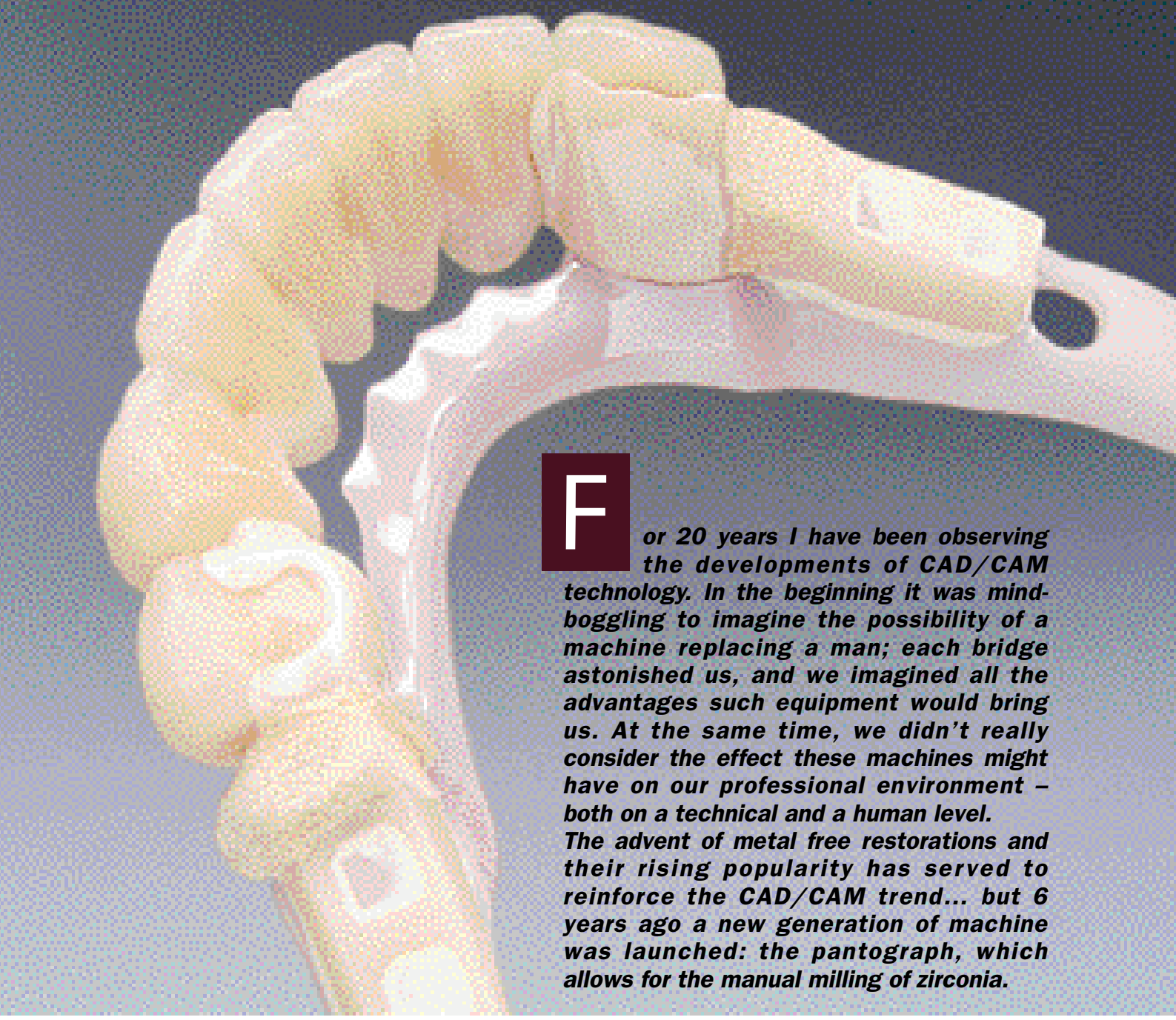
User Review

By Yves Probst
Dental Technician,
Zirconlab

Zirconia...

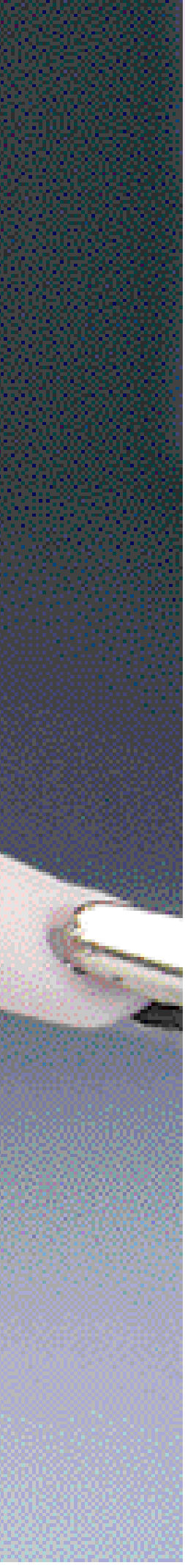
The art of the matter



For 20 years I have been observing the developments of CAD/CAM technology. In the beginning it was mind-boggling to imagine the possibility of a machine replacing a man; each bridge astonished us, and we imagined all the advantages such equipment would bring us. At the same time, we didn't really consider the effect these machines might have on our professional environment – both on a technical and a human level.

The advent of metal free restorations and their rising popularity has served to reinforce the CAD/CAM trend... but 6 years ago a new generation of machine was launched: the pantograph, which allows for the manual milling of zirconia.

INTRODUCTION
Mastering the new material



THE MAGIC OF MILLING ZIRCONIA BY HAND

Personally, I have always felt a need for direct contact with material. The pleasure of creating with your hands doesn't exist with CAD/CAM.

