DENTAVANTGART

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VOLUME VI ISSUE 03 AUTUMN 2016

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DSD
Digital Smile Design

Dental prosthesis is an ancient art: in fact, the first known denture dates from 2600 years ago (Etruscan art). For several years, numerous CAD-CAM systems have been occupying more and more space within our dental laboratories, demonstrating a powerful evolution of this art. However, we must not forget that all that has been developed historically. At present, one technique is coming increasingly back into fashion. In fact, within the range of minimally invasive or non-invasive restorations, the production of pieces known as all ceramic associated with the manual know-how of the technician (hand-made) gives our patients aesthetic solutions while preserving healthy tissue as much as possible. This technique is called stratification on platinum leaf. As a member of the Oral Design Foundation created by Mr. Willi Geller (Fig. 50) and naturally inspired by the teachings of the same (as well as by those of his associates throughout the world), it is up to us to reproduce the patient's teeth as faithfully as possible. Our creation has to be integrated in the patient's mouth effectively and as harmoniously as possible. This hand-made technique using platinum leaf seems to correspond to the aesthetic demands of the dentist's eyes, as well as those of the patient and of ourselves. Within the framework of a DSD (Digital Smile Design) France course set up by Doctors Clément, Noharet and Gaillard, a patient was treated by means of veneers which we made on platinum leaf.

About the DSD course: It is certain that all the teams, whatever the degree of experience, have been confronted with communication problems between the laboratory and the surgery with respect to establishing and implementing a treatment plan. From the dentist's point of view, it is often difficult to communicate objective data concerning a prosthetics project. If fact, whether it be for an assembly or a wax-up, it is vital and imperative to communicate clear, objective data, accurate to the millimetre if possible, in order to best guide the laboratory technician. If the latter is not in possession of all the clinical data, he will not be able to effectuate a quality project which conforms to the expectations of the dentist and the patient. If this guidance is successful, it will permit confirmation of the treatment to be scheduled, and this without loss of time, work or confidence. Faltering by the surgery and the laboratory at this stage will result in a loss of time, a loss of work and a loss of confidence (of the patient in the whole team): this is in no way desirable.

The objective of DSD is thus to provide a precise aid in formalising the idea and creation of a prosthetics project. This latter will naturally be adapted according to the sensitivity of the dental and prosthetics practitioners and the actual clinical situations.

The aim of this article is to present this methodology in theoretical, clinical and laboratory terms, while illustrating it with the treatment of a patient carried out during a Live 'DSD France' course.

1 SMILE DESIGN: PROSTHETIC INTERESTS

The original concept of Digital Smile Design® was created by Christian Coachman (Brazil), who is both a dental technician and a dentist and his friend Livio Yoshinoga (Brazil), who is an architect **[1]**. His idea of DSD arose from issues concerning the initial diagnostics of clinical cases. In fact, patients today are particularly demanding with regard to treatments and therapies, particularly in terms of results. They wish to have a smile which harmonises with their physical features and their personality. The tool of Digital Smile Design® provides precise data for smile rehabilitation, but it must be correlated with the artistic vision of the dentist and the technician, and with their respective competences. Virtual smile design is a multi-purpose conceptual protocol, based on an analysis of the facial and dental measurements of patients. This analysis is made by a predetermined series of high-quality digital photographs as well as videos (permitting among other things the capture of more natural still pictures).

The analysis of these photographic materials highlights the relationships between the teeth, the gums, the lips, as well as the smile (and the face), which is a dynamic element capable of expressing emotions. The protocol is precise: four photographs are indispensible (two frontal views of the patient's face, one occlusal view of the arch and one facing the patient). Then, the stages are clearly identified: the patient is positioned within a framework defined by various tools in order to pursue a progressive analysis of different characteristics of the smile. On the photographs, elements such as the smile lines, the gingival relation and the teeth are entered, which allow a smile correction based on a complex approach. The dental proportions can also be assessed and thus improved.

