

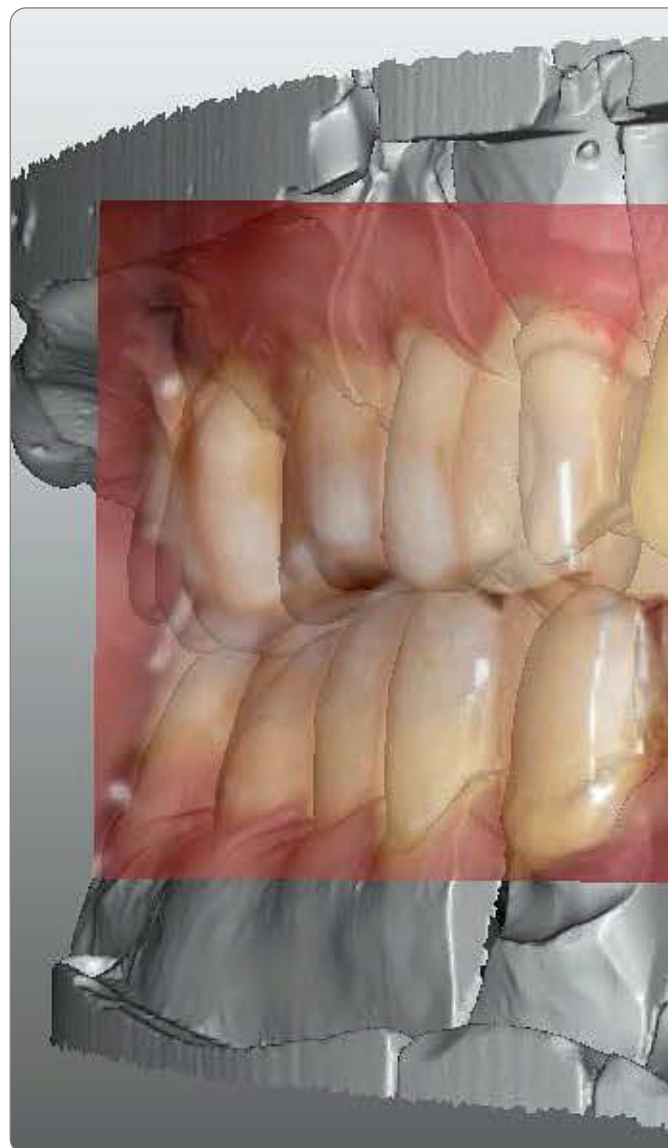
The Pre-restorative prototype, for smile dynamics

For a long time, we took great care to ensure that our restorations rehabilitated disrupted chewing function, in line with precise therapeutic criteria.

More recently, integrating our restorations into the dynamics of a patient's smile has become an additional undertaking for us, as this is closely linked to patient acceptance of their restoration.

Digital photography and Digital Smile Design (DSD) play an important role in smile restoration, and provide an invaluable aid to the dental lab.

An alternative to this digitalised method is to construct a pre-restorative prototype in the patient's mouth using their teeth. It is easier to integrate this prototype to the patient's natural smile dynamic. Although a pre-restorative prototype in the mouth takes longer to design, it allows us to visualise the restorative project very precisely. It must be worn by the patient for several days to several weeks prior to taking an impression. This allows for the patient and their entourage to make adjustments to the prototype. Once the pre-restorative prototype has been approved by the patient, the most important factor will be ensuring that the prototype information is correctly transferred to the lab, which will serve as the basis for the definitive restoration.