I have always been fascinated by gold and the magic of it melting (it is beautiful to watch it form beads), and even though I have done this numerous times, it remains extraordinary – almost esoteric. When I work gold I feel a deep respect for it, and I never leave the bench without sweeping up the powder and brushing my nails so as not to get gold dust on the floor.

You become intimately linked to the object you have created.

Zirconia is another material that gives me the same kind of satisfaction due to the direct contact when manually milling it. When you have spent time over each detail, polishing and re-polishing each area, you become intimately linked with the object you have created and come to love it; you are also quite proud of it.

This relationship between the material, the object and the artisan would be difficult to imagine if a robot made the restoration.
You would just have to press a button for it to be "cloned"; it wouldn't be unique any more!

PANTOGRAPH TO THE RESCUE!

Moreover, CAD/CAM has its limits, even for those of us who know how to use it well (and they are few and far between). Scanning is a science in itself, and numerous problems – with resulting letdowns – exist.

Six years ago Zirkonzahn launched their pantograph, for the manual milling of zirconia. Since then they have been improving technical aspects and augmenting the capacities of their machine. Accessories for the fabrication of atypical restorations are now available.

The machine was invented by Enrico Steger, who – let us not forget – is above all a technician, and a reputed one at that, as those who have been lucky enough to go to his conferences will know.
His pantograph was the first in our industry, and if today other manufacturers have followed suit, it goes to show that he was right, and that these machines have a future. In certain large German labs, they are used as the ideal complement to CAD/CAM.
Conscious that sooner or later we would reach the limits of what IT has to offer, we were the first lab in France to buy a pantograph 3 years ago. Now only our imagination is the limit!

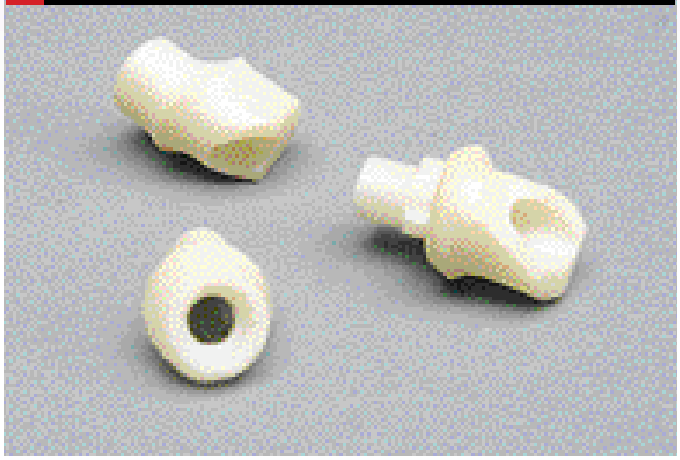
I set up my training centre in 1988, and have always been interested by various milling techniques. Soon after the acquisition of our Zirkograph we decided to run courses on manual milling, and have been offering these for the past 2 years.
Zirkonzahn regularly organises workshops between training centres from various countries, and we find the sharing of ideas and techniques particularly inspiring. This helps us to give a maximum amount of information to trainees who have attended courses at our training centre in Alsace.

THE BUZZ OF MANUALLY MILLING ZIRCONIA

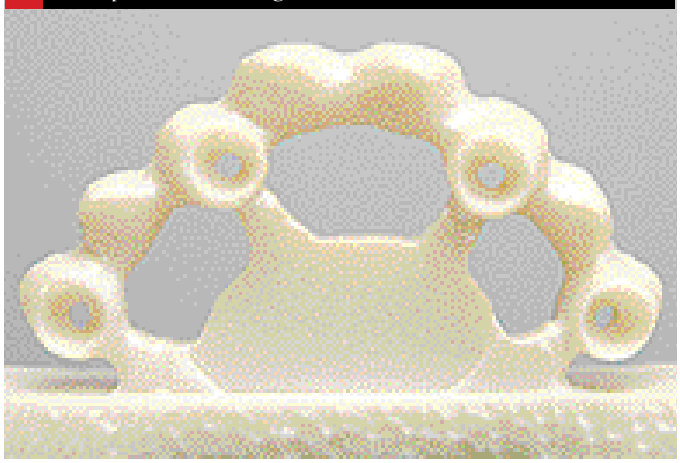
Everybody who has attended our course on manual milling has noticed that when you mill zirconia by hand, you are so concentrated you forget your troubles and even the time. One delegate rediscovered work satisfaction. Funnier still, another attendee was rejuvenated by 10 years!
What is more magical than seeing the exact precision of your work after sintering without needing to adjust the pantograph?
The retraction of Zirkonzahn's zirconia is constant from one block to another, which is a fantastic advantage, as you don't need to recalibrate the pantograph according to the charge.

1 *3 implant abutments in raw zirconia*

2 *3 implant abutments in sintered zirconia*



3 *An implant borne bridge on 4 Multi-units*



4 *An implant borne bridge on 8 Multi-units*

ALL ASPECTS of working zirconia

YOUR FIRST STEPS

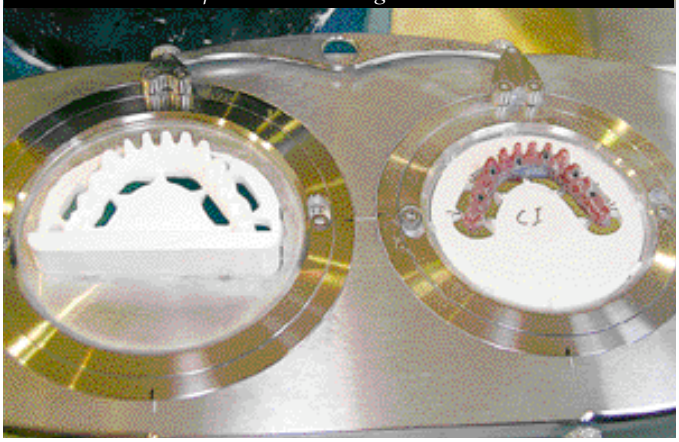
It is a good idea to start by familiarising yourself with zirconia. Gain confidence by milling unitary restorations. It's not rocket science and you will get used to it quickly – the trainees on our courses all manage very well.