The video is a dynamic tool, particularly important in the smile design process. Indeed, our patients are not static and should not be confided to a single snapshot. Viewing the video multiple times enables us to study the various expressions and emotions of our patient, and the lip movements at various instants. The video is thus a valuable tool in the clinical analysis of a patient.

Following the protocol and with the aid of calibration instruments, measurements can be taken which enable a close collaboration with the laboratory technician in order for the pre-determined project to be effectuated properly. It is evident that this clear and comprehensible presentation of the plan enables better communication with the patient: DSD serves to illustrate existing problems and the solutions aimed at dealing with them. In fact, it is always difficult to explain pathologies to a patient: photographic visualisation can provide help with this. It appears more appropriate to use actual photos of the patient (rather than similar clinical cases): identification of the situation is clearly more precise. This identification allows the patient a better understanding, and a better acceptance of the proposed treatments. The patient is an integral part of the design process, and it is very interesting to see how well they are able to understand the complexity of the dental techniques used for their treatment.

DSD: LIVE COURSE

In order to train practitioners in this protocol and also to improve communication between the laboratory, the dentist and the patient, the DSD France team organises three-day courses, the subject of which is DSD and its application. **(Figs. 1 to 4)**

40 persons attended the DSD France 2 course (four of them dental technicians) in order to learn and share this treatment concept. One patient, Anthony, was treated during this three-day seminar. In order to complete the treatment within the time available, it was necessary to bring together an outstanding dentist-technician pair who regularly work together (know each other's working methods, have confidence in each other, etc.).

The clinical and prosthetic treatment is presented in the following.

1–4 Pictures from the live DSD Course.

3 DSD: CLINICAL AND PROSTHETIC TREATMENT

5 The initial state as portrait.

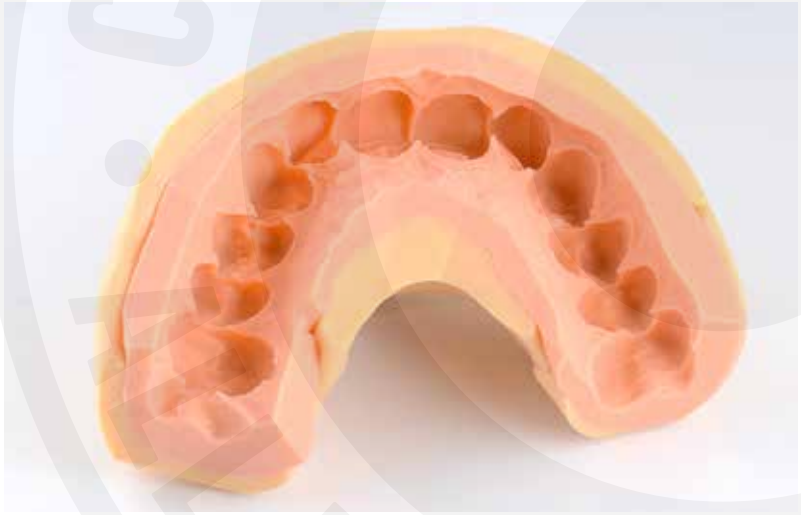
6 The initial state of the smile.

7 The initial intra-oral state.

8 Aesthetic plan produced by DSD.

Our 40-year-old patient came to the surgery with the request for us to perform restoration on his smile which he did not find aesthetic **(Fig. 5)**. We questioned the patient thoroughly about his expectations in order to understand his precise motivation. In fact, he was bothered by the positions of his two lateral incisors as well as the fracture of tooth 11 (and the associated discolouration) and the overall shade of his teeth **(Figs. 6 and 7)**.
First of all orthodontic treatment was proposed, but this was not accepted by the patient.

At this stage, therefore, it was important to analyse the clinical situation in order to propose a treatment plan in line with his expectations. For this, intra- and extraoral x-rays, photographs and videos were taken of the patient (including the four photos needed for the DSD). Imprints of the initial condition were also taken during this session. With the aid of these documents a clinical analysis **(Fig. 3)** was performed, as well as informatics analysis by means of DSD **(Fig. 8)**.



