial Universal Injectable.

Fig. 3b: Temporary restorations in the mouth after relining with G-ænial Universal Injectable.

After patient's consent to proceed with the treatment plan, the veneers were adapted in Exocad and printed again as temporary crowns (GC Temp PRINT, Light shade). These crowns were relined with G-ænial Universal Injectable composite (Fig. 3a), shade A2 and manually polished. Optionally, they could have been glazed with OPTIGLAZE color. The cervical border was kept sandblasted (50 µm is sufficient) so that it could easily be connected to the G-ænial Universal Injectable composite. Then, only the relined part had to be polished again (Fig. 3b).

The vertical dimension was increased with 8 mm. To ensure that this would be comfortable for the patient, 3 months were taken to revise the situation. The patient was not suffering any headaches, muscle stress or any other problems. Hence, the first phase of the aesthetic adaptation was started. A small gingivectomy with bone correction was carried out first. An impression was made and long-term provisional restorations were manufactured in full zirconium. Those were characterised with Initial Lustre Pastes NF and cemented temporarily (Fig. 4).
A recall was planned after 3 months. This period also allowed the soft and hard tissues to heal properly after the periodontal surgery.
Everything was ready to go and start with the definitive work. Due to a ski accident, the definitive impression needed to be postponed for another 3 months. This did not pose a problem because of the highly durable temporary restorations. For cases like this, the comfort of the patient is always the priority.

Fig. 4: Smile with temporary restorations in zirconia, characterised with Initial Lustre Pastes NF.

Hence, after 6 months, the definitive impressions were taken, both digitally and conventionally.
The conventional impression was used to create the master working model.

Fig. 5a: Putty key on the temps.

Fig. 5b: Putty key on the substructure.

Fig. 6a: Washfire: Initial Lustre Pastes NF.

Fig. 6b: Washfire: Initial Lustre Pastes NF, sprinkled with CL-F (anterior).

Fig. 6c: Washfire: Initial Lustre Pastes NF (posterior).

This was mostly out of familiarity with the procedure, with the creed "Murphy doesn't like our industry, never change a winning team". What gives our mind comfort, also will give the best possible end result. However, a digital impression could have been used as well.
For the substructure, multi-layered zirconia was used, shade A2. The design was a small adapted copy of the temporaries. A 0.4 mm buccal cut-back was done for the posteriors and the canines. For the 4 anteriors, a 0.6 mm cut-back was done and the incisal height was decreased for 0.4 mm.
To keep control of the horizontal line, a palatal putty of the temps was made, which could be used as a key during the ceramic build-up (Fig. 5).

The zirconia substructure was slightly adapted and went into the furnace for a regeneration fire.
Thereafter, the workflow continued with the washfire. After applying the Initial Lustre Pastes NF (Fig. 6a), the Initial CL-F (Clear Fluorescence) powder was sprinkled on top of the wet Initial Lustre Paste NF (Figs. 6b and 6c). This gave the opportunity to sandblast after the washfire without damaging the colour. Moreover, it is ensured that the colours won't slip down.

Zirconia does not absorb heat well; hence, the heating program should be carefully adjusted to avoid chippings. Our chipping problem is also a consequence of a bad adjustment of our heating programs. The bigger the zirconia volume, the slower the heating and cooling down should take place. In this case, the heating temperature was dropped to 30° per minute and the cooling down should have a similar timeflow. To keep it simple: the time to heat up should be more or less the same as the cooling down.
The part until the CL-F is the first layer. For the neck, IN-42 (Terracotta; 40%) was used with A2 (60%), then the main colour A2 (Fig. 7). After the full contour with DA2 (Dentin A2), the horizontal line was checked with the putty key (Fig. 8).

After the cutback, the mamelons were shaped. FD-91 (Fluo Dentin Light; 50%) with DA2 (50%), A1 and A1 (50%) with E58 (Enamel 50%) were alternated, as shown in Fig. 9.

Fig. 7: Creation of the neck.

Fig. 8: After the dentine, the horizontal line is checked with the putty key.

Fig. 9a: Mamelons and cervical: Green: 50% FD-91 + 50% DA2; Dark Pink: A1; Blue: 50% A1 + 50% E58.

Fig. 9b: MThe "enamel blocker" (50% A1 + 50% E58; blue) was also used on the cervical part.