By G. DI BACCO, J. CHESNOT & A. DARY

Dental Technicians

Dental Surgeon





1 Full Class II anterior-posterior relation



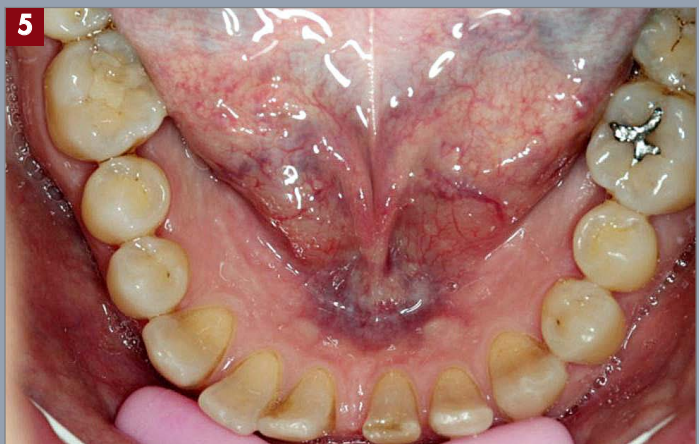
2 11 and 21 are egressed



3 Close up of the general situation



4 Agenesis of teeth 13, 12 and 22 and unevenly distributed diastemata in the maxillary...



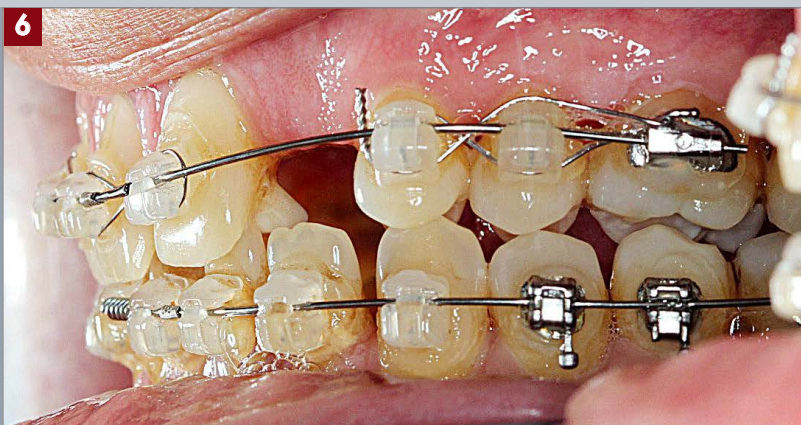
5 ... and the mandible

The clinical case

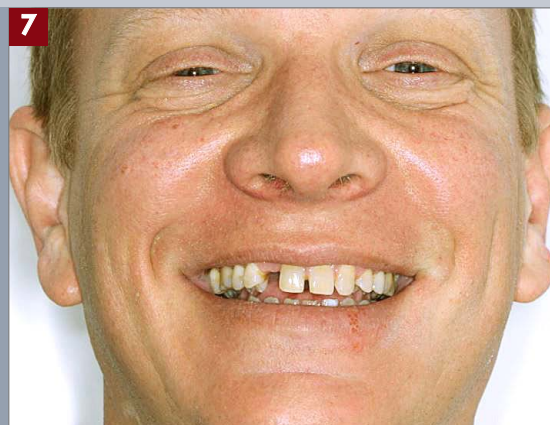
The clinical case presented in this article concerns a 43 year-old man, who needed an anterior aesthetic rehabilitation in both the maxillary and the mandible. Note the Full Class II anterior-posterior molar relation (figs. 1 to 3), the agenesis of teeth 13, 12 and 22, considerable egression on teeth 11 and 21 (fig. 4), diastemata in both the upper and lower anterior blocks (figs. 4 and 5), due to an unfavourable length / width tooth pulp ratio. This patient, a busy professional and the head of a company, had refused numerous restorative solutions in the past since he wanted to preserve the vitality of his healthy anterior teeth. After periodontal assessment by our dental team, the

patient agreed to the following therapeutic solution:

- Orthodontic treatment to bring the maxillary centrals in and make the inter-dental spaces symmetrical.
- The maxillary will be restored with a fixed, six-unit restoration from 14 to 24, with tooth 12 as an inter. 14 and 24 will act as canines, 23 will be transformed into 22.
- The mandible will be restored with 6 combined crowns, from teeth 33 to 43. The restorations will be milled in Prettau Zirconia (Zirkonzahn) and built up with IPS e.max porcelain.
- The restorations will serve the role of fixed-retainers for post-orthodontic treatment.



Multi-attachment treatment (Damon technique)



At the end of orthodontic treatment, the central incisors have been brought inwards...



... and the diastemas have been evenly distributed



Etching five upper and six lower teeth for the construction of the composite prototype



Post-orthodontic contention is obtained using a glass fibre band soaked in acrylic and attached to the back of the teeth



Construction of the missing tooth 12

Pre-restorative orthodontic treatment

The orthodontic treatment lasted for six months. Multi-attachment treatment following the Damon technique, and including lingual facing pegs on the anteriors and springs (fig. 6), was carried out to move the upper incisors inwards and create symmetry of the anterior interdental spaces.