9 Mandible model produced to aid whitening.

10 Gingivectomy of tooth no. 13: 1 mm
(The depth of the gingival sulcus was previously 3.5 millimetres)
2 pictures taken in S. Mosconi's laboratory (wax-up)

11 Silicone model made in the laboratory
before being cut to the level of the teeth
to be restored.

Thus the treatment plan recommended to the patient in order to meet his expectations was as follows:

- As a first step, two onlays were produced for the molar teeth, as well as composite fillings for two teeth earlier given amalgam fillings, under which decay had set in again due to infiltration.
- Then follows whitening treatment as an outpatient **(Fig. 9)**
(10% carbamide peroxide – 15 days),
- Followed by placing four ceramic veneers on the upper front teeth (nos. 11, 12, 21, 22) and trimming the gum of tooth 13, as well as making a slight correction to the crown of tooth 23.

The patient was informed that his ceramo-metal crowns would no longer have the appropriate shade after the whitening and they could be replaced in a second stage for aesthetic reasons. After the treatments on the back teeth and the tooth whitening, two impressions were sent to the technician (Sébastien Mosconi), so he could make a frontal wax-up based on the DSD plan provided **(Fig. 8)**. Before the DSD course, gingivectomy was also carried out on tooth 13 in accordance with the aesthetic plan **(Fig. 10)**.

Following the casting of the impressions in the laboratory, the wax-up was made with the aid of the photographs of the patient and the DSD aesthetic analysis. A duplicate was also made of this wax-up and the silicone transfer model was made from this duplicate **(Fig. 11)**.

12 Mock-up in place on a smile photo.

All the following steps were taken live in the three-day DSD course in the presence of the participants.

Mock-up stage: (4)

The model was cut along the modified teeth in order to eliminate the excess more easily (the model should follow the shaped dental necks). Some Vaseline was applied gently to the patient's teeth and the surrounding gums, then gently spread with the aid of a microbrush. An autopolymerising bis-acrylic composite resin (Provitemp A1 – Bisico) was injected into the silicone model and this was then pressed onto the patient's teeth. After the resin hardened, the excess material was easily removed from the mouth along the cuts in the model. At this stage it is possible to make a clinical assessment of the treatment plan proposed to the patient **(Fig. 12)**. This method allows an exact mock-up to be made, without any deformation, without excess, perfectly reproducing the finest details of the wax-up in terms of macro- and micro relief features. We immediately took further photographs and videos and these were then shown to the patient. It is advisable to take photos and videos in which the patient's whole face is visible. If the field of vision is too small or if the patient is facing a mirror, his attention is drawn to tiny details rather than the overall aesthetic result. Phonetic issues can also be resolved at this stage with the position of the upper and lower lips and the occlusion of the upper and lower teeth. After this trial, the patient is in a position to decide if it is appropriate to pursue the treatment in this form.

Anthony liked the plan and a simple and very easy modification at the level of teeth 11 and 21 was decided upon between the technician, the patient and the dentist in order to give the smile a more natural character.

Preparation of teeth

At this stage, the mock-up served as a guide in preparation of the teeth, in order to implement the final plan with maximum conservation of the tissues. **[5]**