After having successfully fabricated a few crowns and some small bridges, we specialised in implant abutments (fig. 1). What a pleasure to finally work zirconia in your own lab, without outsourcing or transport overheads. Transport costs both time and money. With my pantograph, I know that if I mill something in the evening, the next morning I will have marvellous components in the palm of my hand (fig. 2).

This is now all the more accessible to small and medium labs, with the Zirkograph 025 priced at £2750 GBP / $5425 USD (5 axis optional).

SCREW RETAINED BRIDGES: 5 AXIS PANTOGRAPH

Over time we moved on to milling longer span implant supra-structures (fig. 3), with all the complications this entails. When the implants are parallel, everything is fairly straightforward, but that is rare. So what do you do - especially if you have to deal with a screw-retained bridge? (Fig. 4).



5 *An implant borne bridge in the Zirkograph. Here you can see the mechanism for continuous regulation*

6 *Figs. 6 & 7: implant borne bridge after milling*

7

8 *Implant borne bridge after removal from the Zirkograph*

A pantograph can take all axes into account.

In this case, you need a pantograph that can deal with all axes; this obviously offers more scope than most CAD/CAM systems. Another plus is being able to see your work on the articulator, check the laterals, compare the aesthetics to the wax up, position and re-position transfer coping...

It is also possible to try resin mock-ups in the mouth before copying them; this is what we did for the bridge shown in fig. 5.

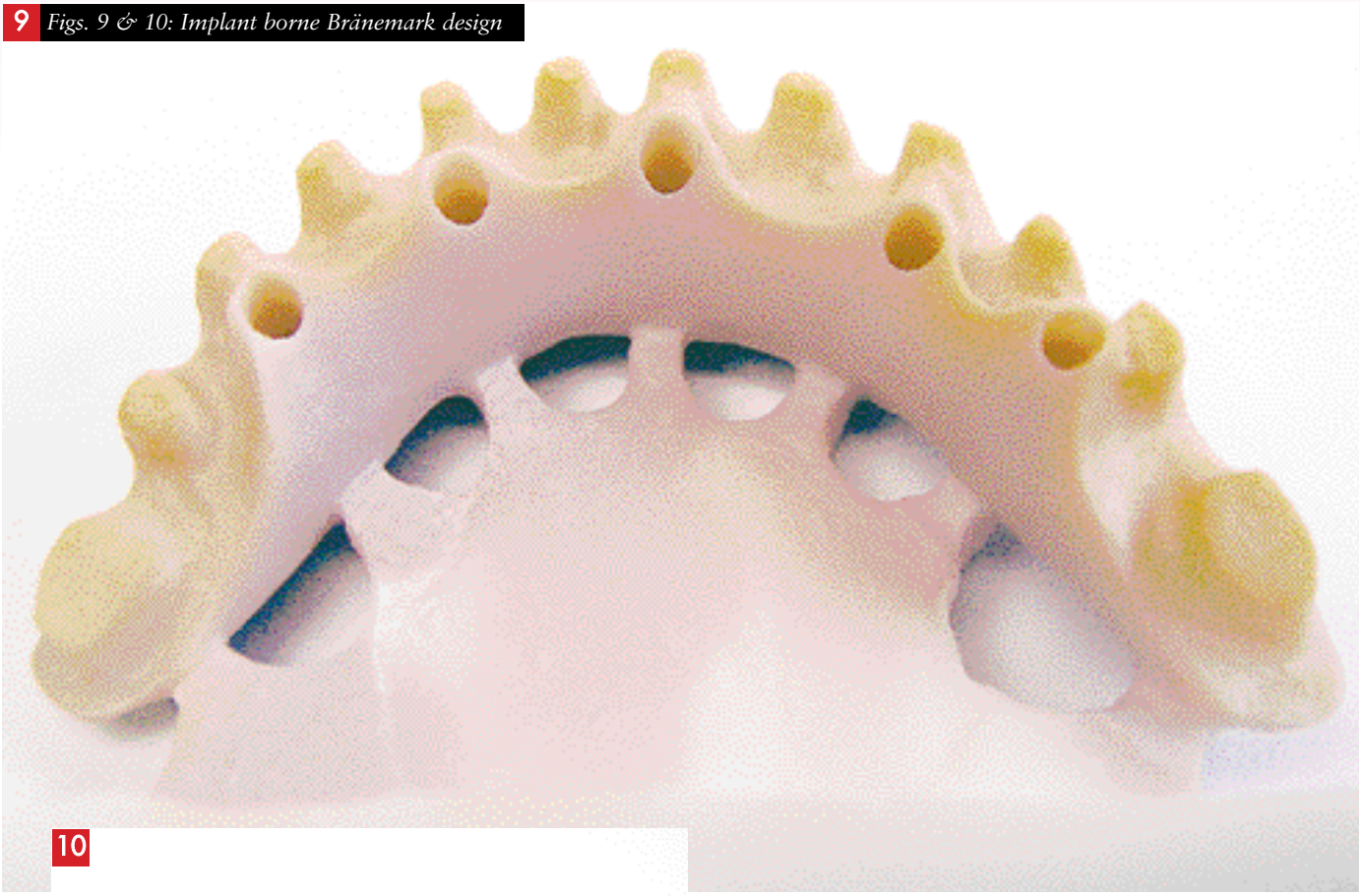
After having validated the plaster transfer coping and tried the mock-up in the mouth, it is positioned in the pantograph. The two plates and the arm that will turn them at the same time are clearly visible here.