In the cervical part, this mixture was also used. This mixture could be called an "enamel blocker"; it works as a softer transmitter of the colour. This mixture can also be used as a transition towards the enamel in the incisal third; however, in this case, it was used as a softer, lighter, cervical part. It's all about breaking the light with a chameleon effect inside the material.

If the mamelons have to "jump out" of the dentine, CL-F should be applied on top of the mamelons (Fig. 10). For "floating mamelons" a wall of CL-F is applied the cut-back, then the mamelons are created and then again a layer of CL-F. In this case, it was chosen to let them "jump out" of the dentine.

This first bake is the colour-fire (Fig. 11); if the colour is not chromatic enough or already too chromatic, it's easier to adapt in this phase. After applying the enamel, colours should not be adapted anymore because it will destroy the appearance and could become very greyish.

The enamel fire could be considered as the "morphology fire". For the enamel, a mixture of E58 with EI-14 (Enamel

Fig. 10: Central Incisor with CL-F

Fig. 11: First bake/colour-fire with CL-F.

Intensive Yellow) and EOP Booster in three equal parts were used (Fig. 12). The program was exactly the same as for the colour-fire.

The correction-fire was done with the same mixture but diluted with a fourth part of CL-F. The temperature was dropped with 5°. In case another fire

Fig. 12: Enamel fire.

would be necessary, the temperature can be dropped with an extra 2°.

After finishing the structure, the crown was glazed with just some liquid, 50° lower than normal. The intention was to "close" the surface. After this fire, the crowns were hand polished with a mixture of pumice and 50 µm Al_2O_3 (Fig. 14).

Fig. 13 and b: Correction fire

Fig. 14a: Restorations before polishing.

Fig. 14b: Restorations after polishing.

The preparations were cleaned and isolated with retraction cords (Fig. 15). The crowns were cemented with a resin-modified glass ionomer (Fuji PLUS Capsule, GC). The cement excess was easily removed when the rubbery state was reached and margins were polished.

Increasing the vertical dimension is often a challenging task. The temporization phase was used to evaluate the influence of the increase on the tempomandibular function. Aside from the function, restoring the vertical dimension also had a positive influence on the aesthetic appearance. After treatment, a better balance in the facial dimensions as well as a fuller, more youthful smile can be seen (Figs. 16, 17 and 18).

Fig. 15: Prepared teeth before luting.

Fig. 16: Final result in occlusal bite

Fig. 17: Night guard to protect the restorations and periodontal tissues of the patient

Fig. 18: Final result - portrait. Patient satisfied with the aesthetic and function of his new smile

References:

1. Bettie NF, Kandasamy S, Prasad V. Management of Tooth Surface Loss of Varying Etiology with Full Mouth all Ceramic Computer-Aided Design/Computer-Aided Manufacture Restorations. J Pharm Bioallied Sci. 2017 Nov;9(Suppl 1):S302-S305.
2. Chu FC, Yip HK, Newsome PR, Chow TW, Smales RJ. Restorative management of the worn dentition: I. Aetiology and diagnosis. Dent Update. 2002 May;29(4):162-8.
3. Edelhoff D, Ahlers MO. Occlusal onlays as a modern treatment concept for the reconstruction of severely worn occlusal surfaces. Quintessence Int. 2018;49(7):521-533. doi: 10.3290/j.qi.a40482.
4. Fradeani M. Esthetic rehabilitation in fixed prosthodontics: Esthetic analysis: A systematic approach to prosthetic treatment. First Edit. Quintessence Publishing, 2004.
5. Green JI. Prevention and Management of Tooth Wear: The Role of Dental Technology. Prim Dent J. 2016 Aug 1;5(3):30-33.
6. Koubi S, Gurel G, Margossian P, Massihi R, Tassery H. A Simplified Approach for Restoration of Worn Dentition Using the Full Mock-up Concept: Clinical Case Reports. Int J Periodontics Restorative Dent. 2018 Mar/Apr;38(2):189-197.
7. Wetselaar P, Lobbezoo F. The tooth wear evaluation system: a modular clinical guideline for the diagnosis and management planning of worn dentitions. J Oral Rehabil. 2016 Jan;43(1):69-80.
8. Warreth A, Abuhijleh E, Almaghribi MA, Mahwal G, Ashawish A. Tooth surface loss: A review of literature. Saudi Dent J. 2020 Feb;32(2):53-60.