First of all, horizontal grooves were made in the mock-up using a "three-headed" diamond drill. The penetration depth of the drill conformed to the thickness needed by the dental technician (0.5 mm), as well as to the double curve of the mouth cavity. A preparation of 1.5 mm of the free edge of the restorations was also made. When the grooves were finished, their bottoms were marked with a propelling pencil **(Fig. 13)**. At this stage, the mock-up was withdrawn and a retraction thread put in place to protect the soft tissues. The zones where the teeth were marked by the propelling pencil must be joined with the aid of a cylindro-conical diamond drill, bearing in mind the double curve of the mouth cavity. The cervical zone was then prepared, dealing with the proximal zones (sloping areas) in accordance with the aesthetic plan. It was thus also necessary to eliminate the point of contact between teeth 11 and 21, as the position of the inter-incisive line was modified with the DSD program. The free edges of teeth 11 and 21 (gently sloping towards the palate) were prepared more lightly, so that the technician could refine the edges to the level of the final veneers. The silicone models permit us to verify the tissue reduction and thus to observe the prosthetic plan **(Figs. 14 and 15)**. As the dental technician was present on the course, his opinion could also be obtained. At this stage, an instant dental sealant (All Bond 2, MR3) was applied to the area concerned, i.e. teeth 12, 22 and 21 using a sterile cloth **[REF MAGNE]**. Finally, a slight crown correction was carried out to tooth 23 on the part not affected by occlusion, in order to be faithful to the plan **(Fig. 16)**.

An impression in double-mix silicone (silicone S1/S2-Bisco) was made **(Fig. 17)** before replacing the mock-up to ensure proper timing. Vaseline was applied to the sealed areas and the model filled with bis-acrylic resin (Provitemp A1), then pressed onto the patient's teeth.

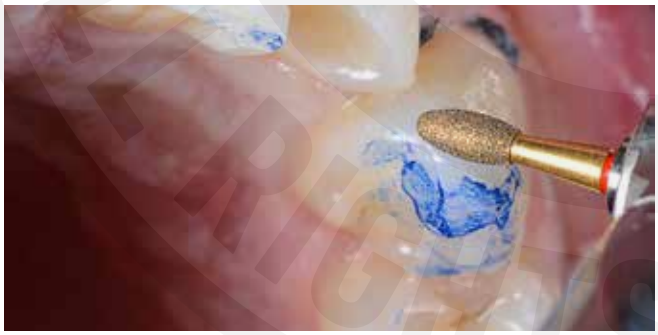
13 Preparation for veneers, by means of the mock-up.

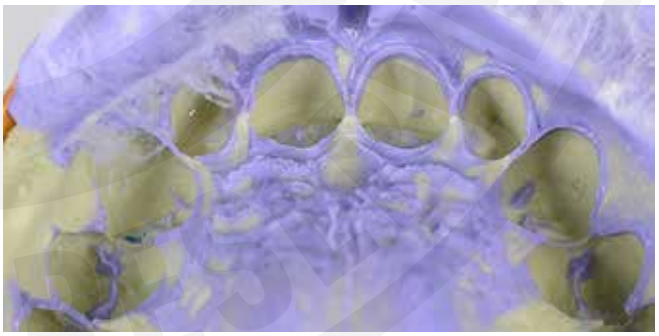
14 Control of the preparations by means of an oral cavity model, in order to approve incisal reduction.

15 Control of the preparations by means of a three-event occlusal model, in order to approve oral-cavity and proximal reduction.

16 Slight crown correction of the medial part of canine no. 23 without affecting the initial function and occlusion.

17 Impression for the four ceramic veneers. Pictures taken in S. Mosconi's laboratory (preparation of veneers)





Laboratory preparation of feldspar veneers on platinum leaf

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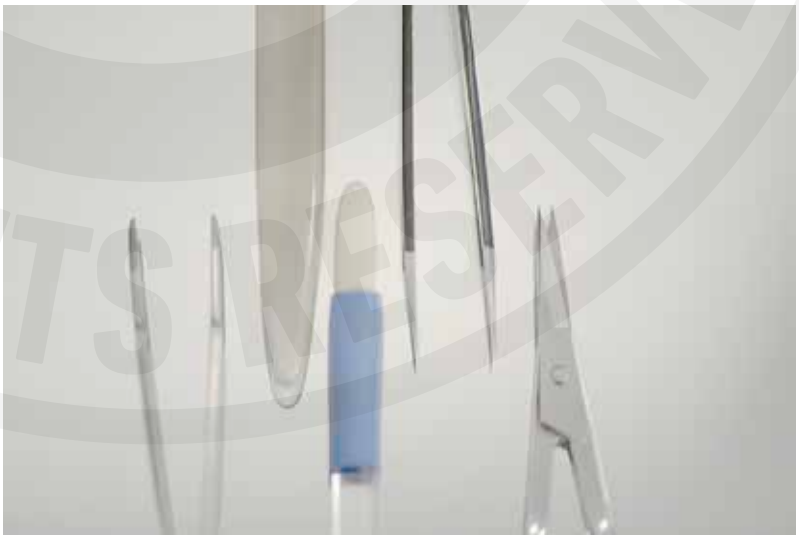