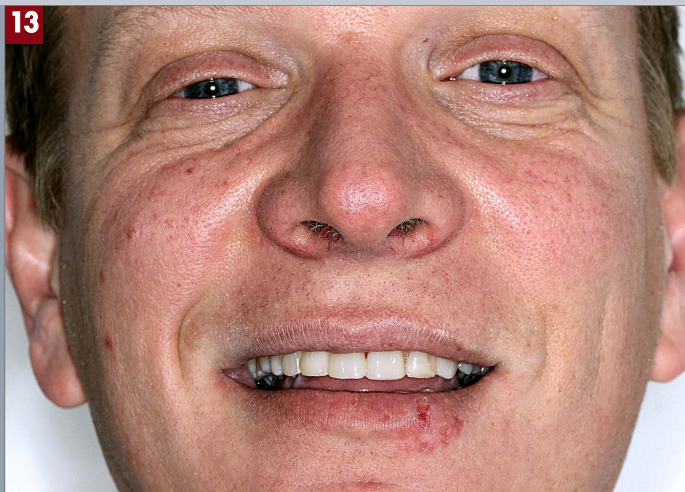
This would mean we could create crowns of a similar volume to restore the patient (figs. 7 to 8).

Designing two pre-restorative prototypes according to smile dynamics

After the teeth had been etched (fig. 9), a glass fibre band was placed and bonded to the back of the maxillary and mandibular teeth. This served as a provisional retainer following orthodontic treatment (fig. 10). This is followed with the application of composite to build up the mesio-distal surfaces of the teeth, reconstruct tooth 12 (fig. 11) and sculpt teeth 14 and 24. These composite prototypes will serve as the blueprint for the whole restorative project, as they will serve as a precise guide for the fabrication of the future restorations.



12 Photos of the patient's smile were taken with the pre-restorative composite prototype in the mouth



13 ... profile and full face photos were taken...



14 ... of the patient's various expressions



15 An onscreen list of adjustments to be made to the prototype for a full integration of the teeth when the lips are both relaxed and smiling



16 The pre-restorative composite prototype is adjusted until approved. Its integration is checked in the mouth

Photographic analysis of the prototype

The key is the construction of the upper central. Its position from front to back (horizontally) is determined by its relation to the lower incisors, as well as by the naso-labial angle.

Vertically, its length is determined when the lip is relaxed. A frontal view of the patient should just reveal the incisal edge of the central.

The laterals and canines must be constructed in relation to the patient's smile (social smile, pre-laugh and laugh) and the incisal edge of the teeth must be harmonised with the upper and lower lip contours.

To ensure that these criteria are respected, a photo procedure is used before and during the construction of the prototype. This photo procedure can be repeated until the desired result is obtained.

The photo procedure has three essential stages:

- 1: Photos of the patient standing are taken, first the profile, then facing the camera, with lips relaxed then in various stages of a smile (figs. 12 to 14).
- 2: Analysis of the photos on a computer screen with the patient. The corrections that need to be made to the prototypes are noted down at this point (fig. 15).
- 3: In light of the observations made, the prototypes are adjusted in the mouth either with a bur or by adding composite (fig. 16).

After this, step one is again repeated: photos are taken to measure the adjustments done and see if new modifications are required.

The final stage uses Fox's Plane to insert the prototype into an occlusal plane, which we refer to as 'the aesthetic occlusal plane'. The construction of this plane, which is essential for the laboratory as a basis for the definitive restoration, may require slight adjustments to prepare the surrounding teeth.



17 The prototype is then removed by trimming it down with controlled penetration



18 Prepared teeth before the impression



19 A silicone impression is taken in two stages



20 Using the auto-mould of the finished prototype...



21 ...the provisionals are an exact reproduction of the prototype

Once the maxillary prototype has been approved by the patient and meets all aesthetic requirements, a silicone impression of the prototypes is taken in order to record all of the contours that will need to be reproduced for the definitive restoration.