In addition, since the central pantograph table can be inclined to the front or the back, with a bit of exploring you will be able to obtain all axes - this is easier if a pendulum is used.

In figs. 6 and 7, the bridge is in the plate. After milling, the bridge is removed from the zirconia block, except for the central part, which will serve as a support during sintering (fig. 8).

The smoother it is before sintering, the less touch-ups will be needed afterwards. Pre-sintered zirconia can be ground down and smoothed without difficulty – you can use new tungsten burrs or even finish with a rubber grinder.

9 *Figs. 9 & 10: Implant borne Bränemark design*



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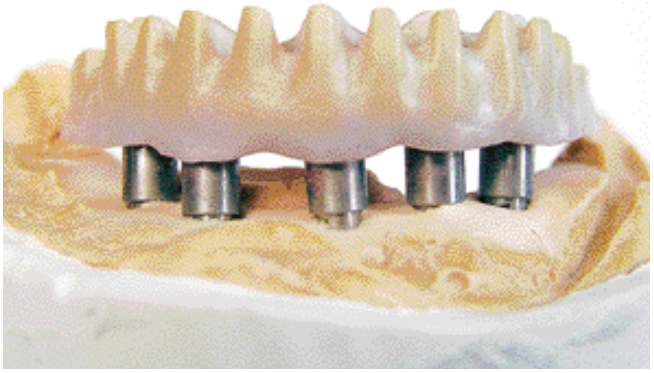


11 *Largest bridge to date (implantology)*

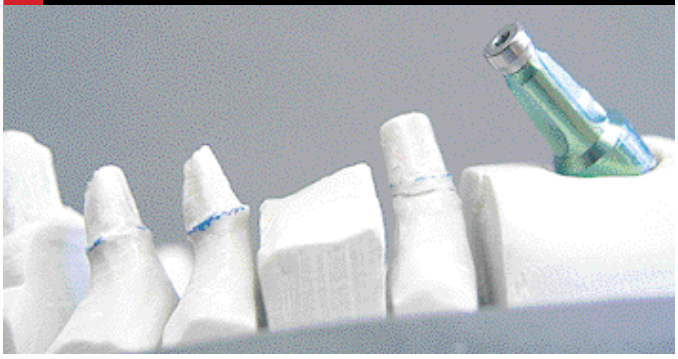
LONG-SPAN BRIDGES

The use of zirconia allows for creations that it would be impossible to make in metal (fig. 9); look at the size - you can imagine how much this would weigh if it were made of metal! It would also be difficult to cast such a piece without porosity problems. With zirconia, this is not an issue, as no material is more homogenous, not even porcelain.

This is a large Bränemark design, which we made for another lab. As you can see, it is voluminous, but the passivity is perfect!
Unbelievable as it may seem, with Zirkonzahn's zirconia, neither the volume nor the geometry of a piece influence its precision (fig. 10).
You can see here that the framework is coloured; 16 shades are available, providing a lot of scope for choice.

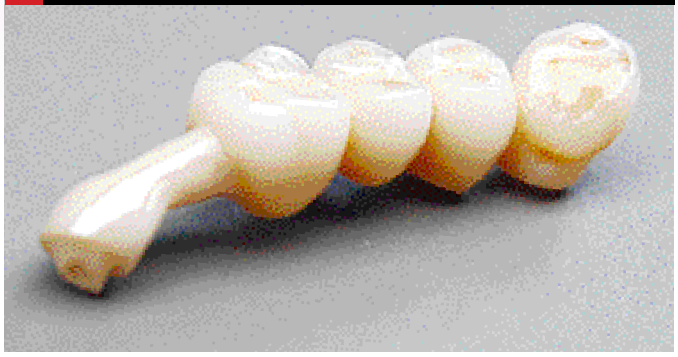
I am planning a separate article about the largest framework we have fabricated, but here is a photo just to give you an idea of the volume (fig. 11).

12 *Atypical bridge – on this model you get an idea of the parallelism*



13 *Framework of the bridge on the model*

14 *The ceramic has been fired – note the anti-rotational part*



15 *Finished bridge on the model*

ATYPICAL BRIDGES

Working zirconia manually has given us the opportunity to rise to challenges such as this half-cemented, half-screwed bridge (fig. 12).
Since there was no antagonist tooth to occlude with, why make an element? (And why bother with an implant?) In order to conceal the pointlessness, a screw-in extension on an anti-rotational part, corresponding to the exaggerated angle, was fabricated. The anti-rotational part was parallelised in one of our pantographs, then flipped over and milled to correspond to the paths of insertion of the three implant abutments.

Once finished the bridge was milled with no problem, and with the same precision as other cases (fig. 13). ICE zirconia porcelain from Zirkonzahn was used for the build up (figs. 14 and 15). Note the anti-rotational part.

ZIRCONIA AND RESIN

As we provide an outsourcing service for other labs we get a real variety of case requests coming in, which we always try to satisfy. This often leads to rewarding discussions that open us up to theories and ideas we would not have thought of.

Zirconia does not provoke allergies.

An example is an implant borne bridge in zirconia, with the cosmetic side completed using acrylic teeth and light curing resin.
This is an ideal alternative to precious metal – especially given the price of gold today – and it is prettier than titanium or non-precious metal.

This also offers a truly biocompatible framework. It will be porosity-free and therefore more hygienic. There are no known cases of allergies to zirconia. There is no risk of bimetallism or toxicity, and no chemical reaction or corrosion. Soft tissue accepts zirconia very well – certainly better than it does metal, which it tolerates badly. The gingiva favours natural teeth, and zirconia resembles bone more closely.