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After preparing a gyroform type working model **(Fig. 18)** which provides high precision and dimensional stability, the underlying parts (dies) were waxed **(Fig. 19)**.

The edges were then traced with a red pencil before applying a plaster hardener. The usage of a piece of platinum foil 0.02 mm in thickness cut to the desired dimensions allows the leaf to be applied manually by holding it firmly between the thumb and forefinger **(Fig. 20)**.

The ideal instrument for shaping the leaf on the die is the thumbnail, or an implement of wood or ivory with a rounded end so as not to tear the foil **(Fig. 21)**.

The foil is then bent down onto the palatal surface making sure that it is not too thick anywhere. The excess is cut off with little pointed scissors. At the joint of the fold of the leaf, Aurofilm 2000 must be applied, after heating it with a small blowtorch or cigarette lighter, thus forming a perfectly smooth gold solder **(Fig. 23, 24, 25)**.

Placing the platinum leaf in position is a very important stage of the work process, requiring prior study and special dexterity. Once the leaf is in place, it has the same function as a metallic framework which is removed from the working model and placed in the ceramic kiln for successive firings **(Figs. 22 to 25)**.

First firing is made with a translucent mass at 40 degrees higher than the normal temperature **(Fig. 26)**.

After this firing, the leaf is reapplied, smoothing in the fine ceramic layer with an agate spatula **(Figs. 27 and 28)**.

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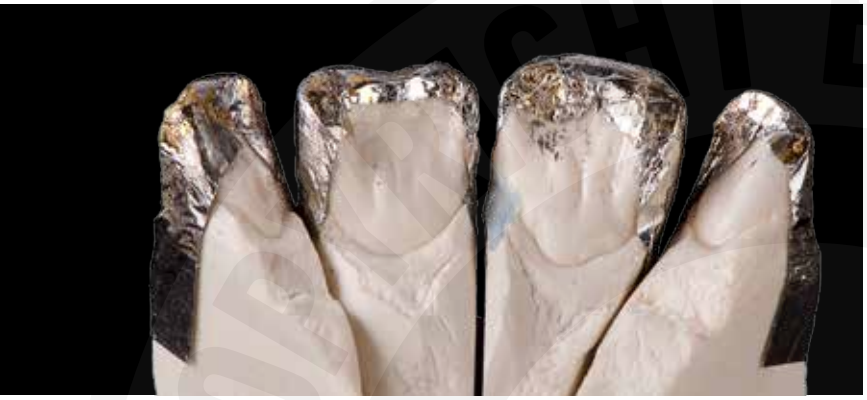

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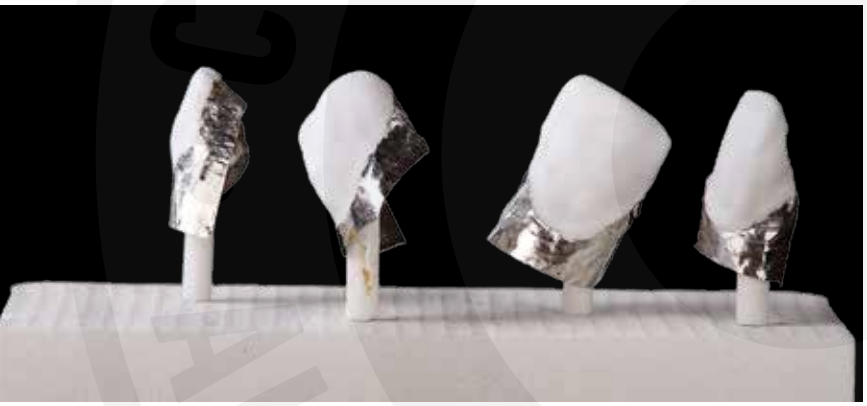