Tooth preparation and taking the impression

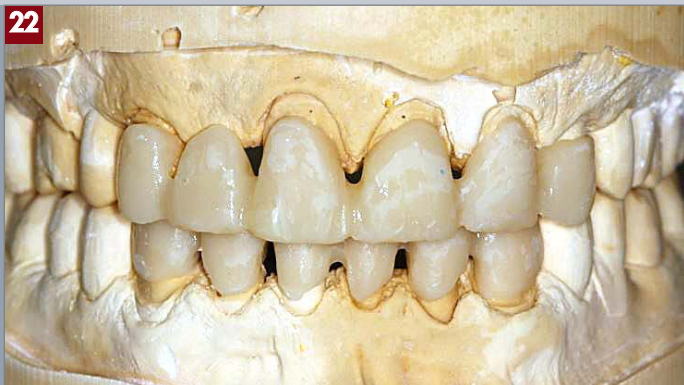
Tooth preparation is done using the controlled penetration technique (fig. 17). The pre-restorative prototype is cut away and the tooth volume is proportionally reduced by 1mm on the labial, buccal and lingual surfaces and reduced by 2mm on the occlusal surfaces. The margins are either juxta or slightly supra-gingival on the labial and buccal surfaces and sub-gingival on the lingual surfaces (fig. 18).

After the impression has been taken (fig. 19) and using the auto-mould that was prepared at the end of the

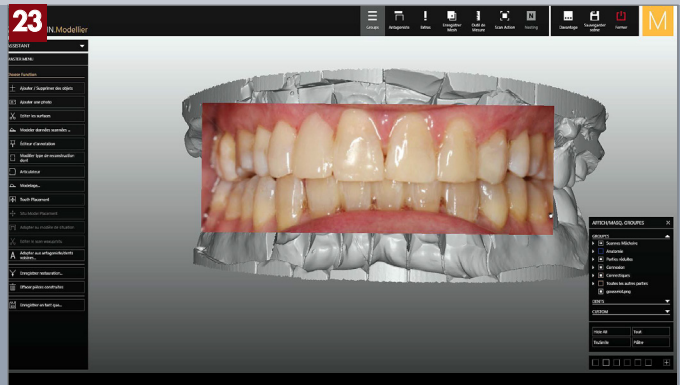
previous appointment once the pre-restorative prototypes had been approved, a replica of these is made in self-curing acrylic and then fitted in the mouth as a provisional restoration (figs. 20 and 21).

Putting the models in occlusion

Once plaster models have been cast from the impressions at the lab, a new appointment is made with the patient. The maxillary and mandibular provisional restorations are removed. Using the initial auto-mould (fig. 20), new maxillary and mandibular provisionals are fabricated in the mouth. They are an exact reproduction of the pre-restorative prototypes. The maxillary and mandibular replicas that have been built up in the mouth now need to be carefully transferred to the cast models. It is essential to prevent all friction on the plaster tooth stumps when repositioning the replicas on the models.



The prototype replica is adjusted on the master model and transferred to the lab as a basis for the definitive restoration



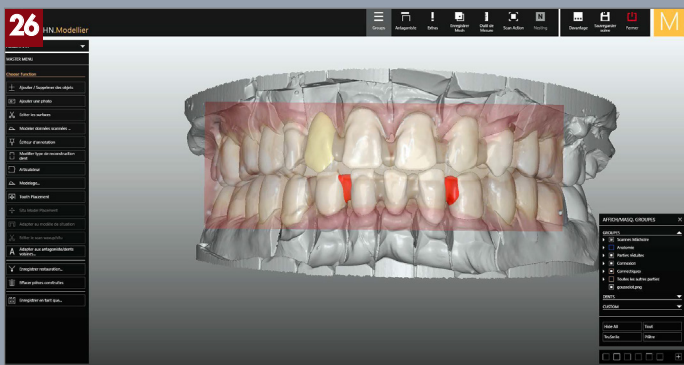
In the Zirkonzahn.Modellier design software, the photo of the prototype in the mouth is merged...