16 *figs. 16 & 17: Pattern of the implant borne bridge to be layered in resin*

17

18 *The bridge has been milled in raw zirconia*

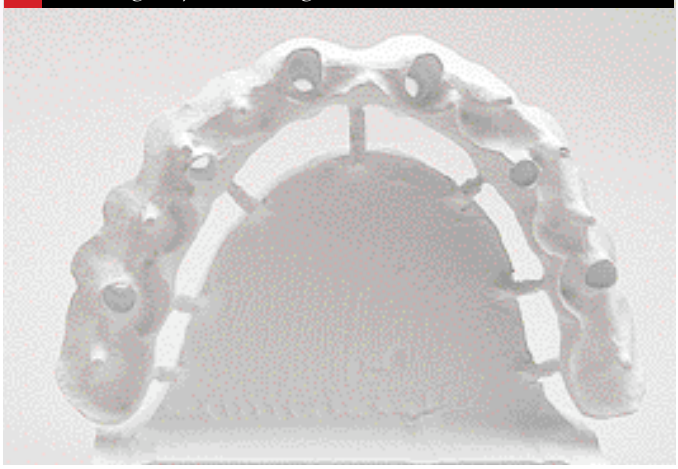
The case presented here was done in collaboration with a friend of ours from Belgium, Paul Henri Trigallez; he designed and modelled it, and we created it (figs. 16 and 17).

In the photo, the milling is completed, but the framework is still positioned in the pantograph (fig. 18). The zirconia block is then removed from the pantograph, and the milled framework is detached from the outer part of the block (fig. 19).
The bridge is then sintered (fig. 20). It is remarkable how the light plays over the sintered zirconia.

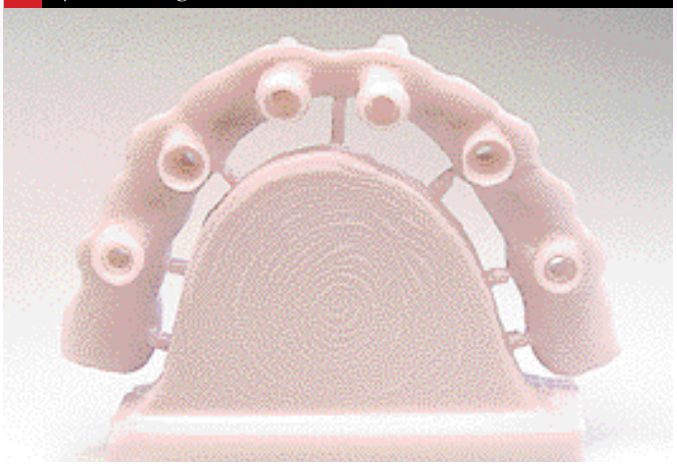
When finishing the surface aspect, the final polishing stage is quite long; this is done with diamond paste and a special Komet rubber polisher. This is not mandatory, but a better result is obtained, and since in this case the framework will not be covered with porcelain, the zirconia will be in direct contact with the soft tissue (fig. 21).

The photograph gives an good idea of the surface aspect that can be obtained (fig. 22) – we know how to say it with flowers!