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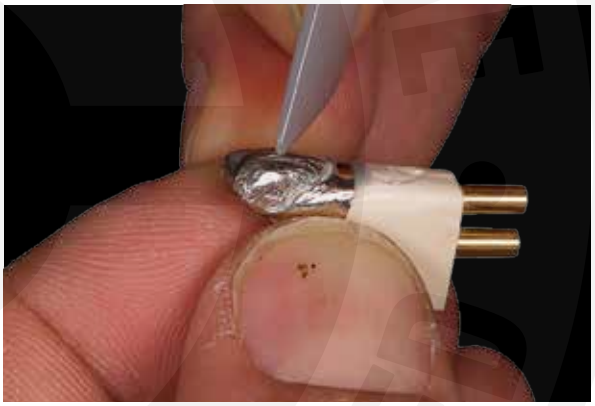

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After having infiltrated the tiny cracks with a 'wash' of glaze (very fine ceramic grains), assembly can be started in accordance with the expectations of the clinical case. For the veneers produced for our patient, an A1 dentine of the Creation brand by Willi Geller was used, followed by horizontal stratification with various intensive and transparent enamels **(Figs. 29 to 33)**.

A natural effect can be obtained with the addition of numerous details, in particular contrasts at the level of colour, value, glazing and surface conditions. A palatal model (made to the approved wax-up) can be used to check the lengths of the tooth edges **(Fig. 30)**.

The platinum leaf was then detached from the model **(Figs. 34 to 36)** and placed on the firing supports. Due to the excellent conductivity of the leaf, the final kiln temperature may be reduced by 10 to 20 degrees.

After firing **(Fig. 36)**, an adjustment is made to the contact surfaces with the aid of a diamond-coated strip **(Fig. 37)**.

Finally, before pre-polishing, work still had to be done on the shapes, the occlusion movements and the surface conditions **(Fig. 38)**.

A readjustment of the edges of the veneers with an agate spatula was necessary after every firing **(Fig. 39)**.

In the clinical case presented, adjustment to the model was carried out before glazing. The veneers were then (after glaze firing and complete cooling) placed in cold water. This facilitates removal of the leaf with blunt-ended tweezers, proceeding from the thinnest edge towards the thickest **(Figs. 40 and 41)**.

Finally, a control of the surface configurations and the contact surfaces was needed on a complete model, before delivering the components to the surgery.

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The adhesion session

The first step was to remove the temporary veneers and to try-in the ceramic veneers with the aid of a coloured try-in paste appropriate to the choice of shade in order to confirm the result with the patient prior to adhesion (EnaCemTry in UD1) **(Fig. 42)**. The fit of the veneers also had to be confirmed before undertaking the adhesion. A choice of the type of adhesive could then be made. In Anthony's clinical case, an adhesive with a Flow composite base was chosen (Flow HRI UD1 Micerium) in order to avoid all risks. As the edges of the veneers are pretty thin and an adhesive with a restoration composite base requiring reheating (for example, with the Enaheat system) would necessitate a strong force of application which could result in fracture of the ceramic.

The adhesions were performed one by one (veneer by veneer) in order not to inflict constraints on the gums for too long a time. This likewise allowed the participants in the DSD course to see the result the same day. The individual placement is also justified as positioning the veneers is pretty simple and stable, so there is no risk of misplacing a veneer.