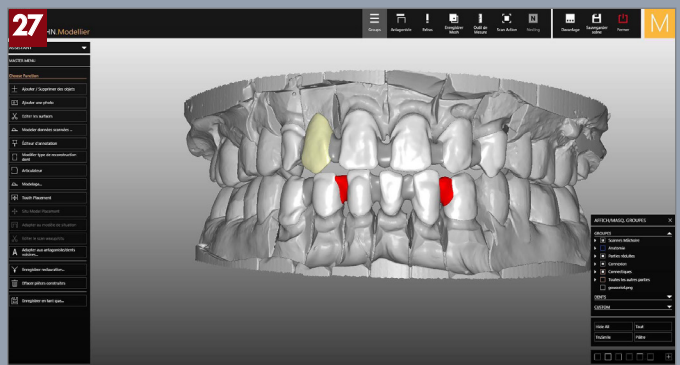
...with the double scan of the models...



...allowing for the transposition of the prototype...



...on to the digital model...



...creating a digital pre-restorative prototype

In the event of friction, the work models could be damaged.

In order to ensure that no tension is created, before fitting them on the model the two replicas are trimmed down: the fit surface of the crowns is reamed, as well as in the interdental areas, and on the palatine surface. Once fitted on the model, the occlusion of the maxillary prototype is checked by placing the upper model and its replica on the work surface, the teeth in contact with the table.

The trimmed prototype replica is re-evaluated in the mouth and photos are taken with the lips relaxed and smiling to ensure integration with the patient's face. Finally, when the maxillary and mandibular replicas are in place, the occlusion is recorded in the mouth, either using Moyco wax or using an occlusal resin. If the occlusal surfaces are greased beforehand, the

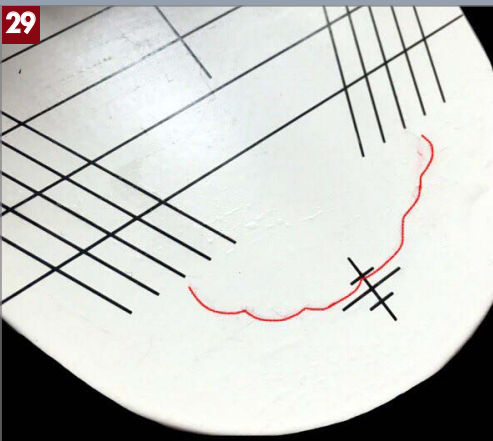
occlusal resin will not stick to the replicas. The following components are then sent to the dental lab: the plaster models in occlusion with the prototype replicas in situ, the auto-mould of the prototype and the photos taken (fig. 22).

Scanning, transferring the replicas to the articulator and recording the information

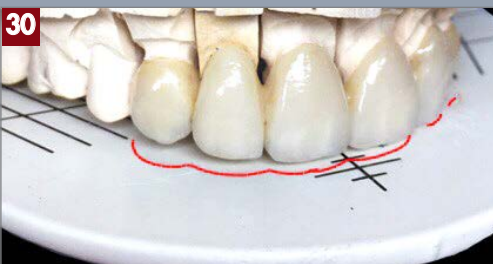
As soon as the master models are received in the lab they are scanned twice using Zirkonzahn's S600 ARTI scanner. The first scan is done without the replicas in place, and the second scan is done with the prototype replicas on the models. Next, the two scanned files are superimposed in the Zirkonzahn.Modellier CAD software. The photo of the prototype in the mouth (fig. 16) is then transposed onto the digital file (figs. 23 to 27). This



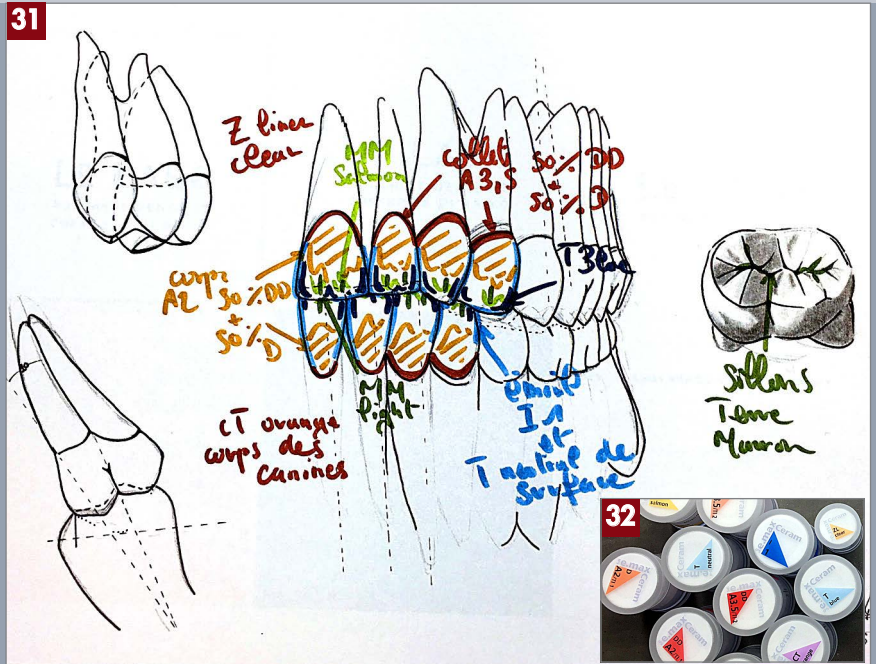
The prototype replica is positioned on the articulator plate and the tooth contour is traced onto the plate...