19 *The bridge before sintering*

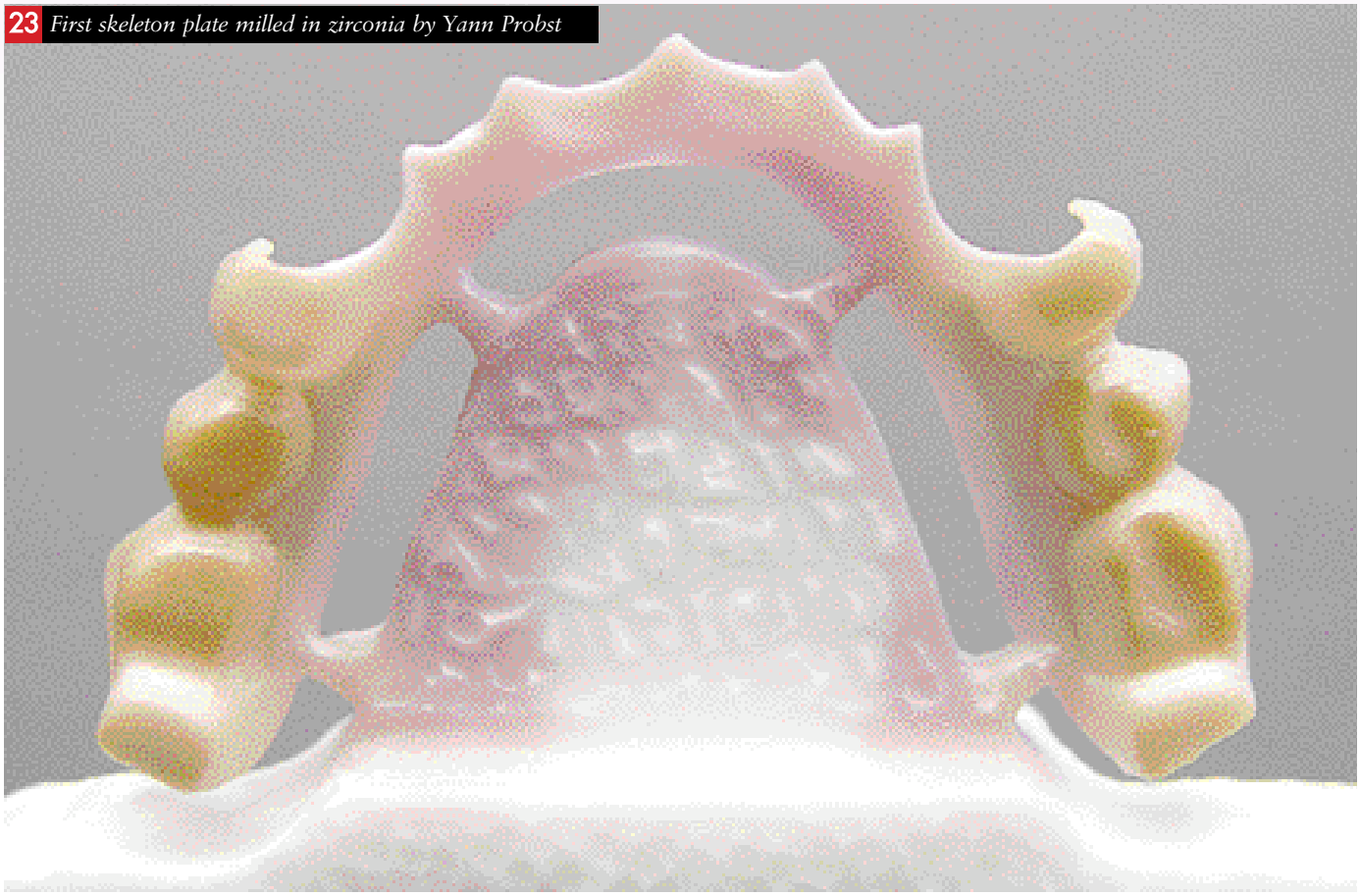


20 *After sintering*



21 *Pattern of the bridge and its replica in zirconia*

22 *Say it with flowers!*



23 *First skeleton plate milled in zirconia by Yann Probst*

SKELETON PLATES

Meeting challenges is essential when you are passionate about something. So two years ago when we were asked to make a skeleton plate, we rose to the occasion.

The patient was allergic to everything – acrylic, metal, and even gold. Zirconia was the only option in this situation. The teeth and the gum – in ceramic – were fired directly on the plate. In this case as well, the precision was absolute.
My son Yann was the first to ever mill a plate in zirconia, since to my knowledge this has never been done before, as I have never read anything about such a case – I would even say such a feat! (Fig. 23).

MILLING AND ATTACHMENTS

How could we resist the temptation to go further still, and do with zirconia what we have been doing with gold for so long? Little by little you get to know the material and become more confident. Why hang back from making telescopic crowns and attachments, since we now have good mastery of zircona?

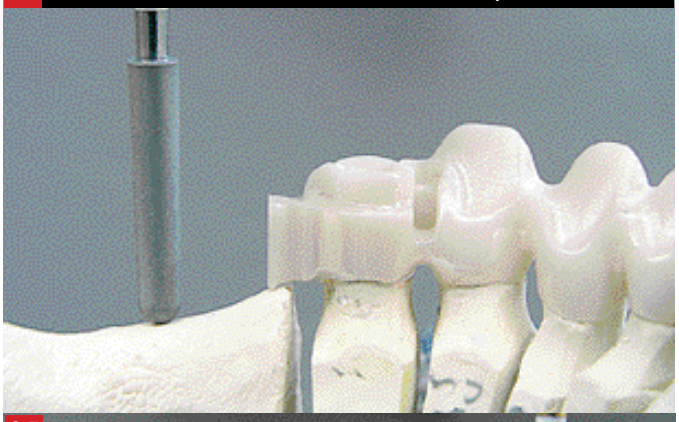
A TRIAL **case**

The last case that I would like to present in this article is a trial case that we did in collaboration with Paul Henri Trigallez and Dr Scalesse.

THE FRAMEWORK AND THE PRIMARY MILLING

First we fabricated a framework using Zirkonzahn composite, 'Rigid'.
At this stage the paths of insertion were designed and milled, and the extra-coronary attachments were placed; in this particular case we used a Bredent Vario Soft 3 mini attachment, which is the best adapted to this type of design due to its flexibility.
You have to be careful and choose your components wisely – zirconia can be fragile!
This pattern was then reproduced using the pantograph. The pattern surface was first carefully prepared and then the milling was done. Here the conventional method, as

24 *The milled contournement and extra coronary attachment*



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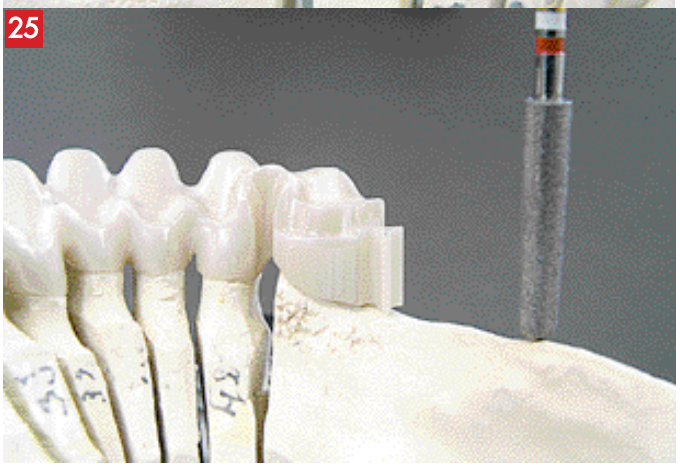