After positioning the sterile cloth (Digue Nic Tone, thin) and a ring (Hu Friedy 212), the veneer was tried in once again **(Fig. 43)** before preparing the veneers and the teeth according to the following protocol:

Preparation of teeth:

- Fine micro-sanding with 27 micron aluminium oxide (Dentoprep sander) **(Fig. 44)**,
- Application of orthophosphoric acid (UniEtch - Micerium) to the enamel and the sealing zones for 30 seconds **(Fig. 45)**,
- Rinsing and drying,
- Application of bonding agent (All Bond 2) at the last moment without polymerisation **(Fig. 46)**.

Preparation of the feldspar ceramic veneer:

- Application of 10% hydrofluoric acid for 70 seconds (Porcelain Etchant 9.5 %) **(Fig. 47)**,
- Extended rinsing with water, then air and water alternately, followed by intensive drying,
- Application of silane for 60 seconds, then drying (Bis-Silane) **(Fig. 48)**,
- Application of non-polymerised bonding agent (All Bond 2) to the veneer at the last moment **(Fig. 49)**.

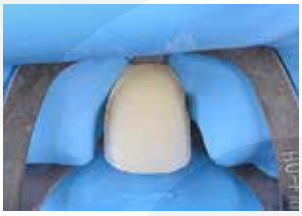
The veneer was stuck with the aid of Flow composite (HRi UD1 Micerium), which was only applied to the veneer. The veneer was applied to the prepared tooth, the excess adhesive being removed with the aid of paintbrushes and a microbrush before polymerisation. Each veneer was then polymerised under pressure from a blunt-ended instrument (OptrascultIvoclar) for 60 seconds. A final polymerisation under glycerine was effectuated at the joints **(Fig. 50)**. The excess remaining after polymerisation was removed with a no. 12 scalpel blade.

This same protocol was followed for each veneer, naturally with a try-in before each adhesion. There was no need for contact point correction in the clinical case presented.

Once the four veneers were stuck on, the occlusion was checked again and approved **(Fig. 51)** in both a static and dynamic state. Controls were carried out after one week and four months **(Figs. 52 to 55)**.

42 Try-in of the four veneers with the aid of a try-in paste and approval of the fit and the aesthetics.

43 Try-in of the veneer after placement of the steril cloth.

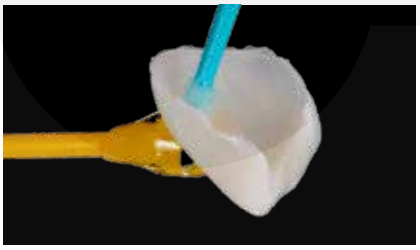


44 Micro-sanding of the prepared tooth (enamel and dental sealing) with 27 micron aluminium oxide.

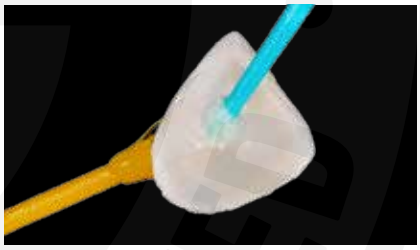
45 Treatment with 37% orthophosphoric acid.

46 Application of non-polymerised bonding agent at the last moment.

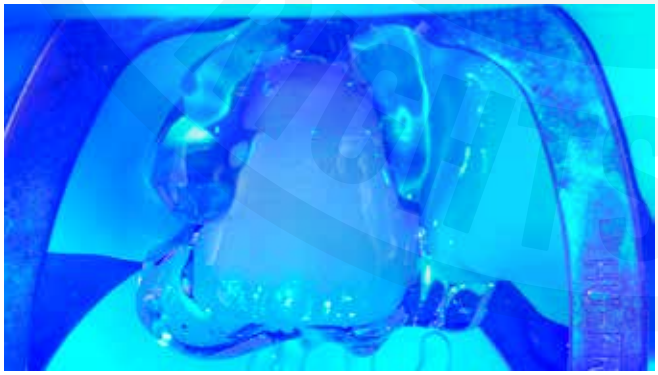
47 Treatment of the inside of the feldspar ceramic with 9% hydrofluoric acid for 80 seconds.