...This outline reproduces the contours of the incisal edges



The prototype morphology is reproduced by building up the porcelain following the contour traced on the plate



Schema for the build-up

E.max powders were used for the build-up



The way the light is reflected and refracted creates a 'true to life' impression

allows for a proportional design of the zirconia copings in relation to the prototype dimensions. Next, the maxillary model with the maxillary replica in situ is placed on the articulator plate. The contour of all the maxillary teeth is drawn on the plate in felt pen (figs. 28 and 29). This traced outline will serve as a guideline for the build-up.

Making the definitive restorations

Using the two scans we took earlier and the CAD design, the zirconia copings are milled in pre-sintered Prettau Zirconia using Zirkonzahn's M1 Wet Heavy Metal milling unit. The copings are then sintered in a furnace at 1500° for four hours. After shade-taking in the lab, the porcelain was built up on the zirconia framework by placing it on the occlusal plate and following the contours drawn on the plate (fig. 30).

The layering was done with IPS e.max following a schema (figs. 31 and 32). An A3.5 and A2 base was used, with CT orange effects added for the body of the canines and Salmon for the mamelons. Light was used for internal relief and I1 for the enamel. TNeutral was added to the surface to add depth. The secret when using e.max resides in mixing the powders to obtain saturated and desaturated powder mixes, which then provides areas of absorption and reflection, giving the restoration a natural, living tooth aspect (fig. 32).

Bonding the restorations

The teeth are prepared with supra-gingival margins in the anterior section, so we decided to use a bonding composite. The crowns were designed and milled with reinforcements to ensure definitive post-orthodontic

34



Interdental areas are protected prior to bonding

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Bonded restoration

contention. When bonding, the inter-dental areas were protected using dental floss, allowing for the easy removal of excess cement in areas that are difficult to access (fig.34).

Monobond Plus was applied to the fit surface and a self-etching, self-curing adhesive (Multilink Primer A et B) on the dental surfaces, a self-curing bonding cement with no adhesive potential was used (Multilink automix, Ivoclar). After curing, the cement joints at the necks were polished using a fine tungsten bur (Komet).

Constructing a prototype in the mouth is a serious responsibility, since you are working directly on your patient's teeth. You have gone beyond virtual simulation using software and photos.

A pre-restorative prototype may include the removal of some dental tissues and is only appropriate once the patient is fully engaged in the restorative process.

Integrating anterior crown and bridgework is all the more important because we are dealing with a patient's reconciliation with their smile – a deeply personal matter that can have far reaching consequences on their self-esteem and relations with others (figs. 35 to 37). The pre-restorative prototype offers the precision needed to capture smile dynamics. ♦

G. Di Bacco and J. Chesnot, Dental Technicians
A. DARY, Dental Surgeon

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35 & 36 The restoration is integrated into the patient's smile dynamics

Investing in CAD/CAM: why we chose Zirkonzahn

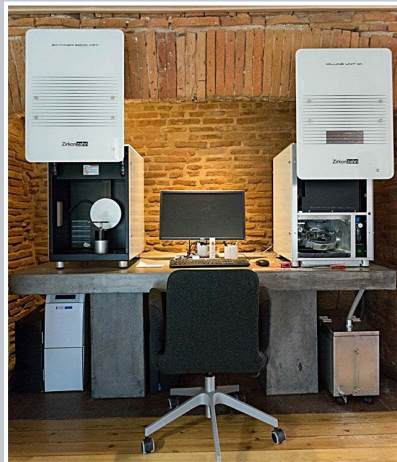
When we created our laboratory in 2012, we knew we wanted to invest in both CAD and CAM, however, the larger and more powerful milling workstations were out of our price range (we are a small, six-person laboratory).