26 *Photos 26 and 27: The final shine is obtained with a diamond paste polish*

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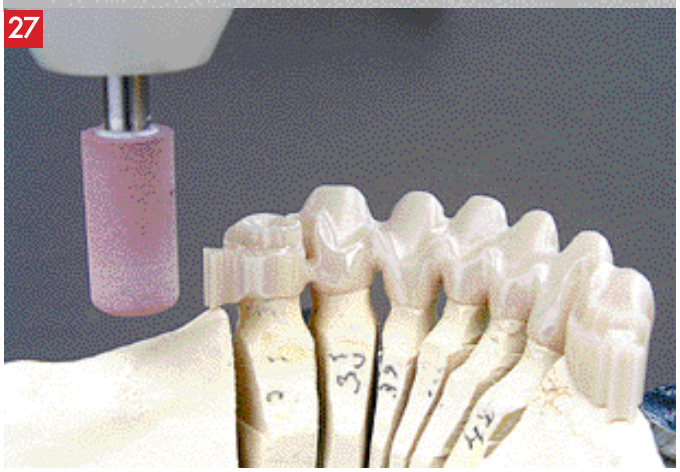
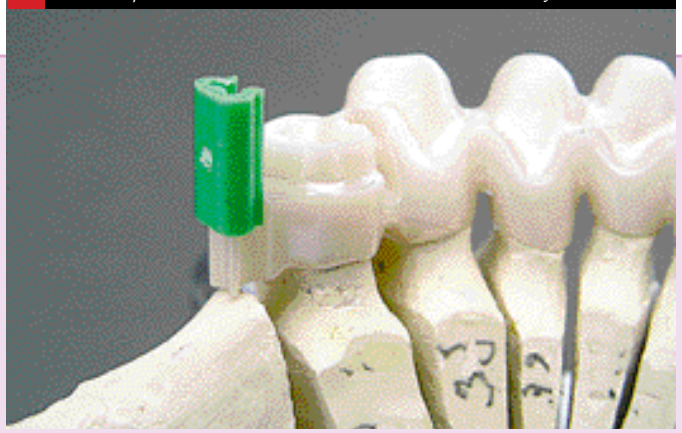


28 *Vario soft 3 mini attachment on the extra-coronary*



29 *The palatine bar in the Zirkograph disc*

for gold, was used - preferably using a bur equipped with an aqua turbine, and naturally without exerting too much pressure. For this particular case we tested various Komet burs, which we found very appropriate for this type of milling - for example the ceramic art 4370 set and the 4439 set (figs. 24 and 25).

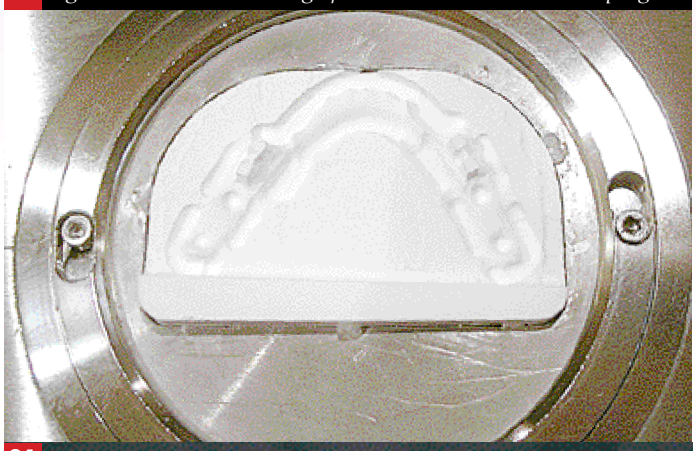
The contournements were polished using Komet polishers. The final shine is obtained by a good polishing with diamond paste (figs. 26 and 27).
The Vario was placed on the attachment (fig. 28).

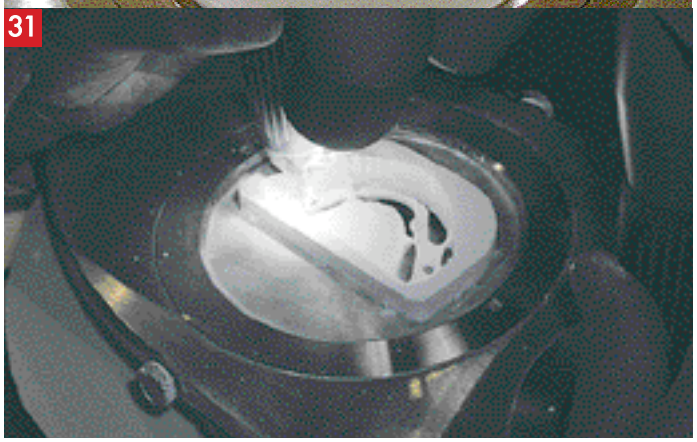
Paul then did the ceramic build-up, and Dr Scalesse did a try in and took an impression, which he sent to us for the fabrication of the palatine bar.

PALATINE BAR

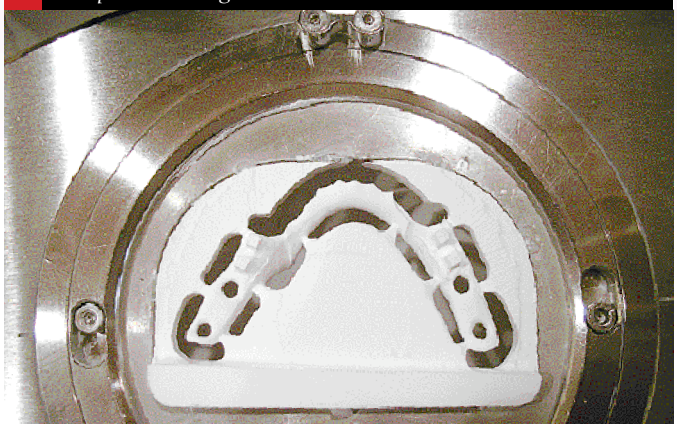
Perfectionists that we are, and so that the pattern did not flex during milling, we first fabricated the bar in Co/Cr/Mo so as to duplicate it as precisely as possible (fig. 29); at this level of trial, we couldn't afford the least mistake.