48 Application of silane.



49 Application of non-polymerised bonding agent.



50 Final polymerisation under glycerine at the joints level.

51 Control and occlusal adjustments.

52 Final intra-oral result (Picture taken with light diffusers).

53 Final intra-oral result (Picture without light diffusers).

CONCLUSION

The quality of communication between the trio of surgery – patient – laboratory is a pledge of an optimal result, in which DSD is a very useful tool.

Furthermore, the technique of stratification on platinum leaf, in comparison with the techniques of refractory die and pressed ceramic, saves considerable time but requires study and special dexterity in order to obtain a perfect precision of fit and the most satisfying result possible for our patients.

54 Final result: the worked ceramic surface.

55 Final result at the smile level.

In these three days of the DSD France course, a great deal of stress and emotion was experienced. As the patient had to be treated live in a limited time, there was no room for improvisation. The patient departed delighted with his new smile and the three days he had spent among dentists and technicians.

In this conclusion, I take the opportunity to thank dentists Marie Clément, Renaud Noharet and Cyril Gaillard for their confidence in me, even under these very unusual working conditions.

DR. MARIE CLÉMENT

Dr. Marie Clement received her DDS degree graduating from the University of Lyon, France, in 2011.

She has a post-graduate degree in aesthetic dentistry graduating from the University of Strasbourg in 2013.

She is a specialist in aesthetic and restorative dentistry with a private practice in Lyon (France).

She also teaches aesthetic dentistry in Lyon Dental School and has been lecturing and teaching extensively both nationally and internationally.

DR. CYRIL GAILLARD

1998: Degree from Bordeaux University.

1998–2000: Certificate Fixed Prosthodontics.

2000–2002: D.U Implantology (Bordeaux)

2003: Certificate Bone grafting (Yvan Poitras)

2005–2006: D.U Maxillo facial surgery (Paris 7)

2005–2008: Graduate from Las Vegas Institute in aesthetic, neuro muscular dentistry and full mouth rehabilitation.

Founder and President of Global Advanced Dentistry (www.gad-center.com)

Dr. Cyril Gaillard, graduated from the University of Bordeaux II in 1998, followed by numerous post-graduate trainings in cosmetic, implant and prosthetic rehabilitation complexes in France and in Europe, Canada and the USA, as well. The mission of Dr. Gaillard's Cabinet is to accompany the patient to regain health, beauty, confidence, helping them in their therapeutic choice. It aims to contribute to the dignity, appearance, quality of life, self-esteem and sociability. The main value of the offered treatments is represented by listening to their patients, the human relationships, and the multi-disciplinary approach to the best achievements of science.

DR. RENAUD NOHARET

Renaud Noharet, Doctor of Dental Surgery, with a degree awarded by the Faculty of Odontology of Lyon. He did a postgraduate full time (3 years) program in implantology and prosthodontics in Marseille (France). He was appointed Associate Professor of University and Hospital Practitioner in 2010. Renaud Noharet is also a doctor of the University of Lyon (PhD). He has a private practice in Lyon too, specialising in the field of implantology and full rehabilitation.

He has many postgraduate diplomas in implantology and prosthodontics. Dr. Noharet is an author of numerous publications (national and international) and also a co-author of several books. He has participated at a lot of national and international conferences.

DT. SEBASTIEN MOSCONI

Born 1975 in Nogent sur Marne, France.

Completed apprenticeship to dental technician in 1995.

Graduated 1997 from master dental technician in Paris.

Worked in several dental laboratories in France and Canada.

In my dental development, I joined courses of Willi Geller, Sascha Hein, Thomas Sing, Jungo Endo.

Own company since 2009.

Oral Design member since 2013, (Oral Design French Riviera).

Opinion leader for Creation, Anaxdent, and Harvest Dental.

Organizing and giving courses, lectures, events in France and to foreign countries in French language, English and Italian.

oral design
FRENCH RIVIERA

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