In our opinion, there was no choice.

A modern lab has to invest in CAD/CAM. We couldn't imagine a lab thriving without this technology. This technology is at our fingertips, and allows us to improve our work processes, the quality of the casework we produce and to move forwards – both today and in the future.

Having looked into the options available, we decided that a smaller milling unit would give us the control we needed over our production from A to Z. Outsourcing our milling on a daily basis would not have given us the control we needed over our casework.

We looked at various CAD/CAM systems, and settled on the Zirkonzahn system. As the name indicates so well, the system is perfectly adapted to zirconia production, which was our main reason for acquiring an in-house milling machine. Moreover, the founder of the company, MDT Enrico Steger, is a dental technician like us! This means that he can anticipate our expectations, needs and daily routines, since he actually understands the work we do.



Integrating the system into our lab naturally took some training. We have two people in-house who are trained in CAD/CAM to ensure we can keep the system working efficiently even if someone is absent. Zirkonzahn provided excellent training and we also trained with Exocad for the CAD design part of the process.

It has been a huge advantage for us to have an in-house milling machine. We have positioned our lab at the cutting edge of technology, and that is the image we want to project. We can design and create the cases exactly as we want them, without having to rely on an external supplier.

One thing that must be taken into account is that these machines are high-



maintenance: they need to be managed properly.

We use the machine to produce all our CAD/CAM work, which is now roughly 40 – 50% of overall production. Since investing in it, our annual turnover has increased by 20%. This makes the system highly cost-effective - if you use it properly, of course.

Having worked with the Zirkonzahn system over the past three years, I can confirm that our expectations were correct – the whole service is excellent, from their machines, to their training and their customer service. They even send out a technician to do maintenance on our machines once a year, which is excellent! On the rare occasions we have had a problem, the customer service hotline manages the problem quickly and efficiently by distance control using the TeamViewer software.

We hope to work more closely with Zirkonzahn in the future.



About the authors

Alain DARY



Having qualified as a Doctor in Dental Surgery in 1985 from the University of Toulouse in France, I started my professional practice as a University attachee in the orthodontics department with Pr RIGAL then Pr CASTEIGT.

I went on to create a group dental practice in Toulouse. Over 31 years of dental practice, this surgery has evolved into a practice with six dentists, four assistants and a secretary. I have been interested in multi-disciplinary treatment plans for many years, due to the therapeutic solutions offered to the patient, and I have also interested in developing strategies for organising this type of treatment. Our team, which includes all dental specialisations (orthodontics, implantology, periodontics, occlusion) meets once a month to discuss our clinical cases: this allows us to treat complex cases in a multi-disciplinary manner.

I find my work very rewarding, and have another interest in acting. Theatre has allowed me to develop social and cultural diversity, as well as my humility and my creativity, which I believe help greatly in my practice as a dental surgeon.

Geoffrey DI BACCO



I am 33 years old, and have been working as a dental technician for 13 years now.

After specialising in sciences at high school, I redirected into dental technology, working and training at the same time, and obtaining my diploma in 2009. After working at several labs, I set up our laboratory, 'Le Labo' with Julien Chesnot in Toulouse, France. We have been working together for six years now, with a constant aim to improve our work and create ever more aesthetic restorations. We share our lab and our professional inspiration with our four employees Élodie Bertin, Léa Lacroix, Arnaud Fasula and Paul Azuelos, who I would like to thank for supporting us and putting up with us on a daily basis! Keep up the excellent work guys!

Julien CHESNOT



I am 36 years old, and started working in dental technology in 2000, after studying sciences at high school. I continued to train professionally as I worked, obtaining my diploma in 2004. I met Geoffrey whilst working at a lab in Toulouse. We hit it off immediately and shared a deep interest for our work. We decided to set up a lab together, and opened 'Le Labo' in 2012.

The energy we get from working together and our principle that if a job's worth doing, it's worth doing well, have meant that we have been able to work closely alongside Dr Dary and his multi-disciplinary team, in order to restore patients with a personalized smile.