30 *Figs. 30 and 31: The milling of the raw zirconia block is in progress*

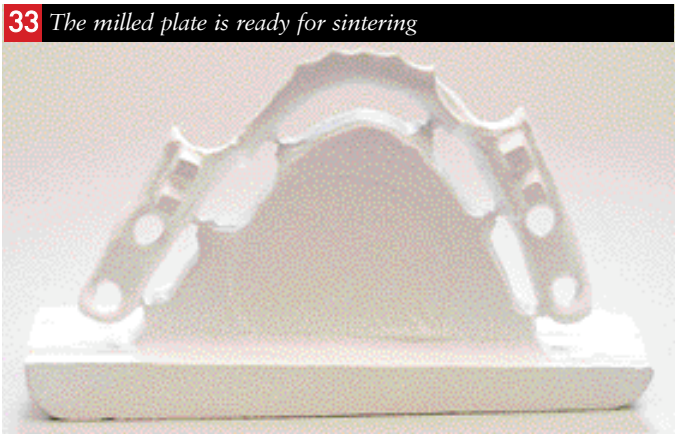




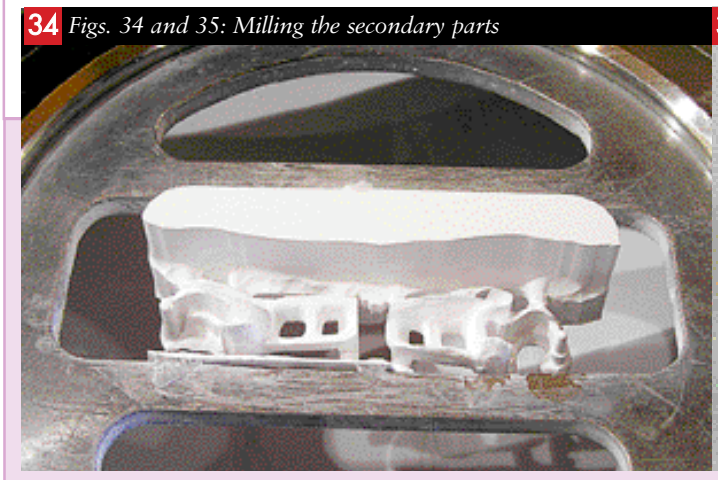
32 *Completed milling*



33 *The milled plate is ready for sintering*



34 *Figs. 34 and 35: Milling the secondary parts*



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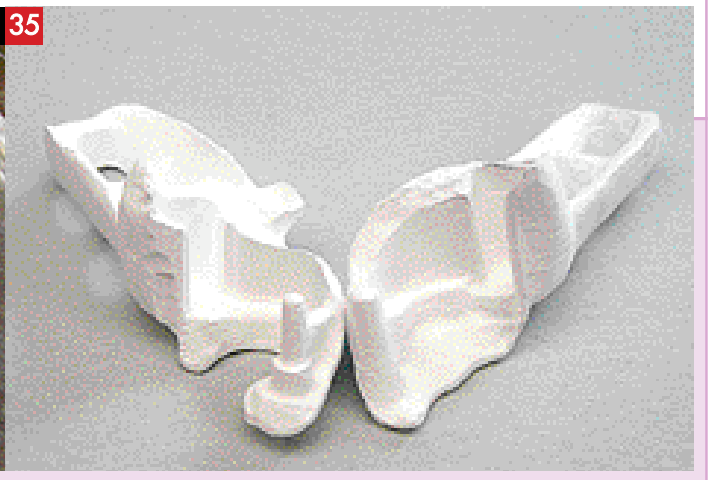

Naturally this kind of milling requires intense concentration and respect (figs. 30, 31 and 32). The block is then removed from the pantograph; even though pre-sintered zirconia is a bit more solid than plaster, you need to be extremely careful, because one false move could ruin everything - it's a bit like walking on eggshells.
At this stage the zirconia plate needs to be smoothed like no machine tool could make it. It is better to do this now than after sintering, when a lot of time would be wasted. The plate is then sintered on a base like the other cases in this article (fig. 33).

SECONDARY ATTACHMENTS

When you have the luck to get given a challenge like this one, and you know what your client's trust in you is worth, you will go to extremes to get the required result... For absolute precision when duplicating in the pantograph, we fabricated milled secondary contoursements in gold.

This had two advantages - on the one hand, the pantograph reproduction was optimised, and on the other (since this was a trial case) the patient was given the

36 *The original parts and their reproductions in zirconia*

37 *View of the palatine bar and bridge with Varios in place*

38 *View of the assembled bridge and palatine bar*

39 *The case in situ*

possibility of having one resto ration in zirconia and the other in metal just in case... (fig. 36).

The milled gold elements were placed in the panto graph and reproduced identically (figs. 34 and 35). The zirconia elements were then sintered, carefully adjusted, and polished.

They we re then be fixed to the palatine bar using ESPE composite Nimetic Grip. The secondary atta chments of the Va rio Soft 3 Mini attachments were then successfully slotted into the hollows designed for this purpose (figs. 37 and 38).

Paul completed the last stage – a resin finish, and at long last Dr Scalesse could fit the restoration – this type of work takes time, and the patient has definitely earned his name! (Fig. 39).

Naturally, it would be unthinkable to this kind of case without passion; you need to get completely into it and be committed. All this has been possible thanks to the energy and fresh approach of our young team.

About the author

Yves Probst

was born in 1948. After completing his diploma in Dental Technology, he worked extensively in Germany and France, before opening his current lab and training centre in Alsace in 1996. He is specialises in milling (in particular zirconia), implants, and ceramic application to zirconia. He has written over 35 articles and given numerous lectures and courses, both in Europe and Canada.

His laboratory was the first in France to acquire a Zirkograph 3 years ago. He quickly became involved in training delegates to use pantographs, and has been running courses on manually milling zirconia for the past 2 years.

Yves' passion for his work is infectious, and he is always looking for new ways to develop and push the boundaries of the possible.

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